4 FISH FROM AFAR: MARINE RESOURCE USE AT CARACOL, BELIZE

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The ancient Maya had strong ties to the sea. The trade, transportation and use of marine resources were important not only to coastal Maya communities, but also to the heavily populated cities that lay many miles inland. Zooarchaeological evidence recovered from excavations at the inland site of Caracol, Belize suggests that the inhabitants imported marine fish for food, marine shell for working into trade items, and sharks teeth and stingray spines for ritual use. This research examines the manner in which fish and other marine resources were used, procured and transported from the coast to the site of Caracol. The possibility that certain marine fish might have been transported alive to the site is explored. An examination of present day fishing and animal husbandry practices suggests that many species could have survived an inland trip in ancient times if transported under conditions that allowed for water exchanges and minimized stress. Marine resources had important economic and ritual significance to the people of Caracol. Understanding the methods by which these valuable items were transported and traded ultimately facilitates a greater understanding of the economic and socio-political relationships among these ancient polities.

Introduction

The ancient Maya city of Caracol flourished in the tropical jungles of what is now Belize between 300 B.C. and A.D. 1050. The city is located in the Maya Mountains, far from the Caribbean coastline (Figure 1), yet archaeological evidence reveals that the inhabitants of this inland city were interested in the sea, and the creatures that lived there. Like the elite inhabitants of other inland Maya cities, residents of Caracol imported fish and other marine resources for use as food, as implements, as adornments and for ritual purposes.

The recovery of marine shell and faunal bone material from marine animals at archaeological excavations in Caracol is evidence that a trade network in marine products occurred between the ancient Maya inhabitants of the city and the Caribbean coast, but the mechanics of how this trade occurred are poorly understood. This study explores how such trade might have occurred, including the possibility of fish being transported alive from coastal fishing grounds to thriving inland cities through a system of river-borne trade.

The Belize River is the closest fully navigable river to Caracol, lying approximately 38 km from the site. The Belize River is one of the largest in the country and the ancient Maya would have relied heavily on it, both as a water source, and for waterborne transportation (Garber 2004). The Belize River has two principal tributaries, the Mopan River and the Macal River. The Macal River is the closest tributary to the Maya site of Caracol (Chase and Chase 1987:1). Unsuitable for waterborne navigation for its full extent (A. Chase personal communication 2010), the Macal River drains water from the Maya Mountains and joins the Belize River approximately two km north of the modern Cayo District town of San Ignacio. From here, the Belize River flows in an east-northeasterly direction to the Caribbean Sea, collecting water from major tributaries along the way.

Coastal trading ports, such as Mojo Cay, may have provided marine goods and resources to inland sites in the central part of Belize. Located at the mouth of the Belize River, the island site of Mojo Cay could have facilitated the importation of marine items to inland sites using the Belize River as its primary conduit (McKillop 2004b:37). Ancient Maya cities far from the coast were dependent on such trading ports for food. Many inland sites, including Caracol, made use of marine resources as food (Chase et al. 2004:15; Powis et. al.1999:6; Wing 1975:383). Lange (1971) suggested that much of the Maya population of the Yucatan Peninsula was dependent on marine resources as a primary protein source. While isotopic studies of the Maya diet do not support this theory (White and Schwartz 1989), there is evidence to suggest that the ancient Maya inhabitants of many inland sites went to considerable effort and expense to import marine fish to supplement their diet (Teeter 2001:81; Wing 1975:379; Wing and Steadman 1980:328).

