

## CHAPTER 8

### DIET, EXPLOITATION STRATEGIES, AND ECONOMIC CONTRIBUTIONS IN SPANISH COLONIAL SETTINGS

When research at Santa Catalina de Guale began in the 1970s, the goal was to provide the first large-scale study of life at missions in Spanish Florida. The project included a team of archaeologists committed to pursuing multiple avenues of interpretation. This project team recognized the important role that environmental variables played in human interactions in colonial Spanish Florida. The results of a portion of this long-term, interdisciplinary study are offered in this monograph as a contribution to the holistic study of missions and colonial contexts not only on St. Catherines Island and Spanish Florida, but in colonial settings elsewhere.

We introduced this monograph with the observation that some scholars have assumed that Native Americans throughout the hemisphere adopted the foodways of the colonizing Europeans relatively quickly and that colonists altered their foodways little, if at all. In particular, it was assumed that priests influenced most aspects of native life at missions. This was, after all, one of the purposes of missionization throughout the Americas. After many decades of research, extending well beyond the boundaries of St. Catherines Island and Spanish Florida, we can say that this dichotomy of colonized and colonizers fails to capture the dynamic interactions of colonial contexts in Spanish Florida and elsewhere. Nor is the idea that Native Americans quickly adopted the foodways of the colonizing Europeans supported by this research. Native Americans drawn to missions did not automatically or universally adopt the dietary practices of the missionaries. In fact, in many locations Spaniards adopted foodways that were

influenced predominantly by traditional Native American strategies. As further evidence of the resilience of Native American traditions, we find that, in most cases, Eurasian livestock did not entirely replace indigenous sources of animal nutrients nor did animal husbandry replace traditional exploitation strategies.

This study also finds that a homogeneous colonial exploitation strategy did not develop even within a single mission, within a single province or colony, and certainly not throughout the Spanish Americas. Every colonial community pursued a novel strategy that emerged from the influence of local indigenous knowledge and subsistence practices, economic needs, specific environmental opportunities and constraints, and the expectations of local colonized and colonizers alike. In this chapter, we explore explanations for these observations, which diverge from long-held expectations for the influence of colonialism on indigenous and immigrant diets, exploitation strategies, and economic aspirations.

The first clue that missions may not have been successful in their goal of “civilizing” the natives is simply that there were very few Spaniards living at large missions, and none at smaller ones (see chap. 1). At Santa Catalina de Guale, for example, the Guale population outnumbered Spaniards posted there by perhaps as much as three to one (Worth, 1995: 100–101; see chap. 2). In addition to being outnumbered, Spaniards relied on local people for much, if not most, of their animal nutrients and exportable commodities. Guale neophytes knew the local resource base far better than did Spaniards posted to the island and they provided both goods and services to the

mission. It hardly seems remarkable that Spanish foodways bear the imprint of Native American practices considering the substantial contributions made by the Guale and other native peoples to the economy of Spanish Florida. Given the rate at which Native Americans died or fled throughout Spanish Florida, the persistence of pre-Hispanic diets and exploitation patterns is particularly remarkable, suggesting that Spaniards embraced this tradition and perpetuated it as their own.

Despite similar cultural backgrounds and regular interaction through civil, military, religious, and social networks, each Spanish Florida community developed its own approach to life under prevailing local conditions. Diet and exploitation strategies at Santa Catalina de Guale were probably unique to that island, rather than common to Spanish or native settlements elsewhere in Spanish Florida. This strongly suggests a great deal of local syncretism, with native knowledge playing a dominant role in the formation of local colonial strategies. To the extent that different communities within Spanish Florida relied on Native Americans, this reliance was predicated on that local knowledge.

In this chapter, we review what we know of change and continuity in diet, exploitation strategies, and the economic support provided by the Guale and other native peoples to the colonial enterprise of Spanish Florida. We then place Spanish Florida into a broader Spanish American colonial context. This is followed by a review of evidence for environmental changes that accompanied the colonial effort in view of the 17th-century drought. This work is viewed as a preliminary contribution toward understanding the dynamics of colonial societies rather than as a finished body of work; thus, the chapter includes numerous suggestions for future research.

#### CHANGE AND CONTINUITY AT SANTA CATALINA DE GUALE

Although animal remains from Spanish contexts at Santa Catalina de Guale may not reflect Guale cuisine, they undoubtedly represent Guale dietary choices, exploitation strategies, and labor. Coercion was clearly part of the system in Spanish Florida, but *encomiendas* and *reducciones* were absent and local chiefs were accorded some degree of independence and deference. Competition among religious and secular authorities within Spanish Florida,

among Spaniards and traders or raiders of various nationalities, and the persistent threat of European wars were characteristic of the colonial setting. In combination, these factors made it difficult to control dietary contributions (either as tithes or tribute), *repartimiento* labor, and overall productivity.

One of the most striking findings of this study is the degree of change in the Spanish diet compared to the amount of continuity in the Guale diet (tables 8.1 and 8.2; fig. 8.1). Similarities in diet and exploitation strategies were more characteristic of Spanish and Guale life at Santa Catalina de Guale than were differences. These reflect mutual accommodations associated with colonization. The similarities between the Spanish and Guale assemblages indicate that Guale neophytes supplied foods to Spaniards, thereby expanding the Spanish menu toward the traditional, pre-Hispanic one.

Neither Guale nor Spanish residents relied on Eurasian animals, though they were present at the mission. Most of the species in the Spanish diet on St. Catherines Island were animals common to the marshes and estuaries of the southern Georgia Bight. These animals were very familiar to Guale and other coastal peoples and many were unfamiliar to most Spaniards. Fishes constituted most of the dietary items for Spaniards and Native Americans alike and venison was the source of most of the animal-derived nutrients. From the Guale perspective, animal-based aspects of their cuisine changed very little with missionization.

Guale residents at the mission did alter their exploitation strategies to some degree, however. They acquired more venison, fewer turtles, and fewer small-bodied fishes; ate less desirable portions of the white-tailed deer (*Odocoileus virginianus*) carcass; increased the diversity of fishes that they caught; and expanded their fishing efforts to include fishes from higher trophic levels (figs. 6.8– 6.10, 6.12, 6.13, 8.1– 8.5). Some of these changes reflect secular and religious demands for economic contributions to the colonial economy, such as increased maize production and *repartimiento* requirements. The higher percentage of other wild mammals (tables 8.1 and 8.2) indicates that garden hunting was common and the higher percentages of sea catfishes (*Ariidae*, *Ariopsis felis*, *Bagre marinus*) argue for the fishing equivalent. Increased garden hunting and use of catfishes may represent responses to scheduling conflicts. Differences

**TABLE 8.1**  
**Summary of MNI Percentages from Coastal Sites, Excluding Commensal Taxa<sup>a</sup>**

	MHF	NDD	Convento	St. Augustine	Plaza Complex	Pueblo
Category	MNI%	MNI%	MNI%	MNI%	MNI%	MNI%
Domestic mammals	—	—	3.5	9.4	2.7	2.9
Domestic birds	—	—	6.2	6.9	14.1	1.5
Deer	4.3	1.6	2.7	1.3	14.6	13.2
Other wild mammals	6.5	2.8	2.7	3.1	9.2	22.1
Wild birds	3.3	0.9	4.4	4.4	7.0	8.8
Turtles/alligators	51.1	3.0	8.0	8.8	11.9	11.8
Sharks, rays, & fishes	34.8	91.7	72.6	66.0	40.5	39.7

<sup>a</sup> Commensal taxa are omitted from this table (see appendix table A.2). Meeting House Field (MHF) percentages combine data from all four mounds (chap. 3). Nombre de Dios (NDD) percentages include both 16th/17th-century and 17th/18th-century mission components from the Fountain of Youth site (chap. 4); Convento de San Francisco percentages include both ca. 1600 and ca. 1650 data (chap. 4); St. Augustine percentages are the secular 17th-century data (chap. 4); Plaza Complex percentages are for the Eastern Plaza Complex at Mission Santa Catalina de Guale (chap. 5); and Pueblo percentages are based on the combined Fallen Tree, Pueblo South, and Pueblo North data from Pueblo Santa Catalina de Guale (chap. 6).

**TABLE 8.2**  
**Summary of Biomass Percentages from Coastal Sites, Excluding Commensal Taxa<sup>a</sup>**

	MHF	NDD	Convento	St. Augustine	Plaza Complex	Pueblo
	biomass%	biomass%	biomass%	biomass%	biomass%	biomass%
Domestic mammals	—	—	18.8	33.3	12.2	3.3
Domestic birds	—	—	3.4	2.5	4.7	0.1
Deer	51.8	5.2	13.7	12.9	72.5	83.1
Other wild mammals	6.8	6.0	1.2	2.1	4.1	4.7
Wild birds	0.2	0.8	5.3	1.8	0.4	0.7
Turtles/alligators	38.7	6.4	11.8	10.8	2.0	4.8
Sharks, rays, & fishes	2.6	81.6	45.8	36.5	4.0	3.3

<sup>a</sup> Commensal taxa are omitted from this table (see appendix table A.2). Meeting House Field (MHF) percentages combine data from all four mounds (chap. 3). Nombre de Dios (NDD) percentages include both 16th/17th-century and 17th/18th-century mission components from the Fountain of Youth site (chap. 4); Convento de San Francisco percentages include both ca. 1600 and ca. 1650 data (chap. 4); St. Augustine percentages are the secular 17th-century data (chap. 4); Plaza Complex percentages are for the Eastern Plaza Complex at Mission Santa Catalina de Guale (chap. 5); and Pueblo percentages are based on the combined Fallen Tree, Pueblo South, and Pueblo North data from Pueblo Santa Catalina de Guale (chap. 6).

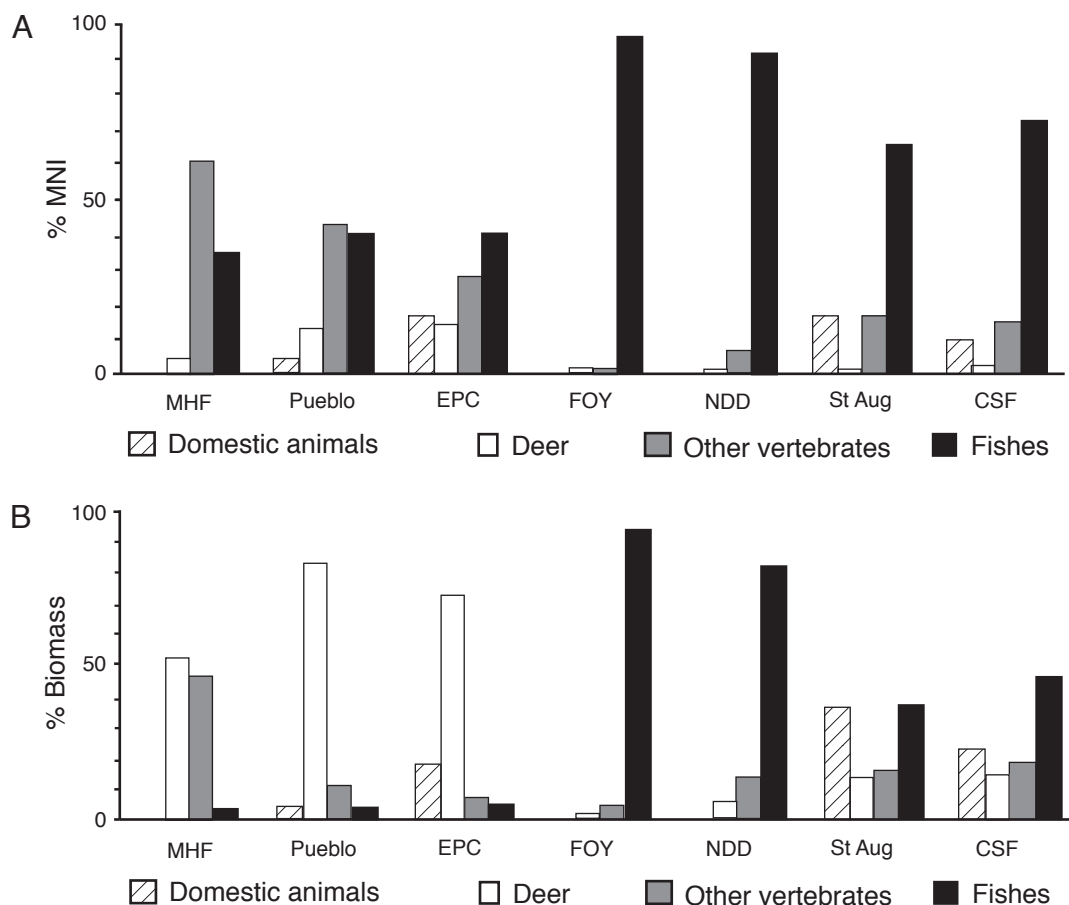


Fig. 8.1. Bar graph of animal use: (A) MNI and (B) biomass. Other vertebrates include birds, reptiles, and wild mammals other than deer, with commensal taxa removed. **MHF**, Irene-period Meeting House Field (all mounds combined); **Pueblo** includes Fallen Tree, Pueblo South, and Pueblo North; **EPC**, Eastern Plaza Complex; **FOY**, St. Johns IIc Fountain of Youth; **NDD**, Nombre de Dios, which combines 16th/17th-century and 17th/18th-century mission components from Fountain of Youth; **St. Aug.**, 17th-century secular St. Augustine; and **CSF**, 1600s and 1650s Convento de San Francisco.

within Pueblo Santa Catalina de Gualé signal that social status and identification with Spanish authorities were factors in some aspects of Gualé life at the mission.