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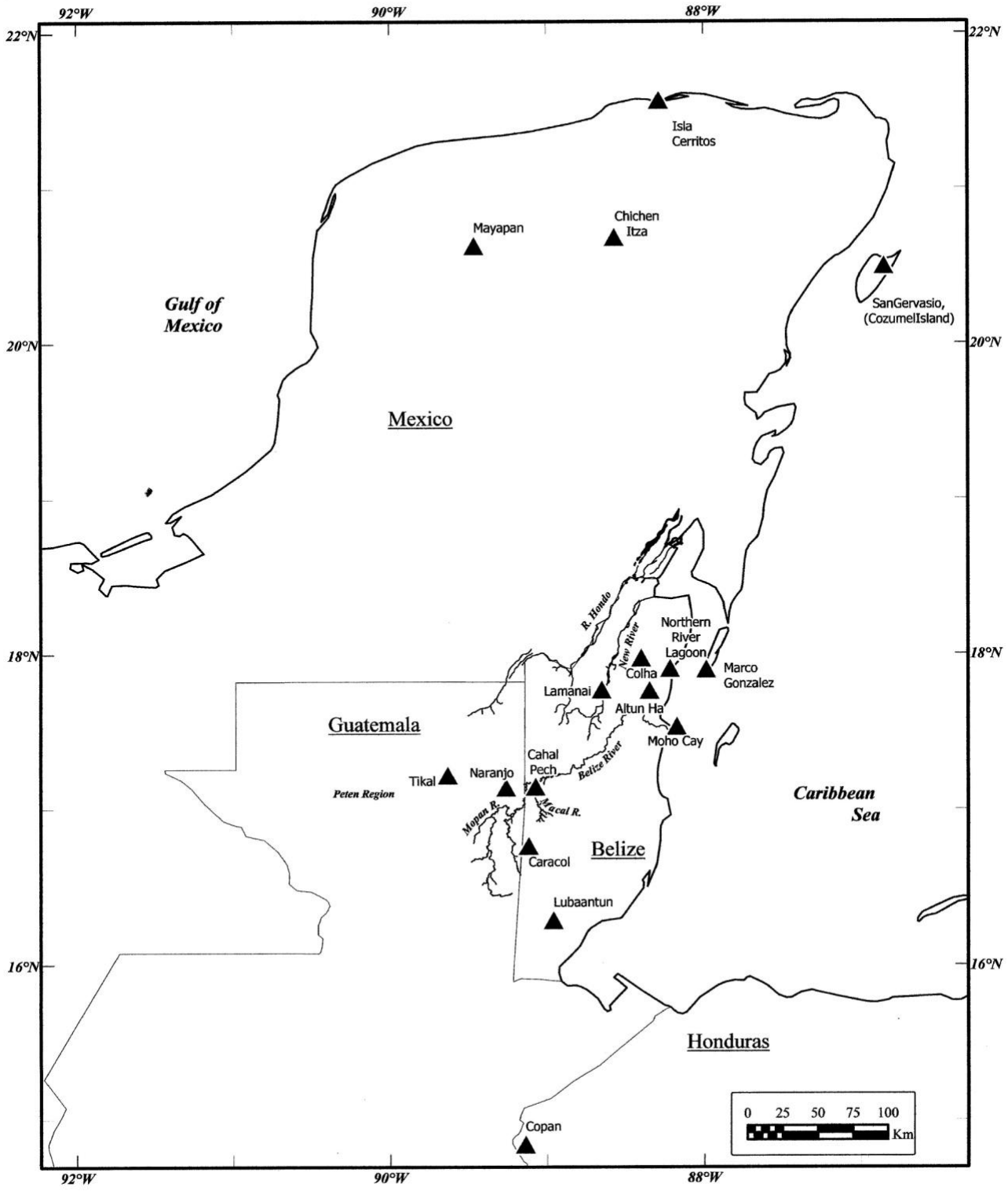

Figure 1. Selected Maya sites and key rivers, referenced in the text. Site locations from Witschey, Walter R. T. and Clifford T. Brown, Electronic Atlas of Ancient Maya Sites, http://MayaGIS.smv.org accessed June 12, 2011. Map by Witschey.

Bishop Diego de Landa documented the extensive fishing industry of the Maya in the Yucatan after the arrival of the Spanish:

> "The others pursue their fisheries on a very large scale, by which they eat and sell fish to all the country. They are accustomed to salt the fish, to roast it and to dry it in the sun without salt and they take into account which of these methods each kind of fish requires, and the roasted keeps for days, and is taken twenty or thirty leagues for sale, and for eating it they cook it again, and it is well flavored and sound. The fish they kill and which are found on that coast are very excellent and very fat skates and trout…" (Tozzer 1941:190).

Landa describes a number of marine species that were particularly favored by the Maya fishermen, both for consumption and trade. Chronicles such as these, while they were written during the contact period, suggest that fishing and commercial trade in food fish were profitable occupations that utilized contacts and trade routes that had likely been in place for generations.

In addition to their value as a food item, abundant evidence also exists for the ceremonial or religious use of both marine fish and mollusks (Wing and Hammond 1977:50-51). The demand for these items were remarkably consistent across the Maya Lowlands, with some items, such as sting ray spines, being found in similar contexts throughout this vast area.

Faunal Analysis at Caracol

Zooarchaeological examination of faunal remains from inland sites can provide a wealth of information about the trade and use of animal resources (Emery 2003). Initial analysis of faunal remains recovered from archaeological excavations at Caracol was conducted by June Morton (1987). Morton's work concentrated on 537 faunal elements from excavations conducted at the site during the 1985 and 1986 seasons. Morton identified eight species, primarily terrestrial animals indigenous to the surrounding areas. Stingray spines, recovered from a human burial were the only marine resource identified. Morton concluded that stingray spines, used for ceremonial purposes, were the only evidence of animal resource trade at Caracol. No evidence of other marine fish use was recorded in this study.