Spaniards, for their part, added their own ingredients to the menu by raising pigs (*Sus scrofa*), cattle (*Bos taurus*), and chickens (*Gallus gallus*) or encouraging this behavior in amenable Gualé converts, by using, or encouraging the use of, cast nets to capture mullets (*Mugil* spp.), and through privileged access to choice cuts of venison. By-products from deer and fur-

bearing animals were important commodities in the regional economy.

#### CHANGE AND CONTINUITY IN SPANISH FLORIDA

The unreliable *situado*, the importance of native peoples in provisioning the colony, and the presence of native women as wives, mothers, and cooks were important in shaping the diet in Spanish Florida (Deagan, 1973, 1993, 1995). The people who provided much of the food and

labor in Spanish Florida were more familiar with traditional local practices than they were with animal husbandry and cuisines featuring pork, beef, and chicken. It is not surprising that wild resources formed a major portion of the diet for both Spanish colonists and native peoples throughout Spanish Florida. It appears that: (1) the Spanish diet changed more with colonization than did native diets; (2) more animal-derived nutrients were obtained from wild game than from Eurasian animals in most parts of Spanish Florida; and (3) diets within the colony reflected local environmental conditions and many of the cultural practices of the colonized rather than the colonizers.

Within a specific setting, local pre-Hispanic strategies continued into the 17th century in some cases altered, primarily, by the addition of some Eurasian animals to the diet (fig. 8.1). No homogeneous, colonial-period exploitation strategy prevailed in Spanish Florida, however. Strategies on St. Catherine's Island were very different from those in other provinces. The high percentages of deer in the St. Catherine's Island assemblages, for example, contrast with those in Spanish and Native American assemblages from the St. Augustine area; but are lower than in some noncoastal mission assemblages. The role of fishes at Santa Catalina de Guale was minimal

compared to that in the St. Augustine area, though higher than at some noncoastal missions.

Although many aspects of pre-Hispanic traditions continued into the 17th century, others changed. Both Guale and Spanish strategies at Santa Catalina de Guale differed from the strategy practiced at pre-Hispanic Meeting House Field. Evidence for continuity between the pre-Hispanic and 17th-century strategies is stronger for the St. Augustine area in terms of diversity, though greater access to domestic animals distinguishes Spanish from Native American diets. The Convento de San Francisco strategy was more similar to that elsewhere in the St. Augustine area than it was to that at Santa Catalina de Guale.

This latter point is clearer if cats (*Felis catus*) and other commensal taxa are removed from the Convento de San Francisco calculations. The Convento MNI diversity is 2.995 and the biomass diversity is 2.675 if commensal animals are omitted, bringing the Convento diversity estimates in line with those from the other St. Augustine assemblages.

Fishing is an aspect of the exploitation strategy that seems to have experienced several changes. These include alterations in fish diversity and in the percentages of small-bodied and mass-captured fish taxa used (fig. 8.4). Though such changes reflect shifts in emphasis within the

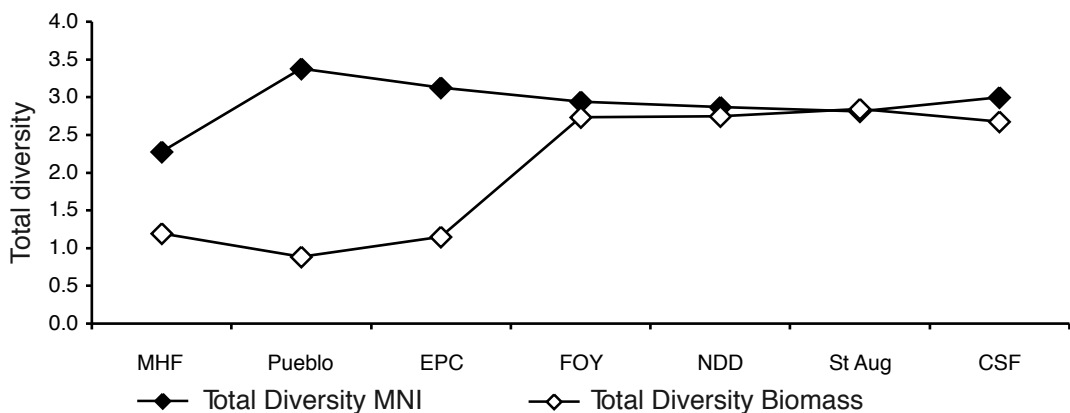


Fig. 8.2. Total collection diversity based on MNI and biomass, including commensal taxa. **MHF**, Irene-period Meeting House Field (all mounds combined); **Pueblo** includes Fallen Tree, Pueblo South, and Pueblo North; **EPC**, Eastern Plaza Complex; **FOY**, St. Johns Ilc Fountain of Youth; **NDD**, Nombre de Dios, which combines 16th/17th-century and 17th/18th-century mission components from Fountain of Youth; **St. Aug**, 17th-century secular St. Augustine; and **CSF**, 1600s and 1650s Convento de San Francisco. CSF data exclude commensal taxa.

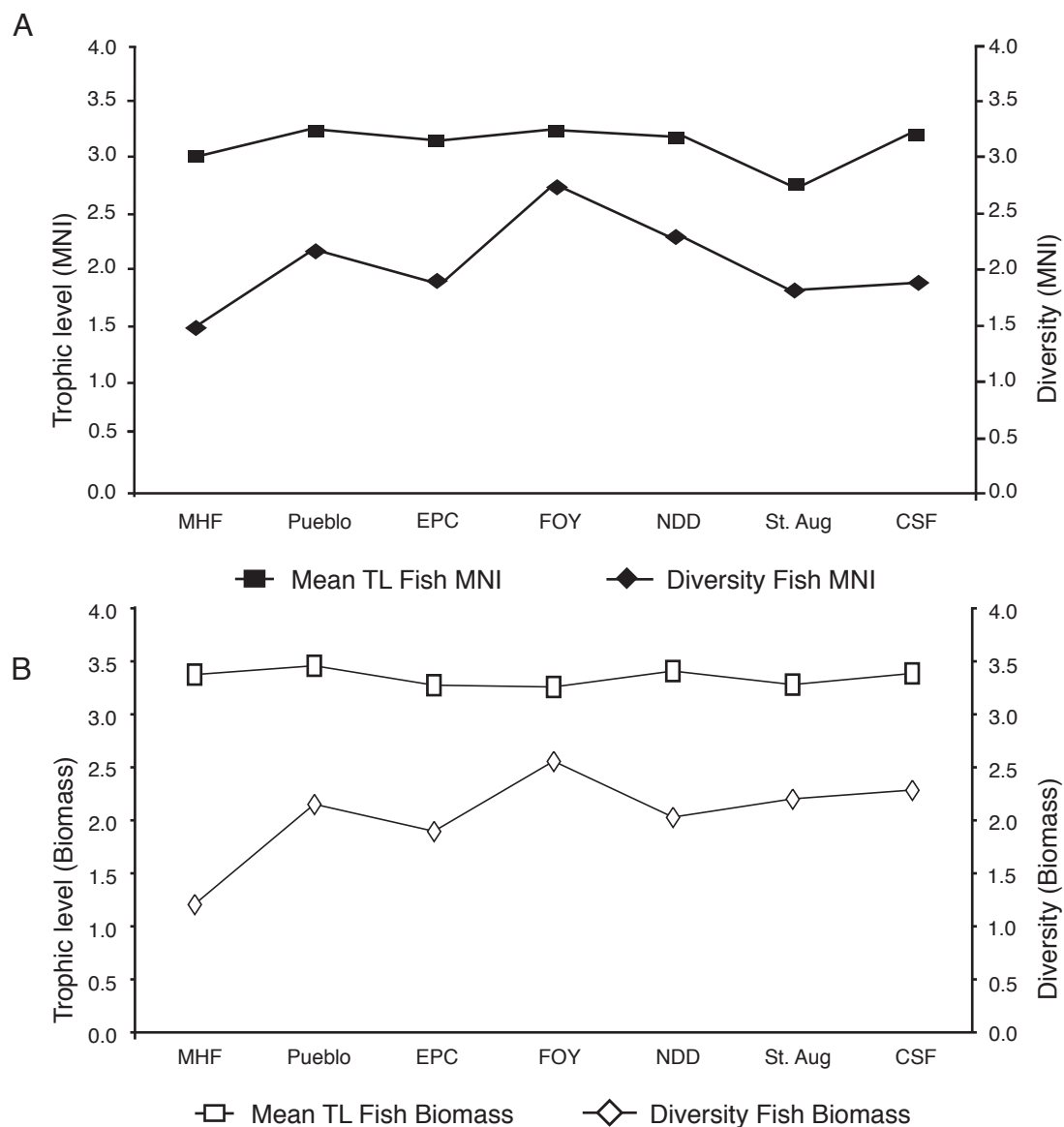


Fig. 8.3. Relationship between mean trophic level and fish diversity: (A) MNI and (B) biomass. **MHF**, Irene-period Meeting House Field (all mounds combined); **Pueblo** includes Fallen Tree, Pueblo South, and Pueblo North; **EPC**, Eastern Plaza Complex; **FOY**, St. Johns Ilc Fountain of Youth; **NDD**, Nombre de Dios, which combines 16th/17th-century and 17th/18th-century mission components from Fountain of Youth; **St. Aug.**, 17th-century secular St. Augustine; and **CSF**, 1600s and 1650s Convento de San Francisco.

traditional, pre-Hispanic suite of fishes, in no case did offshore fishing replace estuarine fishing. Changes in mean trophic level exploited suggest more continuity than change, though the

preference of some Spaniards for low-trophic-level mullets is apparent (fig. 8.5). (Although mullets of all body sizes are low trophic-level fishes, young mullets are very small and older

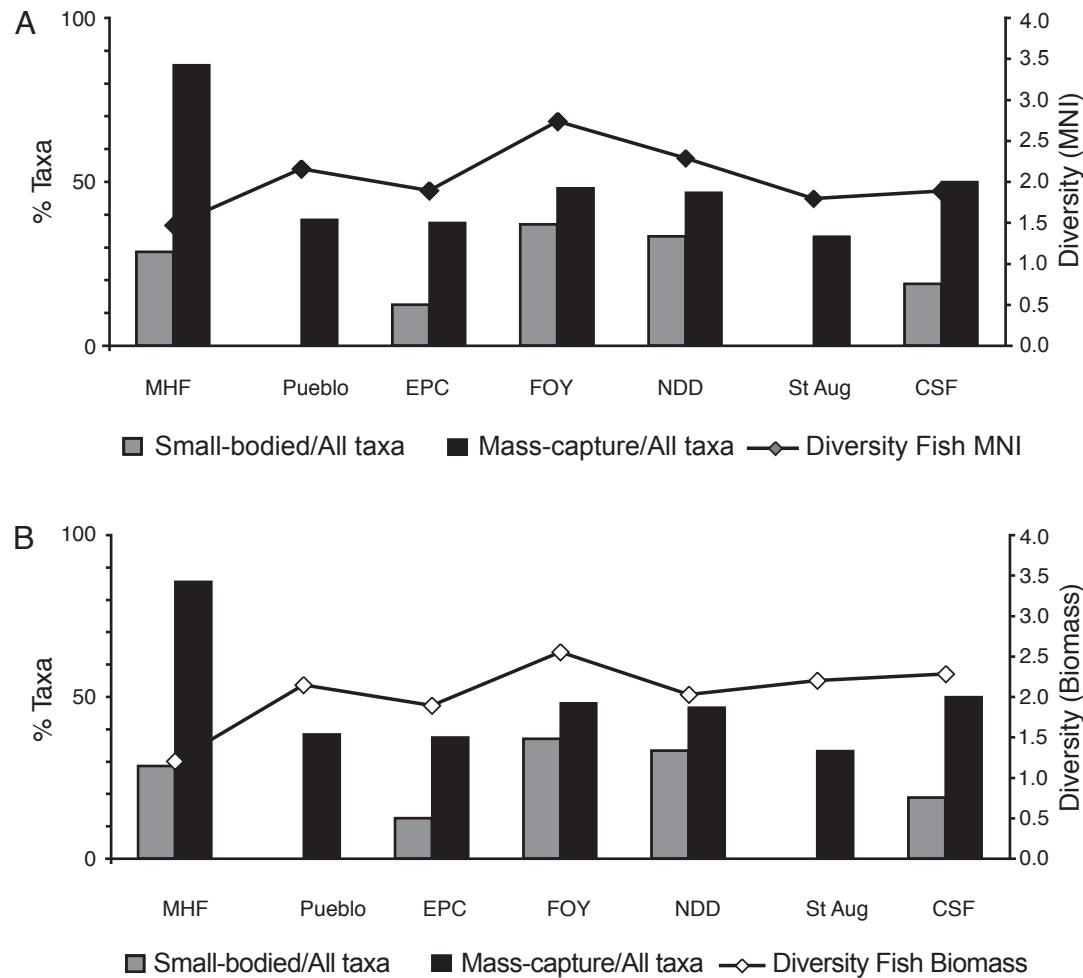


Fig. 8.4. Relationships among small-bodied fish taxa, mass-captured fish taxa, and diversity: (A) MNI and (B) biomass. **MHF**, Irene-period Meeting House Field (all mounds combined); **Pueblo** includes Fallen Tree, Pueblo South, and Pueblo North; **EPC**, Eastern Plaza Complex; **FOY**, St. Johns Ilc Fountain of Youth; **NDD**, Nombre de Dios, which combines 16th/17th-century and 17th/18th-century mission components from Fountain of Youth; **St. Aug.**, 17th-century secular St. Augustine; and **CSF**, 1600s and 1650s Convento de San Francisco.

mulletts may reach a body size of 76 cm or larger. Both young and adult mulletts are vegetarians, but they feed in different locations.)

Fish diversity changed from the pre-Hispanic levels both at Santa Catalina de Guale and in the St. Augustine area, though in different ways. On St. Catherines Island, fish diversity increased whereas in the St. Augustine area, diversity declined. The 17th-century diversity values contrast with the notably low fish diversity in the pre-Hispanic

Meeting House Field assemblage and the notably high fish diversity in the pre-Hispanic Fountain of Youth assemblage (fig. 8.3). The fishing strategy reflected in the Plaza Complex assemblage was more specialized than that reflected in the pueblo assemblage. A similar pattern is found in St. Augustine, except that the higher diversity of fish biomass in secular St. Augustine and at the Convento reflect the lower fish richness and more equitable use of fish taxa in the town compared to

the very rich, but less equitable, Nombre de Dios fish assemblage. Changes in fishing strategies resulted in 17th-century diversity patterns that are very similar at both Santa Catalina de Guale and the St. Augustine area. The average 17th-century MNI diversity at both places is 2.0; the average biomass diversity at Santa Catalina de Guale is 2.0 and average biomass diversity in the St. Augustine area is 2.2.

This change in emphasis could be the result of several simultaneous processes that influenced fishing strategies. The increased diversity at Santa

Catalina may reflect efforts to resolve scheduling conflicts between farming and repartimiento requirements, to the extent that Native Americans did most of the fishing. At the same time, Spaniards may have influenced native fishing to reflect their own preferences for the variety of fishes that they wanted to use at both Santa Catalina de Guale and in the St. Augustine area. This direction could have influenced the diversity of fishes used by Native Americans in the pueblo and at Nombre de Dios, as well. If Native Americans fished primarily for themselves and Spaniards fished only

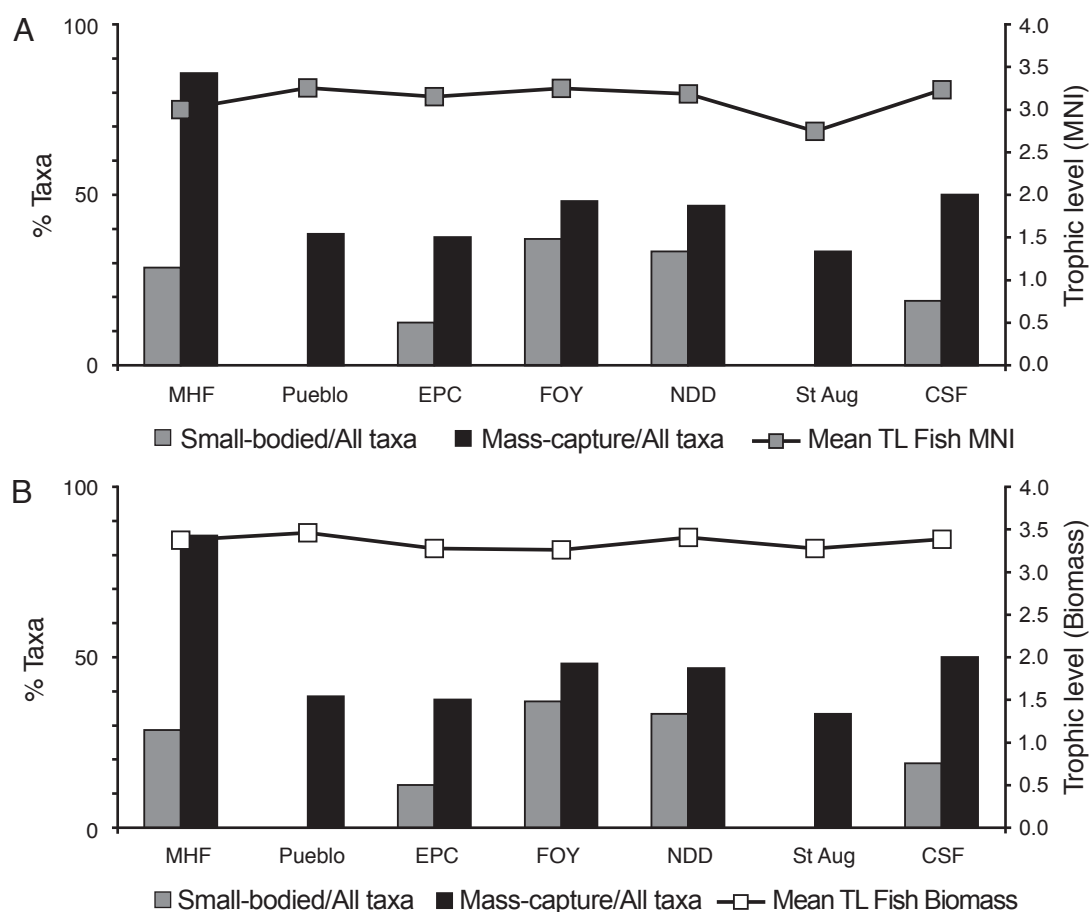


Fig. 8.5. Relationships among small-bodied fish taxa, mass-captured fish taxa, and mean trophic level: (A) MNI and (B) biomass. **MHF**, Irene-period Meeting House Field (all mounds combined); **Pueblo** includes Fallen Tree, Pueblo South, and Pueblo North; **EPC**, Eastern Plaza Complex; **FOY**, St. Johns Ilc Fountain of Youth; **NDD**, Nombre de Dios, which combines 16th/17th-century and 17th/18th-century mission components from Fountain of Youth; **St. Aug**, 17th-century secular St. Augustine; and **CSF**, 1600s and 1650s Convento de San Francisco.

for themselves, these shifts in diversity may also reflect responses to a broader phenomenon that influenced fishing strategies by all ethnic groups throughout the southern Georgia Bight. The 17th-century drought undoubtedly altered the estuarine ecosystems at St. Catherines Island and in the St. Augustine area and may have stimulated an expansion of the niche at St. Catherines and a contraction of the niche at St. Augustine.

Additional changes in fishing strategy can be seen in the percentages of small-bodied and mass-captured fish taxa (fig. 8.4). One of the characteristics distinguishing Spanish from pre-Hispanic Native American fishing techniques is the size of fish targeted. Although both Spaniards and pre-Hispanic Native Americans used essentially the same fish taxa, Spanish assemblages tend to contain fewer small-bodied fish taxa than do most Native American assemblages. Furthermore, the 17th-century percentages of small-bodied fish taxa are lower at each location as compared to pre-Hispanic levels. The Convento de San Francisco is the only case in which the use of mass-capture fishing techniques was higher in the 17th century than it was in the pre-Hispanic period in the same area.

This suggests that Native Americans used somewhat different habitats and techniques to capture fish than they used prior to the 17th century, or that Spaniards did some of their own fishing. The size of fish found in pre-Hispanic archaeological collections suggests that Native Americans exploited waters and marshes immediately adjacent to the shore, perhaps using fine-gauge nets, rakes, weirs, traps, or basketry scoops and thereby captured relatively small individuals. After 1565, Spaniards and Native Americans alike used some of these same techniques, but they also used cast nets and seine nets in deeper estuarine waters. Small individuals are typically found in grassy areas at the marsh edge and larger individuals of the same species are found in deeper waters, so changes in fishing location, timing, and technology could result in increased capture of large fishes that is not reflected in the species lists. The importance of location, timing, and technology in influencing the size of animals captured is most clear in the case of mullets, which tend to be small and rare in Native American deposits but large and common in Spanish contexts.

To explore the role of Native American contributions to the Spanish economy, we look

for evidence that missions provided live animals, meats, and hides to either secular 17th-century St. Augustine or to the Convento de San Francisco in St. Augustine. Interpreting change and continuity in other aspects of diet, exploitation strategies, and economic contributions of Native Americans requires distinguishing among several avenues through which animals and their products circulated in Spanish Florida. At one extreme, Spaniards and other colonists are assumed to have used their traditional exploitation strategies to obtain a diet that was familiar to them. For example, San Luis de Talimali, in Apalachee province, may be evidence for the survival of an Iberian strategy, though it is likely that much of the food consumed at San Luis was raised by Native Americans (table 4.4; Deagan, 1993; McEwan, 1993, 2004). At the other extreme is the assumption that all foods consumed by colonists were provided by Native Americans. Neither extreme applies to the Spanish Florida context.

Native Americans did raise Eurasian animals in Spanish Florida (Deagan, 1993; McEwan, 1993, 2004) but such animals are rare in these faunal collections. Perhaps Native Americans did not consume the animals they raised, with the result that the role of Eurasian animals in native economies is underrepresented in the archaeofaunal record. It seems more likely, however, that Native Americans simply did not raise or consume many Eurasian animals. Although traditional Native American farming techniques could accommodate Eurasian crops (Gremillion, 1993, 1995), indigenous peoples had no prior experience with the needs of domestic animals (Pavao-Zuckerman and Reitz, 2006). Other than dogs (*Canis familiaris*), domestic animals had no role in traditional southeastern cuisines or in other cultural institutions. As elsewhere, the transition to animal husbandry likely required a redistribution of labor among men, women, and children that undoubtedly left some tasks undone. As Diane Gifford-Gonzalez and Kojun Sunseri (2007) note, children are often delegated to collecting firewood and if their time is diverted to herding livestock instead, this could add to the labor burden of women.

Protecting livestock from predators, keeping them out of gardens and fields, treating their diseases, ensuring reproductive success, and other aspects of animal husbandry were novel techniques to Native Americans in Spanish Florida and not accommodated easily into the

daily schedules of farming, gathering, fishing, trapping, and hunting. Pigs, cattle, and chickens generally were left to fend for themselves. Some of these animals developed strategies for self-preservation and became expert at surviving with minimal human protection. Many did not flourish and the ones that did were essentially wild.