A subsequent detailed analysis of the faunal assemblage from Caracol was conducted by Wendy Teeter using information collected from excavations at the site between 1985 and 1998. Teeter (2001) analyzed over 84,000 pieces of animal bone recovered from a wide variety of contexts that included refuse deposits, burials, caches, in-situ floors, and construction fill. In addition to identifying bone to the most discrete taxonomic unit, Teeter examined the context of the assemblage to determine the subsistence and ceremonial practices of the ancient Maya residents across time. This detailed analysis became the subject of Teeter's 2001 University of California PhD. dissertation, and resulted in a number of other publications (Chase et al. 2004; Teeter 2004; Teeter and Chase 2004).

Teeter's investigation into animal use at Caracol revealed that a diverse number of marine vertebrates were used at Caracol (Teeter 2001; Teeter 2004; Teeter and Chase 2004). Teeter identified 194 fish elements from at least eight different taxa at Caracol. While a number of elements recovered could be identified only to the level of *osteichthyes* (bony fish), the majority could be distinguished between Rajiformes (skates and rays) which made up half of the marine assemblage, and different species in the Perciformes order. Teeter found that reef fish dominated the number of identified taxa at Caracol (Teeter 2001:81). Stingray, grouper, jack, snapper, parrotfish, sea catfish, grunt and barracuda were among the identified remains found at Caracol. Sharks were represented by teeth found in ritual caches (Chase and Chase 1998; 2007).

Teeter (2001:72) found that stingrays were the most common species of fish remains recovered at Caracol. Teeter identified at least fifty tail spine elements in burials and caches at Caracol that ranged in date from the Preclassic to the Late Classic Period. Teeter (2001:73) also noted that at least three caches and one burial contained stingray vertebrae or cranial elements. The use of vertebra centra appears to be limited to ceremonial caches and offerings, which

Teeter (2001:87) interpreted as being restrictive of their use.

The presence of stingrays at archaeological sites throughout Mesoamerica is nearly ubiquitous due to the demand for their spines. For the Maya, stingray spines had very strong religious and ceremonial significance, thus they are found in caches and burial offerings throughout the Maya world (Beaubein 2004:45-52; Chase and Chase 1998:316; Hamblin 1985:169; Moholy-Nagy 2004:199; Pohl 1983:75). The spine of the stingray was often used in bloodletting rituals to pierce the tongue, ears and penis (deBorhegyi 1961:283; Miller and Taube 1993:46 Schele and Miller 1986:71; Sharer 1994:108). Bloodletting ceremonies by Maya nobles are graphically depicted in Maya art, most notably at the site of Yaxchilan, where a number of stone sculptures celebrate the ceremonial bloodletting of several high status individuals (Schele and Miller 1986:189; Tate 1991). This ceremony, integral to Maya religion, gave the royal Maya access to the gods and confirmed the divine right of kingship (Schele and Freidel 1990:87). Stingray spines are found throughout the Maya world, and were likely a high-demand trade item at all sites (McKillop 2004a:222).

Parrotfish, another species identified by Teeter at Caracol, may have been especially desired for their beauty, as they are extremely colorful and distinctive. Hamblin (1984:37) described parrotfish as one of the "most popular fishes" in the faunal assembly at Cozumel. The stoplight parrotfish (*Sparisoma viride),* the type identified by Teeter (2001) from the Caracol faunal assemblage, is generally found on offshore reefs (Humann and Deloach 2002). As such, considerable effort would have been required to catch and transport them from off-shore waters to coastal trading ports, and then from coastal areas to inland sites. Other reef fish found at the site, such as snapper, barracuda and grouper, may have had high value as food items.

Vertebrates were not the only important marine resource used at Caracol. Marine shell from a large variety of mollusk species has been recovered from the site. Cobos (1994) also reported on evidence of worked shell and ornaments, suggesting that shell workshops were a significant part of the local economy. Marine shell, primarily *Strombus gigas* and *Spondylus americanus,* are also found in burials and ritual contexts at Caracol, suggesting their importance as a ceremonial item (Chase and Chase 1998).

Transportation of Live Fish

The use of fish as food does not come without peril. The ingestion of bacteria associated with spoiled fish and the often fatal infections that follow could quickly decimate a population. The ancient Maya developed the methods of preparing and storing fish so that they did not spoil. Various methods of fish preservation- including salting, filleting and drying- would likely have been used for the transportation of fish from the coast to distant inland destinations such as Caracol. However the transportation of some species of fish alive would have been possible, and is, in fact, suggested by some archaeological contexts.

The presence of fish vertebrae and cranial elements at Caracol (Teeter 2001:75) suggests that not all fish coming into the site were processed elsewhere. Ethnohistorical accounts of fish being prepared for trade, such as those described by Landa and recounted above, would produce processed fish with little or no skeletal remnants to be found by archaeologists during excavation. Wing (1977:51) suggest that vertebral remains could be recovered in such cases if the fish were simply split down the middle, smoked or salted, with the vertebral column being left intact. These methods are plausible, but do not account for the recovery of some individuals, such as stingrays, which appear to have been used for ceremonial purposes and deposited intact (Chase and Chase 2008a).