Cattle ranching was embraced in Apalachee province and in portions of Timucua province to a much greater degree than elsewhere in Spanish Florida. In addition to an environment more agreeable to cattle pioneers (see appendix B), an important difference between the cattle-ranching portions of Spanish Florida and non-cattle-ranching areas was the secular, commercial interests of Spaniards. These commercial interests provided an economic environment in which native peoples could benefit from animal husbandry. A stable, large population committed to a farming tradition in Apalachee province facilitated the transition from a farming economy to one that combined mixed farming with animal husbandry (Hann, 1988: 5–10; McEwan, 1993; Wenhold, 1936: 7). There was also a ready, profitable market for cattle products accessible via the Gulf of Mexico (McEwan, 1993). It helped that Apalachee province was separated from St. Augustine by a long, difficult journey, and that local authorities encouraged and protected commerce that was at odds with official Spanish mercantile policies. Animal husbandry enabled people in Apalachee and western Timucua provinces to take advantage of economic and political opportunities that those living on the Atlantic coast did not enjoy.

Archival sources indicate that substantial quantities of food and other goods were sent from missions to St. Augustine. Most of these sources emphasize transactions between Apalachee province and St. Augustine (Boyd et al., 1951; Hann, 1986b, 1988, 1990, 1993), but a similar system operated along the Atlantic coast (Bushnell, 1981: 11–13, 97–99; García, 1902; Hann, 1986b: 197). Transportation over water might have been less difficult, less time-consuming, and less costly than overland routes in a colony where roads and beasts of burden were limited and many goods were carried by Native Americans as part of their service obligation to the Crown (e.g., Bushnell, 1981: 11; Hann, 1986b: 176). According to Alonso de Leturiondo, Santa Catalina de Guale sent hogs, butter or lard, rabbits, and deer to sell in St. Augustine and was the sole source of such goods

for the town (Hann, 1986b: 197).

Leturiondo's account is highly suspect. It hardly seems likely that Santa Catalina de Guale had enough hogs, milk cows, or rabbits to send live animals, meat, or butter to St. Augustine, and most of the meats consumed in St. Augustine appear to be from local sources. To the extent that missions did send provisions to St. Augustine, most of these provisions probably were directed preferentially to the religious community. If that were the case, the Convento de San Francisco faunal assemblage should be similar to those from outlying missions; and the Convento does have slightly higher percentages of venison and chickens compared to secular 17th-century St. Augustine (tables 8.1 and 8.2). Nonetheless, far more venison and chickens were consumed at Mission Santa Catalina de Guale than at the Convento and far more beef was consumed at San Luis de Talimali than at either of these other locations. Animal use at the Convento conforms more to local habits in the St. Augustine area than to those on St. Catherines Island or at San Luis de Talimali.

The material culture recovered during excavations at Mission Santa Catalina de Guale is consistently richer than that from other Spanish contexts (Thomas, 1993a; see chap. 2). In Spain, hunting was restricted to the elite class (Altamira, 1949: 459). Thus, venison could have been a status marker among priests, regardless of whether they were *criollo* or *peninsulare*. The greater use of venison and chickens in Spanish contexts at Mission Santa Catalina de Guale may be an additional marker of prestige or higher status at that outpost. Chickens were considered expensive in Spanish Florida (Geiger, 1937). To the extent that people at the Convento de San Francisco also enjoyed greater access to venison and chicken, this could have been evidence of prestige and influence in the St. Augustine community as well. Elizabeth Scott (2007) suggests that the American setting may have enabled nonelite households to have access to wild foods that were available only to elite households in post-medieval Europe.

#### CHANGE AND CONTINUITY ELSEWHERE IN SPANISH AMERICA

Studies of animal use at colonial sites elsewhere in New Spain are not as common as those for Spanish Florida, but this growing body of research highlights the conclusion that animal

use in Spanish colonies was highly variable, with both change and continuity reflecting responses to local ecological, economic, and social conditions more than intentional Spanish colonial policy. In other Spanish colonies, different patterns emerged in which a locally distinct suite of Eurasian animals is prominent in each case, but rarely to the exclusion of indigenous animals. Although missions are often cited as dominated by Eurasian livestock, in only a few cases is this supported by quantified zooarchaeological data. Eventually, it will be possible to review these data with control over Spanish and indigenous contexts at missions and at other settlement types throughout the Americas. At this time, however, data from other Spanish colonies is too limited to compare specific ethnic and social groups.

Below, we review the practice of animal husbandry and the role of indigenous foodways at Spanish missions and other colonial contexts elsewhere in the Spanish Americas. This body of Spanish colonial zooarchaeological research suggests that differences in animal use reflect local environmental conditions, the ability of specific Eurasian animals to reproduce in each setting, pre-Hispanic indigenous knowledge of animal domestication, the global commercial potential of the outpost, and the organization of indigenous labor. In terms of labor, much appears to depend on whether or not native labor and economic contributions were organized through *encomiendas* and *reducciones*. To this list, Gifford-Gonzalez and Sunseri (2007) add the need for native peoples to decide who owned these animals (individuals, households, lineages, communities) as well as their by-products, labor, and the infrastructure they require. It was also important to determine who was responsible for managing these animals and how to resolve disputes over the damage free-ranging animals inflict on fields, gardens, and structures.

#### SPANISH TEXAS

As in Spanish Florida's Apalachee province, it appears that cattle ranching became an important economic activity at missions located in the more open and pasture-rich environment of eastern Spanish Texas (fig. 8.6). Research at several Spanish missions on the Texas coast, including Mission Espíritu Santo de Zúñiga (1726–1749), Mission Espíritu Santo de Zúñiga at Goliad (1749–early 19th century), and Mission Nuestra Señora del Rosario (1748–early 19th

century) indicates some success in introducing animal husbandry to the missionized Aranama, Tamique, and Karankawa indigenous communities (deFrance, 1999; Walter, 2007). Zooarchaeological evidence indicates that cattle ranching was a primary economic strategy at all three missions. Missionaries attempted to restrict hunting in order to keep converts under the close religious supervision of the priests and to provide ready access to an indigenous labor pool to support intensive ranching (deFrance, 1999). It is not clear, however, that this economic dependence translated into a substantial modification of the daily subsistence practices of the indigenous subjects, and it is clear that reliance on indigenous resources was somewhat variable between missions in the region. For example, wild game contributed a greater proportion of subsistence resources at Mission Rosario, supporting earlier work indicating that the Karankawa neophytes at Rosario were more resistant to missionary attempts to alter their daily subsistence practices (deFrance, 1999).

Military communities in Spanish Texas were also dependent on wild resources, in concert with animal husbandry. Reliance on local resources appears to have been a necessity for the multiethnic presidio community at Nuestra Señora del Pilar de los Los Adaes, which served as the capital of Spanish Texas from 1729 to 1772. While the animal husbandry strategy at the presidio was based on cattle ranching, all of the households studied relied substantially on wild game (Pavao-Zuckerman, 2001). The use of low-status local resources, such as alligators (*Alligator mississippiensis*), freshwater catfishes (*Ictalurus* spp. and *Pylodictis olivaris*), and shellfishes by households associated with widely different social and economic classes indicates either that domesticated livestock resources were not sufficient to support the presidio's population, or that indigenous cuisines were syncretized with Spanish foodways within this multiethnic community.

#### SOUTHWEST

Animal husbandry took on greater importance at Spanish missions and other colonial contexts in the arid environments of the western reaches of New Spain. In southwestern North America, wild resources could not provide the same level of support as the productive natural resources of Spanish Florida, particularly with the population

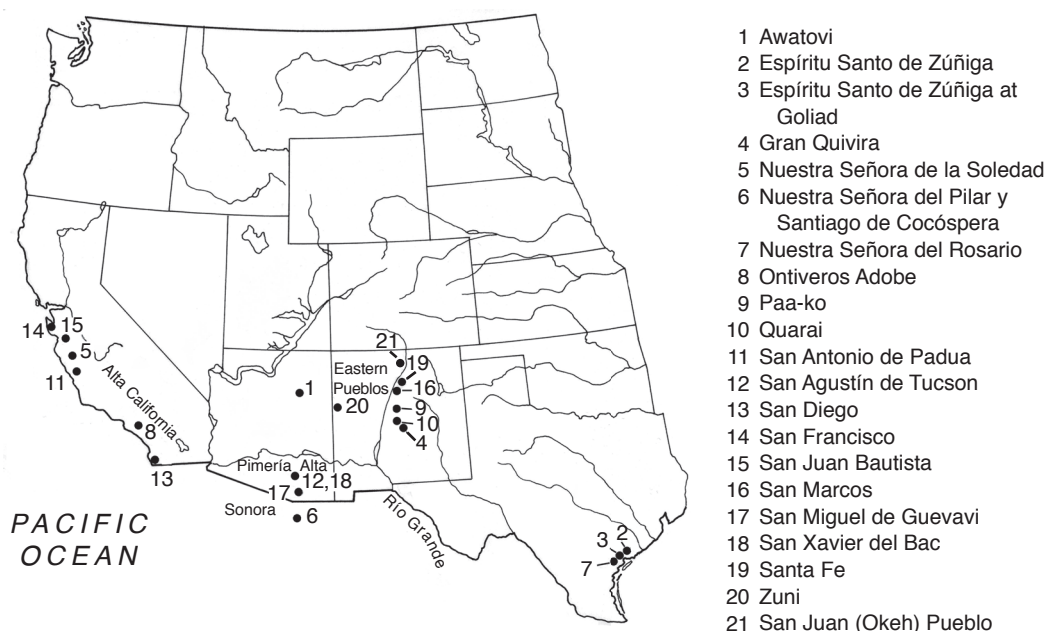


Fig. 8.6. Locations in northwestern New Spain.

increases and concentration that accompanied Spanish colonialism. Animal husbandry, with all its attendant costs, became essential to the colonial strategy in the Southwest (Gifford-Gonzalez and Sunseri, 2007).

Spanish colonial-period zooarchaeological research in southwestern North America has generally concentrated on two main regions: the Puebloan region of northern Arizona and northern and central New Mexico and the Pimería Alta, the region encompassing southern Arizona (USA) and northern Sonora (Mexico) (fig. 8.6). This research suggests that animal husbandry, particularly the extraction of secondary animal by-products, became a critical economic base for Spanish missionization and colonialism in the region. It is noteworthy that some southwestern groups had experience with domesticated, or at least tamed, animals (Gifford-Gonzalez and Sunseri, 2007; Minnis et al., 1993). This prior experience with domesticated animals may have had some effect on indigenous interactions with introduced livestock in the region (Pavao-Zuckerman and Reitz, 2006).

Missions in all colonial regions served as

mechanisms for labor exploitation. However, whereas in Spanish Florida native labor was enlisted primarily to support local economic and construction projects, in the greater Southwest, native labor was enlisted in large part to extract animal by-products, most notably wool, hides, and tallow, for regional and extraregional commercial markets. Despite these generalizations, however, significant intraregional differences in animal husbandry practices are found, particularly in the suite of domesticated livestock represented. These differences are attributable, in large part, to environmental differences, though regional economic demands no doubt also contributed to the development of divergent strategies within the southwestern region.

Greater attention has been paid to zooarchaeological investigations of colonial-period sites in the Puebloan region than in Pimería Alta. Within the Puebloan area, however, far more information on colonial-period vertebrate exploitation strategies is available for the Eastern Pueblos, centered on the Rio Grande and its tributaries in central and northern New Mexico,

than for the ancestral pueblos of the Hopi and Zuni that comprise the so-called Western Pueblo subregion. Despite differences in data availability, zooarchaeological research in the larger Puebloan region suggests that small livestock, notably caprines, was more important than cattle to mission economies, but that local wild game contributed significantly to both Spanish missionaries and missionized Native American diets.

Within the Eastern Pueblo subregion, zooarchaeological remains from the 17th-century mission church and convento at Mission San Marcos indicate that traditional Spanish dietary practices changed considerably in the mission setting. Although chickens, horses (*Equus caballus*), pigs, cattle, and caprines were raised at the mission, local resources, including indigenous domesticated turkeys (*Meleagris gallopavo*), contributed substantially to the missionary diet at San Marcos (Lucas et al., 2002).

Cattle and caprines dominated the animal husbandry strategy at San Marcos, but the domestic animal assemblage at the Eastern Pueblo village of Paa-ko (Lycett, 2002) is primarily dominated by caprines, particularly goats (*Capra hircus*; Gifford-Gonzalez and Sunseri, 2007). The prominence of goats in the assemblage diverges from the animal husbandry patterns at other colonial-period missions. Butchering marks suggest that livestock carcasses were processed in a manner consistent with traditional Puebloan practices. The presence of a smelting industry at Paa-ko depleted firewood sources near the mission, perhaps adding animal dung as another important animal resource for human use.

Outside Spanish Florida, opportunities to compare the diets of Spanish missionaries with those of missionized Native Americans are rare. Research at the Eastern Pueblo community of Quarai is an exception to this rule (Jones, 1997). At the Native American village at Quarai, wild game contributed greatly to the subsistence strategy, and sheep (*Ovis aries*) and goats were raised in small numbers. In contrast, domesticated livestock were more common in the mission assemblage, though these herds were likely under the care of Native American labor. At the nearby pueblo of Gran Quivira (McKusick, 1981), population growth and the coopting of indigenous labor for mission-related tasks caused a decrease in the proportion of large to small wild mammals, and a replacement of large wild game

with cattle. Differences between pueblos are also noted; animal husbandry appears to have been more important at Gran Quivira than at Quarai (Moore, 1994).

The role of animal resources in the Western Pueblos during the Spanish colonial period has received much less attention than elsewhere in the greater Southwest. At ancestral Zuni Pueblo, it appears that caprines were adopted rapidly and quite early in the missionization process (Tarcn, 2005), probably for the exploitation of wool and dung. As at several of the Eastern Pueblos, including Gran Quivira, it appears that caprines, particularly sheep, largely replaced indigenous wild resources such as lagomorphs (rabbits and hares) and turkeys during the colonial period at Zuni Pueblo.

At the ancestral Hopi Pueblo of Awatovi, located in northern Arizona, domesticated livestock, including chickens, horses, pigs, cattle, and caprines were quickly incorporated into economic and subsistence practices (Chapin-Pyritz, 2000). Wild resources remained important at the pueblo, but declined over time with missionization. It is possible that the greater engagement of this village with Spanish colonialism was responsible for the greater reliance on Eurasian animals. Greater engagement with the colonial system, and failure to reject Spanish colonialism, is believed to have been the reason for the eventual destruction of Awatovi by neighbors hostile to the colonial presence.

Colonial-period zooarchaeological research in the Pimería Alta highlights the diversity of economic strategies at Spanish colonial missions in southwestern North America. Although an emphasis on small stock and on a wool economy developed in the Puebloan region, cattle ranching for secondary products such as hides and tallow was central to Pimería Alta mission economies (Pavao-Zuckerman, 2010). As a result, economic strategies at Pimería Alta missions were more similar to practices that later developed at distant missions in Alta California than they were to practices at the Puebloan missions.

To date, four 18th-century mission sites in the Pimería Alta have been subject to zooarchaeological analyses: Mission San Xavier del Bac, Mission San Miguel de Guevavi, Mission San Agustín del Tucson, and Mission Nuestra Señora del Pilar y Santiago de Cocóspera. Early research at Bac, completed without the benefit

of screening, indicates that cattle ranching was the predominant activity at the mission (Cheek, 1974; Olsen, 1974). A very small assemblage (NISP = 289) of animal remains was recovered from Mission San Miguel de Guevavi during excavations in preparation for stabilization of the ruins of the mission church's walls (Gillespie, 1992). Pigs, caprine, and cattle were identified in the zooarchaeological sample, in addition to several species of reptiles and amphibians, lagomorphs, rodents, and a possible badger (*Taxidea taxus*). It was not possible to interpret broader patterns of resource utilization, given the limited sample size.

Zooarchaeological investigations of animal remains from two Pimería Alta missions, Mission San Agustín del Tucson and Mission Nuestra Señora del Pilar y Santiago de Cocóspera, provide the first reliable examinations of subsistence strategies and economies at missions in the region. Both of these large assemblages indicate that cattle ranching was the predominant activity at Pimería Alta missions (Pavao-Zuckerman and LaMotta, 2007). Without information specifically from the residential areas of these missions, like that available for Santa Catalina de Gualé, the extent to which economic reliance on cattle influenced daily subsistence practices of the O'odham Native Americans who lived at these missions cannot be determined. The scale of ranching at the missions, however, suggests that O'odham households contributed much of the labor that supported the ranching-based economy. Although cattle dominated the assemblages from these missions, the substantial contribution of wild game to the assemblages may indicate that opportunistic garden hunting continued to be an important dimension of the subsistence strategy. The presence of wild animals within the mission compound suggests that Spanish personnel at the mission incorporated the meat of wild game into their diet. Apparently, both European and O'odham individuals experienced changes in their daily cuisines as a result of their interactions at the missions. Although Spanish Florida missions primarily supported local economies, it appears that production of secondary animal products linked Pimería Alta missions to the economies beyond the local exchange system. Extensive postmortem processing of cattle carcasses suggests that the missions engaged in tallow rendering at a scale beyond what was necessary for local use. This product was in demand by

mining industries in northern Sonora for candles, lubricants, and, likely, soap (Jordan, 1993: 126; Pavao-Zuckerman and LaMotta, 2007; Trigg, 2005: 184). Ranching at missions in the Pimería Alta appears to have played a critical role in the economic development of the Spanish colonial program in northwestern New Spain.

Not all Native American groups in the southwestern region were missionized. Evidence from these groups would provide an interesting counterpoint to the examination of economic and cuisine practices at southwestern missions. Unfortunately, as in the Southeast, archaeological evidence from nonmissionized Native American groups is scant. Documentary evidence, however, indicates that domesticated livestock were incorporated into the subsistence and economic systems of nonmissionized nomadic Native American groups in the southwestern region with dramatic effect. These groups eventually transformed their economies, basing them primarily on raiding livestock from both Spanish settlements and Pueblo villages (Spicer, 1962: 546–547).

#### ALTA CALIFORNIA

Spanish colonialism in Alta California in the 18th century began as an extension of missionization efforts in the Pimería Alta. The primary catalyst for the expansion of Spanish colonialism westward was the encroachment of Russian interests from the northwest (Lightfoot, 2003, 2005; Lightfoot et al., 1998). In response to Russian mercantile expansion, an extensive network of missions and presidios was quickly established following a strategy that was already well rehearsed in other Spanish colonial regions. As observed above, the goals of the missions in Alta California ultimately were similar to those of the missions in Pimería Alta.

Investigations at the Ontiveros Adobe ranch site, Mission Nuestra Señora de Soledad, Mission San Antonio de Padua, and Mission San Juan Bautista reflect the similarities between missions in Alta California and in the Pimería Alta in terms of their economic bases. Archaeological and documentary evidence indicates that cattle ranching, supported by indigenous labor, was the dominant activity in the region. Cattle herds were exploited for tallow and hides, commodities that became more economically important even than meat (Barker et al., 1995; Dallas, 1955; Farnsworth, 1987; Langenwaller and McKee, 1985; McKee

and Langenwalter, 1985; St. Clair, 2005). In order to feed the expanding market for these secondary animal products, many missions maintained distant cattle ranches, literally throwing meat in the trash in the process of harvesting carcasses for hides and tallow (Costello and Hornbeck, 1989; Dallas, 1955).

These ranches were not exclusively focused on cattle, however. At the Ontiveros Adobe ranch site, other livestock including sheep and a few pigs were also found, though these latter resources were minor when compared to cattle (Gust, 1982). Animal husbandry was not the exclusive subsistence strategy, either. At most missions and ranches, localized hunting and fishing of wild resources played an important, if minor, role in Native American diet, perhaps as a supplement to inadequate mission rations. Data from the Ontiveros Adobe ranch site and Mission San Juan Bautista demonstrate widespread adoption of Spanish carcass butchering techniques by native laborers at Alta California missions and ranches (Gust, 1982; St. Clair, 2005).

Variation in ranching strategies also occurred over time. Ethnohistorical documents pertaining to Mission Nuestra Señora de Soledad indicate that sheep herds increased over time, and sheep eventually came to outnumber cattle two to one by the turn of the 19th century (Farnsworth, 1987). While meat, tallow, and hides continued to play an important role in regional economic interactions, it appears that the Soledad mission was part of a growing wool industry in the region.

Although this growing body of research reflects on mission economic strategies, very few zooarchaeological data from Alta California pertains directly to Native American dietary pattern at missions. Two important exceptions are from a neophyte dormitory (and kiln) from Mission San Antonio de Padua and the neophyte quarters and courtyard area of Mission San Juan Bautista. Cattle dominate both assemblages, followed by a minority contribution of caprines and other small stock (Langenwalter and McKee, 1985; McKee and Langenwalter, 1985; St. Clair, 2005). The lower representation of caprines, particularly sheep, may be somewhat misleading. Historical documents report that sheep were as abundant as cattle near Mission San Juan Bautista. Sheep may have been raised at outlying ranches, explaining the absence of their remains at the mission proper. It is also

likely that exploiting sheep for wool meant that animals were slaughtered for food less frequently than cattle, which had to be slaughtered in order to harvest most of their secondary products.

Although beef may have been discarded in the quest to extract the valuable hides and tallow at the mission ranches, it was the most important protein source at the dinner table of military citizens at Presidio San Francisco (Voss, 2008). The team of archaeologists lead by Barbara Voss demonstrates that beef was central to the colonial diet, and that households were likely in charge of their own cattle herds (Voss, 2008: 238). Chickens also are common in this collection, but other domestic animals are rare or absent. The presence of numerous species of wild game and fish, coupled with the above evidence, suggests that nonmission households were responsible for providing most, if not all, of their own subsistence resources.

#### CARIBBEAN

Zooarchaeological remains from Spanish colonial sites in the Caribbean provide further evidence of the diversity of animal exploitation strategies employed in response to specific environmental and cultural conditions. Deposits from Spanish colonial sites on the Caribbean island of Hispaniola, in the West Indies, reflect the flexibility and variety found in Spanish Florida. The environmental history of Hispaniola facilitated a rapid increase in cattle, in sharp contrast to Spanish Florida and other areas of mainland Spanish America (Deagan and Reitz, 1995; Reitz, 1992a; Reitz and McEwan, 1995; Wing, 1989, 2008; see appendix B). At Puerto Real, a 15th-century town on the island of Hispaniola (now in Haiti), beef dominated the meat-based portion of the diet (Deagan and Reitz, 1995; Reitz and McEwan, 1995). Although the remains of some indigenous animals are present in the Puerto Real assemblage, these are minor. This contrasts with 16th-century through mid-18th-century animal remains from the Convento de San Francisco in Santo Domingo (Dominican Republic, Hispaniola), in which Eurasian animals were merged with local resources (Cumbaa, 1975: 61–66). In the convento faunal collection, 25% of the individuals are caprines (probably sheep), 33% are other noncommensal domestic animals, and 40% are fishes, turtles, manatee (*Trichechus manatus*), and a cetacean. The fishes are typical Caribbean reef fauna, most of which

could have been captured in nearshore waters.

An example more typical of Spanish Florida is found in the southern Caribbean at Nueva Cádiz, a 16th-century Spanish pearl fishing station on Cubagua Island off the north coast of Venezuela. Nueva Cádiz was occupied by Spaniards as well as African and Native American slaves (Goggin, 1968: 42; Rouse and Cruxent, 1963: 134). Cubagua Island had limited resources and many foods were imported from nearby, better-endowed Margarita Island. In the Nueva Cádiz collection, 21% of the individuals are Eurasian species, with pigs the most intensively used of these (Wing, 1961). Heavy use was made of marine individuals, 47% of which were from the inshore-estuarine area, but sea turtles probably contributed over half of the meat (Wing, 1961).

#### CENTRAL AMERICA

A similar diversity of responses is found in examples of Native American colonial strategies in Central America, including Belize and elsewhere in the Yucatán Peninsula. Pre-Hispanic Mayas had prior experience with managing domestic animals for food, specifically dogs and turkeys. They also hunted and managed some tamed animals (deFrance and Hanson, 2008; Emery, 2004; Wing, 2004).

People at Lamanai and Tipu, in Belize, were subject to *encomiendas* and *reducciones* and the two sites were both *visitas* (Emery, 1999). Despite this, no Eurasian animals were used by Mayas at these two colonial-period sites. Although different proportions of native animals are present in Postclassic deposits compared to colonial-period ones, this reflects a trend that began before Spanish colonization. At Lamanai, which experienced a more direct Spanish presence, the richness of animal resources expanded under colonial rule to focus on resources from cultivated lands and rivers. The overall health of people at Lamanai declined. At Tipu, which was more remote, animal use continued relatively unchanged and human health remained relatively good.

In contrast, traditional hunting was limited at the 16th-century Spanish *encomienda* and mission of Ek Balam, in the Yucatán Peninsula, Mexico. Legal restrictions reduced hunting and otherwise limited the mobility of the Maya labor pool (deFrance and Hanson, 2008). Instead of hunting, the Mayas at Ek Balam raised pigs and chickens (7% of the individuals) and continued their pre-Hispanic tradition of eating

dogs (37% of the MNI). Pigs and chickens are the ecological equivalents of dogs in terms of flourishing on human waste and discarded food as well as being compatible with village life. Hunting did continue, however, with white-tailed deer, peccary (*Tayassuidae*), birds, and other wild terrestrial animals contributing 53% of the individuals in this collection. Use of marine products was limited by the policies restricting Mayan travel and trade (deFrance and Hanson, 2008). Spanish policy, prior experience with domestic animals, and the habits and habitats of dogs, pigs, and chickens facilitated increased use of Eurasian animals.

#### SOUTH AMERICA

South American examples reinforce the conclusion that flexibility was characteristic of colonial settings. In these cases, Eurasian animals were introduced into a region with a long pre-Hispanic tradition of animal husbandry. Wealthy Spaniards living on the outskirts of Potosí, a Bolivian mining town, during the first half of the 17th century procured meats in a fashion that more closely conforms to what is presumed to have been the preferred Iberian diet (McEwan, 1995; Reitz and McEwan, 1995; see chap. 1) rather than indigenous Andean foodways (deFrance, 2003). Although some indigenous elements are present in the Potosí collection, most of the meat was pork and beef. On the other hand, at four wineries in the Moquegua valley and at the late pre-Hispanic/colonial site of Torata Alta, both in Peru, Susan deFrance (1996) found that Eurasian animals were combined with South American llamas (*Lama glama*) and alpacas (*Lama [Vicugna] pacos*), though the faunal assemblages otherwise were more similar to the hypothetical Iberian diet than were those in Spanish Florida.

#### SPANISH FLORIDA IN INTERREGIONAL PERSPECTIVE

The above examples from elsewhere in the Americas stand in sharp contrast to those from Spanish Florida, but explanations for the differences are not difficult to find. Several aspects of indigenous life appear to have been particularly important to the unfolding of human and livestock interactions in the colonial period (Pavao-Zuckerman, 2000; Pavao-Zuckerman and Reitz, 2006). Ecological conditions influenced the ability of domesticated animals to

survive and thrive in new environments and influenced whether or not they were perceived as higher-yielding resources than indigenous wild game. Demographic pressures due to overall population growth and loss of traditional lands also could be associated with the adoption and intensified use of domesticated animals. The development of markets for livestock, meats, and secondary animal products could stimulate adoption of animal husbandry as native peoples took advantage of new economic opportunities. Animal husbandry might have been more or less attractive depending on precolonial dietary and cultural practices. Colonial goals and investments, as well as the relative political power of individual missionaries and indigenous leaders, were also important factors influencing how animal husbandry was, or was not, incorporated into indigenous practices. These considerations for human and livestock interactions are explored in the following sections.

#### ECOLOGICAL TOLERANCES

The success of Eurasian domesticated animals in colonial settings was influenced by the environmental tolerances of each species (Reitz, 1992a). This was especially the case prior to the development of modern breeds selected for success in specific environmental conditions. Factors such as temperature, elevation, humidity, primary production, predation, and the presence of ruminant diseases in wild ungulates influenced the ability of each species to survive, reproduce, and increase in a specific colonial setting. Humid and shady subtropical and temperate regions, such as characterize much of Spanish Florida, favored pigs and chickens (Reitz, 1992a, 1993a), while sheep and cattle, under the same conditions, were more susceptible to heat stress, parasites, disease, and reproductive failure. Sheep and cattle can tolerate high temperatures, but fare better when high temperatures are coupled with low humidity, conditions typical of parts of western North America. Although sheep and cattle share similar environmental constraints, cattle are better able to handle moderate humidity and are more resistant to predators. Pigs sport very little body hair, a distinct disadvantage in environments with high solar exposure. It is no surprise, then, that zooarchaeological assemblages in Spanish Florida and the Caribbean are dominated by pigs and chickens, whereas assemblages in the arid

Southwest and Alta California are dominated by cattle and caprines.

#### HUMAN DEMOGRAPHY

European-introduced epidemic diseases greatly affected indigenous human populations throughout the Americas beginning in the 15th century (Cook, 1998; Larsen et al., 2001a; Ramenofsky, 1987; Reff, 1990). The consequences of population loss due to epidemic disease were no doubt profound, though it is difficult to associate this with the reaction of indigenous groups to Eurasian livestock. Demographic collapse reduces competition for wild game, but significant mortality also disrupts social systems and the transfer of knowledge, while undermining confidence in the existing leadership. Epidemics are often compounded by deaths from malnutrition and starvation if essential subsistence-related tasks are left undone when workers fall ill. During times of extreme stress, the steady source of sustenance offered by missionaries was likely difficult to reject. That the mission priests were not as susceptible to these epidemics may have further shaken confidence in native leaders. Through these secondary effects, population loss from epidemic diseases may have drawn indigenous groups toward the missions and fostered willingness to alter basic exploitation and economic patterns in favor of foreign cultural practices.

#### PREEXISTING SUBSISTENCE PRACTICES

When Eurasian livestock were introduced to North America, most Native Americans had little or no experience with domesticated animals other than dogs. Animal husbandry is labor and time intensive and is not a subsistence strategy easily incorporated into existing economic systems, especially those that involve a significant amount of mobility. Adopting animal husbandry nearly always requires investments in infrastructure and changes in concepts of land ownership, land use, labor practices, schedules, and dispute resolution. Further, the adoption of Eurasian animals required the acquisition of an entirely new knowledge set.

Free-roaming livestock cause considerable damage to fields and gardens. Prior to the arrival of livestock, the idea of fencing fields was an entirely foreign concept, and was likely met with deep skepticism. In addition to protecting fields, people had to protect livestock from predators, raiding, straying too far, and the weather. Hen

houses, corrals, and other devices for controlling and sheltering animals were necessary to protect animals from loss, illness, and weather.

As observed above, established subsistence and economic systems involve cultural practices for the allocation of resources, rights, and responsibilities within households, kin groups, and communities. All activities related to the care and maintenance of livestock required an input of labor and decisions as to who would take on these new responsibilities in addition to existing labor requirements. No doubt, incorporating domesticated animals into the pre-Hispanic schedules of production, distribution, and consumption was not a simple process. Under missionization, colonial officials imposed new expectations for gender roles, labor management, and work cycles that were commonly at odds with indigenous cultural practices.

#### COLONIAL STRATEGY AND INVESTMENT

In Spanish Florida, colonists could not rely on their presumed technological superiority and control from Spain was weakened by distance and the impractical nature of some demands (i.e., that wheat and sheep be raised in Florida). Eurasian livestock and crops were not readily transferred to Spanish Florida, whereas Native Americans had a very successful suite of technologies. A certain lack of interest on the part of the Spanish Crown, given the costs of maintaining the colony, its lack of success in defending the Atlantic coast from Dutch, French, and English incursions, and what sometimes was a flourishing illicit trade network (Bushnell, 1981; P. Hoffman, 1980; TePaske, 1964) may also have shaped human-livestock interactions.

Although missionization of the southern Georgia Bight preceded missionization elsewhere in North America by decades, or centuries in some instances, the better-known missions of the Southwest, Baja California, and Alta California encompassed a larger territory and more diverse ecosystems. Missions and colonies in Spanish Florida were primarily restricted to coastal zones, extending into the southeastern coastal plain only in peninsular Florida. The mission systems of Alta California and the greater Southwest extended throughout much of the interior regions, particularly along river systems. These missions of northwestern New Spain were often clustered so that individual priests could serve more than one mission. Further, many southwestern and

Alta California missions were near presidios and secular colonies whereas many 17th-century missions in Spanish Florida were isolated from other types of colonial outposts, by difficulty in travel if not in actual distance. The isolation of Spanish Florida missions may have made it more difficult to access the animals and technologies needed for animal husbandry and to develop an economically viable commercial network in livestock, meats, and by-products except in the case of Apalachee and western Timucua provinces. They certainly had difficulty obtaining adequate military protection. Spanish missions elsewhere in New Spain may have benefitted from better access to livestock, labor, markets, and presidios.

The colonial expectations for Spanish Florida and other North American colonial holdings also differed substantially. After several failed attempts, the goal of secular colonization of Spanish Florida became secondary to the goal of protecting Spanish interests in the Caribbean and along the Atlantic shipping route to Spain. Spanish Florida boasted no significant mineral or other natural resources that could enrich the Crown or private individuals. Missions and other colonial communities acted more as symbols of Spanish claims to the land itself, rather than as effective buffers to the territorial expansion of English and French interests. The southwestern and Alta California colonies were richer in mineral wealth and both the Pimería Alta and Alta California supported substantial ranching enterprises. Missionization in the Pimería Alta and the Puebloan region was accompanied by extensive secular colonization, as well as the extraction of mineral wealth and other natural resources. The establishment of presidios and mining communities opened up new markets for mission products, particularly subsistence resources and raw materials from domesticated livestock.

Spanish colonial diets and exploitation strategies were the result of complex interactions among traditional diets, adaptations to the local resource base, cultural patterns, economics, and the response of Eurasian animals to specific environments in the Americas. In this cultural transition from habits in place before the First Spanish period began and the new patterns that emerged in the colonial environment, foodways may have been quickly transformed into practices that were as diverse as the colonial settings in

which they emerged. Deagan (1995) points out that foodways were most often shaped by the hands of local women, in contrast to other aspects of colonial life that were managed by immigrant men. It is from interactions like those at Santa Catalina de Guale that the patterns of flexibility, acculturation, adaptation, and accommodation emerged in the colonial frontier; patterns that came to typify colonies in other settings and resulted in different outcomes.

Colonization was, of course, not limited to the post-1492 Americas (e.g., Cusick, 1998b; Dietler, 2007; Fitzhugh, 1985). Studies such as those of Gil Stein (1998) in 4th-century B.C. Mesopotamia and Christopher DeCorse (1998) at Elmina (in present-day Ghana) indicate that continuity instead of change in foodways was not unique to Spanish Florida and other parts of the Americas. These studies from colonial settings elsewhere also indicate that, in some cases, indigenous diets and exploitation strategies may remain unchanged or be adopted by colonizing groups even in colonial contexts in which otherwise extensive changes occurred in other cultural institutions. As in Spanish Florida, colonizers elsewhere combined self-sufficiency with symmetric exchanges within the local economy to obtain critical resources instead of relying on coercion or external trade (Stein, 1998).

#### ENVIRONMENTAL CHANGE

The archaeological record is an important source of information about each locality's environmental history. The data from Spanish Florida provide some evidence of environmental change that was either associated with broader climate change or with human agency. The First Spanish period coincides with the Little Ice Age, an important era of climatic instability that almost certainly played a role in the colonial enterprise (Anderson et al., 1995; Stahle et al., 1998). At the same time, anthropogenic impacts on the resource base due to fishing, clearing land, and introducing Eurasian livestock likely also altered the environment and ecosystems. These aspects of Spanish colonization in the southern Georgia Bight have seldom been explored and it is premature to argue for causal relationships or a primary role for one or more of the variables involved. Nonetheless, hints about the effects of environmental change are found in these data and should be pursued through further research.

One aspect of environmental change pertains to the distribution of organisms in the landscape (biogeography). The Santa Catalina de Guale data contain several examples of biogeographical changes. The first of these is evidence that the range of gopher tortoises (*Gopherus polyphemus*) has contracted since the 17th century. Gopher tortoises are of particular interest because the only modern record of these animals for the Georgia coast is from Cumberland Island, where they are said to have been introduced (fig. 1.2; Johnson et al., 1974). Today, gopher tortoises are largely confined to the sandy soils of the Florida peninsula (Carr, 1952: 332; Johnson et al., 1974: 166).

In earlier faunal reports from St. Catherines Island (Reitz and Duncan, 1993), gopher tortoises were interpreted as evidence of an exchange network between St. Augustine and Santa Catalina de Guale because it was thought that they were not native to the island. Subsequent work at the St. Catherines Shell Ring shows that gopher tortoises were present on the island as early as the Archaic period (Colaninno, 2007). Thus, it appears there was a resident population of gopher tortoises on St. Catherines Island prior to the 17th century. Gopher tortoises also have been identified at Santa Elena, the original capital of Spanish Florida, and these originally were interpreted as evidence of an exchange in foods between St. Augustine and Santa Elena (fig. 1.1; Reitz and Scarry, 1985). It now appears that the gopher tortoise range was once more extensive than was previously thought, with a resident population on St. Catherines Island and a range that may have extended at least as far north as Santa Elena.

As these burrowing tortoises require deep, dry, sandy soils, a resident population on St. Catherines Island suggests that such a landscape once was present on the island. Given the Spanish relish for gopher tortoises, we are inclined to suggest that Spaniards targeted this animal and extirpated it from this portion of its range, though it will be important to demonstrate that gopher tortoises were present on the island during the centuries between the Archaic and the First Spanish periods, a proof that requires expanding the faunal record for the intervening time beyond what is available from the transect survey (Reitz, 2008; see chap. 3).

Bowfin (*Amia calva*) is another example of a biogeographical range contraction. Bowfin is a

freshwater fish that is not found on St. Catherines Island today. Bowfins, and other freshwater fishes, are present in the miscellaneous context assemblage at Santa Catalina de Guale (see appendix D). Bowfins also have been identified from the Archaic period St. Catherines Shell Ring (Colaninno, 2007). This could be evidence that habitats suitable to sustain freshwater fishes were present on the island. As with the gopher tortoises, it is necessary to expand the data set for the time period between the Archaic period and the 17th century before interpreting these data as evidence of environmental change or considering causality.

Another aspect of the St. Catherines study has implications for the management of wild turkeys. Turkeys are rare in the transect survey assemblage (Reitz, 2008) and very rare in Santa Catalina de Guale assemblages. No turkeys are present in either the church or the Eastern Plaza Complex assemblages and only two specimens are present in the miscellaneous context assemblage (see chap. 5 and appendix D). One turkey specimen is present in the Fallen Tree collection (Reitz and Dukes, 2008) and none in the other pueblo collections (see chap. 6). These observations have implications for restocking and managing turkey populations on St. Catherines and the other sea islands. It is possible that these observations do not accurately reflect turkey populations on the island. Use of wild birds was not a common pre-Hispanic strategy in the southern Georgia Bight so the low numbers of turkeys, and other nonpasserine birds, may reflect another Guale aspect of the Spanish diet (Reitz, 1988; see chap. 3). On the other hand, it is possible that turkeys were rare on the sea islands and that efforts to maintain turkey populations that can sustain modern hunting techniques will not be successful.

The environmental changes associated with the expansion of Eurasian animals and field cultivation of grains (Crosby, 1972; 1986) are rarely studied in this area. If cattle ranches were common in Apalachee and western Timucua provinces, we should expect environmental differences in soil characteristics, drainage patterns, and plant communities. A different suite of plants, those better able to survive in disturbed contexts, likely replaced previously dominant vegetation. Ranchers and farmers probably altered the landscape intentionally by encouraging or discouraging specific trees and

grasses, clearing marshes, providing water for livestock, and otherwise "improving" the land. Extensive clearing for fields and military defense encouraged some indigenous wild animals and discouraged others. Such landscape modifications almost certainly resulted in erosion that impacted the estuaries as well.

Many of these changes would be associated with grazing by Eurasian animals or with the impact of their hooves. Pigs are notorious for the damage their rooting behavior does to sea island ecology in general and sea turtle nests in particular. Feral and wild populations of pigs became established on the islands and mainland very early in the colonial era (Bonner, 1964; Gray, 1933; Ribault, 1927; Thompson, 1942; Towne and Wentworth, 1950) and undoubtedly altered coastal plant and animal communities.

Although native populations declined in the face of European expansion, overall human population size and density increased in the southern Georgia Bight. Fishing in estuaries continued unabated during the First Spanish period and the fishing strategy expanded to include some of the highest and lowest mean trophic levels estimated for any faunal assemblage in the southern Georgia Bight (Reitz, 2004; Reitz et al., 2009). As a result, both predators and prey incorporated increased predation and competition into their life strategies. This might result in overfishing or resource depression (e.g., Butler and Campbell, 2004: 337; Jackson et al., 2001; Lyman, 2003a, 2003b; Nagaoka, 2002; Pauly and Christensen, 1995; Reitz, 2004; Reitz et al., 2009).

A simplified version of resource depression draws on prey choice models in which a predator ranks resources according to body size and other variables. Increased use of small-bodied organisms would indicate resource depression stimulated by a decline in the abundance of preferred, large-bodied prey. Deer, the largest common mammal in the region, are noteworthy because they are rare or absent in many pre-Hispanic zooarchaeological collections, as are most vertebrates other than fishes (fig. 3.4). The St. Catherines and Sapelo island faunal records differ in this respect from other southern Georgia Bight faunal collections (figs 3.4, 3.10, and 3.11). This may be a result of the circumscription of the island environment facilitating search and pursuit, the use of 6.35 mm (1/4 inch) mesh recovery methods, or the social functions of the

specific sites in this study.

The heavy use of deer prior to and during the 17th century is an unresolved aspect of exploitation strategies on St. Catherines Island. The percentages of deer individuals and deer biomass in 17th-century Guale and Spanish contexts are even higher than in pre-Hispanic contexts (figs. 3.10, 3.11, and 8.1). On the one hand, crops and extensive clearing for crops and for defense offered an additional source of food for edge-feeding island deer. On the other hand, this same clearing placed an additional stress on deer as foraging and refuge areas were replaced by unproductive open ground just as hunting pressure increased. Extensive clearing for new fields also could have altered drainage patterns and increased erosion, outcomes that would impact both terrestrial and estuarine habitats.

Although a high level of predation was sustained for millennia on the island, it is possible that the island's deer population was stressed. Initially, it was thought that some of the deer identified from St. Catherines Island were hunted on other islands or on the mainland. This seemed a particularly necessary explanation for the First Spanish period when a great many deer were killed in a relatively short period of time. To test this hypothesis, a study of deer size was undertaken using measurements of the astragalus (one of the tarsal bones). The transect survey demonstrates that the size of deer declined steadily from the Archaic period into the First Spanish period, a trend that continued into the 20th century in both male and female animals (table 8.3; Brisbin and Lenarz, 1984; Purdue and Reitz, 1993; Reitz, 2008; see appendix F). Data from other southeastern locations suggest that this trend was not limited to the sea islands. Because the trend is at least regional, it seems unlikely that the island deer population experienced reductions in body size entirely because of hunting pressure. It is more likely that factors ultimately related to climatic variables, such as reduction in food quality, were involved (Purdue and Reitz, 1993).

Intense deer hunting might have resulted in overhunting, reducing the deer population and leading to an increase in the use of smaller-bodied terrestrial animals or of fishes. A transition from deer to small-bodied animals is not observed in the pre-Hispanic pattern of animal use in the transect survey, elsewhere in the Georgia Bight, or in the 17th-century mission component compared to the pre-Hispanic

strategy (figs. 3.4, 3.10, and 8.1; Reitz, 2008; Reitz et al., 2009). The 17th-century increase in garden-hunted animals came about through a reduction in the use of turtles, not of deer. Use of fishes also did not increase. The Santa Catalina de Guale archaeological deposits are only minimally stratified, so the impact of the 17th-century increase in deer hunting cannot be assessed through a comparison of early mission and later mission deposits. Perhaps the 17th-century emphasis on venison was too brief to have a measurable impact on deer populations or other exploitation strategies. Data from 18th-century plantations on the island might clarify the impact of 17th-century hunting on the island ecosystem.

When use of marine resources is a major exploitation strategy, overfishing can result (e.g., Jackson et al., 2001). Following the model for resource depression in terrestrial mammals, perhaps heavy use of marine resources produced a transition from larger to smaller fishes. If larger-bodied fishes, many of which feed at higher trophic levels, become scarce due to fishing pressure, this might lead to an increased use of small-bodied fishes, many of which feed at lower trophic levels. Small-bodied fishes are prey for large-bodied fishes, so human predation on smaller animals would impact predators, trophic structure, and other ecosystem processes.

Observing changes in small-bodied and large-bodied fishes is difficult because this class of animals experiences indeterminate growth; smaller-bodied young mature into larger-bodied adults. Fish body size, habits, and habitat preferences change with age, as do the most productive capture techniques and locations. Sometimes this size difference is reflected in measurements, such as those used to estimate total length for Atlantic croakers (*Micropogonias undulatus*) from otoliths in the Fountain of Youth assemblage (Hales and Reitz, 1992). Similar otolith measurements and body size estimates are unavailable for other fishes in most of these collections. To compensate for the limited measurements available, fish taxa are classified as small or large bodied in this study (fig. 8.4; see appendix A for a discussion of this classification).

With two exceptions, a mix of small-bodied fishes and large-bodied fishes is present in all of these assemblages. Apparently all of the fishes used in Pueblo Santa Catalina de Guale and in secular St. Augustine were large-bodied

TABLE 8.3  
**Comparison of Modern and Archaeological Deer Astragali Using  
 Greatest Lateral Length (GLL) Measurements, in mm<sup>a</sup>**

GMNH no.	Sex	Age	Location	GLL, mm
<i>Modern</i>				
126	unknown	mixed	Michigan	42.1
126	unknown	mixed	Michigan	42.1
126	unknown	mixed	Michigan	42.7
134	Male	Adult	GA, Ossabaw Island	34.5
349	Female	Subadult	GA	37.2
1385	Female	Subadult	GA, Clarke Co.	36.7
1802	Female	Adult	GA, Clarke Co.	38.0
2686	Male	Adult	GA, St. Catherines Island	35.4
<i>Archaeological</i>				
Santa Catalina de Guale average				35.0

<sup>a</sup> Dimensions are from Driesch (1976). Individual measurements for Santa Catalina de Guale deer are in appendix F. GMNH, Georgia Museum of Natural History, Zooarchaeology Laboratory Specimen Accession Number.

fish taxa and a third of the fishes in these two assemblages were susceptible to mass-capture techniques. Otherwise, small-bodied fishes are rare in 17th-century collections and a third to half of the taxa were susceptible to mass-capture methods.

A decrease in fish diversity, which occurred in the St. Augustine area (fig. 8.4), may be equated with increased efficiency because it indicates a more targeted subsistence effort involving mass-capture methods (e.g., Butler and Campbell, 2004: 336, 338). Thus, small-bodied fishes might increase because the local resource base was used more efficiently. Mass-capture techniques that target a select group of smaller fishes reflect this efficiency. This relationship between decreased diversity and an increase in mass-captured fishes is not apparent in the St. Augustine assemblages; but increased diversity at Santa Catalina de Guale is associated with a decrease in fishes susceptible to mass-capture techniques (fig. 8.4).

As predators feeding relatively high on the food chain, people impact the organisms on which they feed. By overfishing higher-trophic-

level, larger-bodied fishes, people could influence predator-prey relations at high trophic levels and affect all organisms in the ecosystem as well as ecosystem processes (top-down impact; Halpern et al., 2006; Myers et al., 2007; Myers and Worm, 2003; Navarrete et al., 2005). If lower-trophic-level, smaller-bodied fishes are overfished, food becomes limited for higher-trophic-level fishes. As a result, both predators (people) and their preferred prey (large-bodied, higher-trophic-level fishes) are constrained by the primary production rate of the resource base and vulnerable to adverse impacts on that base (bottom-up processes; Ware and Thomson, 2005).

The prominence of large-bodied fishes, the presence of small-bodied fishes, the frequent use of fishes susceptible to mass-capture techniques, and the high mean trophic level of the fishing strategy highlight the potential for adverse impacts on local resources in the 17th century (fig. 8.5). The prominence of large-bodied fishes in all of the 17th-century assemblages, sometimes to the exclusion of small-bodied fishes, may be evidence of a top-down impact as large-bodied

predators were removed from the ecosystem. Bottom-up processes would be demonstrated by a decline in small-bodied fishes. Although small-bodied fishes were not removed from the local resource base; they were not used in the 17th century at the same rate as they had been prior to the 17th century (figs. 3.8 and 8.5).

Spanish preference for large-bodied, low-trophic level mullets, in particular, had the potential to impact the entire ecosystem. The high mean trophic level of the 17th-century fishing strategy, increased predation on this low-trophic-level fish, and the use of cast nets could have had serious consequences. This combination suggests that both top-down (removing predators) and bottom-up (competing with our own prey for low-trophic-level fishes) processes occurred at Santa Catalina de Guale and in the St. Augustine area.

In both locations, these changes could have been responses to either anthropogenic or nonanthropogenic factors. They could reflect cultural choices, cultural responses to a change in the resource base, or both. Potential scheduling conflicts between farming and other demands on time and labor in Spanish Florida most likely influenced decisions about fish diversity, mean trophic levels, and other aspects of fishing strategies. Spanish preferences for certain fishes also were important.

Resource depression is not exclusively a consequence of human behavior; it also may occur when nonanthropogenic factors impact ecological patterns and processes. Such nonanthropogenic resource depression may be an additional variable in these data. Changes in growth habits, body size, and size-at-age are responses either to anthropogenic resource depression or to external biogeophysical conditions beyond human causality. The average body size and the range of body sizes in the fishes used at each site are unknown. We do know that Atlantic croakers in the St. Augustine area experienced a pre-Hispanic decline in growth rate and mean body size that continued into the First Spanish period (Hales and Reitz, 1992). Today, croakers are small-bodied animals that seldom reach the advanced age and large size found in the archaeological record before modern fishing techniques were deployed against them. Reduction in body size might be evidence of a change in capture location, season, or method if the earlier strategy resulted in the capture of larger croaker, but the simultaneous

change in the growth pattern of this fish makes this explanation unlikely. It is more likely that this change in the maturation process was a response to resource depression, probably of anthropogenic origin, or to altered water conditions, probably of nonanthropogenic origin.

Similar changes in growth and reproduction probably will be found in other fish species in the southern Georgia Bight, as they have been elsewhere (e.g., Butler and Delacorte, 2004; Leech, 2006; Nagaoka, 2002). If changes similar to those found in croakers in the Fountain of Youth assemblage are observed in other taxa in collections recovered from sites associated with other estuaries, it will be evidence of a regional pattern beyond the scope of optimal foraging theory and evidence for external forces such as climate change. To test this hypothesis, changes in body size need to be linked to estimates of age at sexual maturity and isotopic studies of ambient water temperatures throughout the region.

The changes observed here may be evidence of a cultural response to climate changes that impacted the resource base. Regional impacts and timing of global climatic events (e.g., Medieval Warm and the Little Ice Age) are hotly debated. The relationships between global climate events and local sea surface temperature, estuarine salinity, mean sea level and tidal ranges, nutrients, ecosystem diversity and resilience, oceanic currents, storms, productivity, and other marine parameters in the past are unknown and likely to have been asynchronous at both local and global scales. Nonetheless, ample evidence for changes in some climate parameters coincident with the St. Catherines Island sequence is available and suggestive (table 2.1; see Anderson et al., 1995; Blanton and Thomas, 2008; Delcourt and Delcourt, 2004; Stahle and Cleaveland, 1992, 1994). For example, the Wilmington occupation (A.D. 350–800) occurred during a warmer climate period that ultimately led into the Medieval Warm between 800 and 1200 (Bond et al., 2001; Bradley et al., 2003; Broecker, 2001; deMenocal et al., 2000; Kerr, 1999; 2002, 2005; Luterbacher et al., 2004; Shindell et al., 2001; Stahle and Cleaveland, 1994; Stahle et al., 1998; Stahle et al., 2000; Steig, 1999). The Medieval Warm approximates the St. Catherines period (800–1300; see table 2.1). The Irene period (1300–1580) roughly coincides with the early part of the Little Ice Age, which occurred between approximately 1350 and 1860 (dates from

Broecker, 2001; deMenocal et al., 2000; Shindell et al., 2001). The second half of the Little Ice Age encompasses the First Spanish period, the British period, and the Second Spanish period.

More research is needed to correlate the Spanish colonial effort and the archaeofaunal data with the timing of global climatic events and their local consequences. Local evidence is necessary because climate change is asynchronous regionally and globally (Little, 2003; Lynch-Stieglitz, 2004; Nakagawa et al., 2003). Further, temperatures, rainfall, and other components of climate fluctuated within each of the major climatic events characterized as the Medieval Warm and the Little Ice Age (e.g., Karlén and Larsson, 2007). Some of this evidence may be more obvious on the local level than on the global scale. Whether these environmental changes are simply coincidental to cultural developments during the First Spanish period or had a causal role in the economy of Spanish Florida remains to be explored.

The theoretical link among components of ecosystems would predict that a change in one component will affect others in the southern Georgia Bight if these climate cycles were expressed there. Fisheries research shows that temperature changes of only a few degrees can alter a marine ecosystem in a variety of ways (Attrill and Power, 2002; Finney et al., 2000; Perry et al., 2005). Changes in sea surface temperatures impact the productivity of estuaries, the reproductive and growth habits of both predator and prey in the estuarine system, and the distribution of these animals. In any given estuary, warmer waters are more productive through the annual and climatic cycle than are cooler ones. The growth rates of some fish species may slow if the water temperature is outside that species' optimal growth temperature. Such an event would increase the length of time during which developing juvenile fishes were exposed to predation. In other words, they remain at a smaller, more vulnerable size for a longer time. Warmer waters enhance fish egg development in some species, which may increase survival and productivity (Haynes and Ignell, 1983). Due to the dominance of protein, fat, and fat-soluble vitamins from fishes (as well as from crustaceans and molluscs) in these subsistence strategies, any of these changes would, of necessity, elicit a human response.

Although warmer Woodland and early

Mississippian estuaries may have been more productive than cooler estuaries of the late Mississippian and First Spanish periods, this cannot be tested directly on St. Catherines Island. Fishing data for the Woodland period are only available in the form of aggregated data from many small samples from 22 transect survey locations (Reitz, 2008: 825). However, the 17th-century increase in diversity and the high mean trophic levels exploited may have been responses to a decline in fish productivity and diversity related to cooler water conditions along the coast of Georgia that coincided with Spanish colonization, but were not caused by it. The stage may have been set for the depleted fisheries of the 20th century by the higher diversity and high trophic levels that continued to characterize fishing strategies along the southern Georgia Bight into the 19th century (Reitz, 2004).

This, of course, raises additional questions. To what extent did the changes in fishing strategies result from a creolization of Guale and Spanish traditions? To what extent were these changes, or others, responses to changes in the coastal fishery related to climate change regardless of cultural context? To what extent were Guale fishing strategies responses to the need to manage their time and labor to meet increased commitments to farming, hunting, religious instruction, and the repartimiento?

Just as ecosystems are complex webs of interrelated parts, so too are cultures. For Spanish colonists, Spanish Florida was unfamiliar territory. They would not necessarily have known that the climate and the fishery had changed, but native peoples of the coast had been dealing with changes in their resource base for several centuries by the time they were confronted with the additional challenge of Spanish immigrants. The ensuing biological and cultural stresses of the colonial era may simply have been the last challenge in a complex set of challenges that directly impacted the estuarine resource base on which people had previously relied. Native peoples elsewhere in the Spanish Americas likewise confronted climate change, but there may have been other viable alternatives in those settings.

#### DIRECTIONS FOR FUTURE RESEARCH

Differences in animal use within Spanish Florida and between Spanish Florida and Spanish settlements elsewhere in the Americas suggest that

additional research is needed at these and other colonial settings. It should not be assumed that there was a homogeneous response or outcome; or that cultural change was unidirectional: from colonizer to colonized. Nor are the explanations limited or simple. A variety of dietary and economic strategies arose as each colony transformed from precolonial cultural patterns to creole ones. These hypotheses can only be tested adequately if a number of improvements are made in the quality and quantity of zooarchaeological research.

Colonization was not a phenomenon limited to the post-1492 Americas (e.g., Cusick, 1998b; Dietler, 2007; Fitzhugh, 1985). Further research into diet, exploitation strategies, and economies at other colonial settings, in the Americas and beyond, is critical in order to place Spanish Florida into a broader cultural context.

In Spanish Florida the absence of data from cattle ranches, which may have supplied the secular town rather than the religious community, is a critical gap in our ability to study the distribution of livestock and beef in the colonial economy. Additional data from western Timucua and Apalachee missions are needed, as are data from other missions on the sea islands and from the adjacent mainland. Data from Native American contexts not associated with the missions, such as those from the southeastern village of Fushatchee (Pavao-Zuckerman, 2000, 2007), are also needed. Additional zooarchaeological data from contemporaneous but nonmission contexts on St. Catherines Island and other sea islands would improve our knowledge of strategies by Native Americans who avoided Spanish missions and ranches or allied themselves with other colonial interests.

Future research in Spanish Florida should attempt to reconstruct spatial patterns of element distributions at each site. This may clarify patterns of meat distribution and the source(s) of meat at each location. In the meantime, the size of deer does not appear to indicate that mainland deer were brought to the island, and DNA analysis does not suggest this either (James R. Purdue, personal commun., 1993). However, it remains possible that additional deer were brought to Santa Catalina de Guale, not from the adjacent mainland, but from other sea islands. Careful evaluation of the spatial distribution of deer specimens at the mission and elsewhere on the island, especially if combined

with DNA analysis from adjacent sea islands and the mainland, may eventually resolve this issue. Genetic and geochemical analysis may provide information about the sources of deer at other locations.

The temporal sequence for diminishing deer body sizes should be extended into the 18th century to determine if deer body size rebounded when hunting pressure and other disturbances briefly abated. The sea island plantations of the late 18th and early 19th centuries would be ideal sources for such information. Hunting, of course, resumed during the plantation era, and extensive land clearance accompanied plantation-era cultivation of indigo, rice, and sea island cotton, but several decades passed between the time Santa Catalina de Guale was abandoned in 1680 and American plantations were established on the island in the 1740s (Durham and Thomas, 1978). Although the island was not abandoned during these decades, this interlude might have given the island deer population time to rebound if hunting was the primary cause of their reduced body size.

An array of biological and geochemical techniques should be routinely combined with traditional zooarchaeological identifications and analysis at all colonial settings. Perhaps because many scholars labor under the impression that documentary records provide most of the information needed about diets, economies, animal husbandry, and other aspects of the colonial enterprise, many highly productive perspectives have not been directed toward the study of historic sites. For example, the genetic ancestry of domestic animals in these collections should be sought through DNA analysis. Study of incremental growth structures and isotopic analysis of teeth, otoliths, and mollusc valves should be routine as these will provide information about ambient water temperatures, salinity, and other geophysical parameters in addition to the biological responses of these organisms to harvesting pressures. In particular  $\delta^{18}\text{O}$ , changes in the body size of fishes, and changes in the growth rate of fishes should be explored further. More attention should be paid to recording standard morphometric data, not only for fishes but for all of these animals, to enable assessment of stresses associated with environmental changes and harvesting pressure. Extensive studies of soils, arthropods, botanical remains, and terrestrial gastropods would greatly

enhance our understanding of landscape changes resulting from climate changes and from colonial farming practices as well as other colonial enterprises.

The period of European expansion not only was one of intense cultural change in most parts of the world but it coincided with a period of major climate change. In order to correlate these events more successfully, and to explore the causes and consequences of these two events, we need to have better control over their timing and sequence at the local level within the archaeological context. Expanded studies involving dendrochronology, geomorphology, palynology, and other climate proxies should be included in all coastal and colonial studies. Such studies would also improve our understanding of other changes in the environment such as biogeographical range expansions and contractions, the impact of Eurasian animals on plant and animal communities, and the consequences of livestock and land clearance on local ecosystems.

Lastly, it is imperative that archaeologists develop a consistent recovery strategy that enables all geological and biological data to be collected without sample bias and facilitates inter- and intrasite studies that synthesize knowledge gained from soils, macrobotanical and microbotanical remains, organic residues, invertebrates (including insects), and vertebrates.

## CONCLUSIONS

Over the last 30 years, archaeological studies have found that a rich, complex, multiethnic community existed in the southeastern United States during the First Spanish period. This community merged pre-Hispanic and Spanish traditions to form new relationships with their abiotic, biotic, and cultural environments. This new model replaces the stereotype that Spanish Florida was a poverty-stricken colony dependent on imported goods and institutions.

The study of animal remains from missions and towns in Spanish Florida highlights the dynamic interchange between natives and immigrants in highly fluid landscapes. Instead of a single, inept, transient Spanish government dominating an invisible native population, we must now think of Spanish Florida as a dynamic colony in which Native Americans exchanged ideas and developed new patterns of animal use as did immigrants from Europe, Asia, and Africa. This response was not unique to Spanish Florida but how the colonists and the colonized responded was unique, drawing on the local circumstances, cultural histories, and resources of those involved. Researchers in other geographic settings should develop hypotheses that test the possibility that similar dynamic transformations characterized many other colonial settings as criollo patterns replaced those of colonizers and colonized alike.