Transporting fish alive to inland sites has been proposed as one means of acquiring the entire fish without having it spoil upon arrival. Healy and colleagues (2004:119) suggest that fish may have been transported up the Belize River in canoes partly filled with seawater. For ritual creatures, such as sponges and stingrays, seawater filled crocks might have been used to transport the items inland (Schele and Freidel 1990:200).

A canoe journey from the mouth of the Belize River to its apex at the modern town San Ignacio likely would take at least three full days

(A. Chase, personal communication, 2009). A modern canoe race, La Ruta Maya Belize River Challenge, takes place each March and takes four days of paddling in three-man canoes on the Belize River, from San Ignacio to Belize City, approximately 180 miles (paddling for approximately 6 hours each day)- and this is downriver. Depending on river currents and seasonality, paddling from the Caribbean Sea to San Ignacio, upstream, would be considerably more arduous.

The transportation of live fish from reef areas, often located many kilometers off shore, to coastal trading areas, where they could be loaded onto canoes for the trip up river to inland sites, would require careful planning. Fish would have to survive in shallow water containers for at least four days and possibly longer. In the case of salt water fish, additional sea water would have to be carried to replace spilled water, or oxygen depleted water. Alternatively, the fish would have to be able to survive the lower salinity created by dilution with small amounts of river water when salt water was not available. Consequently, estuarine species, or at least 30 species that could survive in brackish water, would be best suited for such a journey. However, hardy reef fish in good condition would also be candidates.

To determine if such transportation was possible, an examination of modern fish husbandry practices is in order. Aquarium curators and tropical fish retailers often transport live fish long distances in closed containers. While some aquarists use mechanical aids, such as fish aerators to increase dissolved oxygen in the water, and chemical enhancers to slow fish metabolism, a great many fish are simply transported in containers from one location to another over many hours or even several days.

Miller (1956) describes a typical fish transport container as being a plastic bag containing approximately 5 gallons of water placed in a single-ply cardboard box. Fish thus packaged were transported by motor vehicle and by air from the interior of Mexico to the town of Tijuana. The elapsed time between capture and release of the live fish was 80 hours. Miller reported no mortalities among the transported fish.

Not every species of fish would survive transportation under these conditions. However, of these species whose remains were recovered at Caracol, small stingrays, grunts, sea catfish and parrotfish would be likely candidates. Modern research methods show that management of water quality enhances the survival rate of fish undergoing transport (Lim et al. 2003). Maintenance of water salinity improves water quality and, thus, enhances survivability.

Fishermen have known for generations that water quality must be maintained and fish must be kept alive long enough to get to market in the best possible condition. Archaeologists in Italy recovered the remains of a Roman fishing vessel in Grado, Italy dating to 200 AD that bore evidence of a well in the hull with a hydraulic feature designed to keep and transport live fish (Beltrame, et al 2011:276).

Modern fishing vessels use mechanical means to keep fish in a fresh state. Most modern fishing vessels are equipped with water aeration and circulation equipment to maintain water quality and keep fish alive until they can reach market. Prior to the availability of such mechanical devices, fishermen needed to rely on live bait wells to keep fish alive, sometimes for many days, during offshore trips for fish.

It is difficult today to find fishing boats with live wells that do not rely on mechanical means to keep fish alive. However, in the Bahamas, some older fishermen still fish the reefs with older boats that do not have aeration equipment in their fish holding tanks. Using the Bahamas as a reference point to make comparisons is valuable because many of the fish utilized there are the same as those found in the Maya area, and the history of the maritime economies between the ancient Maya and ancient Caribbean cultures share many similarities (McKillop 2010).

Cunningham-Smith (2011) observed modern fishermen in the Bahamas who use boats for offshore and reef fishing that do not have aeration equipment in its live well. These boats are generally older, with live wells that have been modified so that sea water is able to flow into the well with the motion of the boat, creating a continuous water exchange in the hold, and thus increasing oxygen content and

improving water quality which allows the fish to survive longer in the hold. Typically, this modification involves creating openings in the hull of the boat to allow for a free exchange of sea water. The fishermen who utilize these vessels are often gone from port for many days, and the oldest of these fishing boats do not have refrigeration on board. Thus, the fish must remain alive in the hold until the fishermen can get them to the fresh fish market, located in Nassau on the Isle of New Providence, Bahamas.

While not meant to draw direct comparisons between contemporary Bahamian fishermen and ancient Maya canoe traders, observation of the above fishing and animal husbandry practices strongly suggest that select fish could have been kept alive in containers for the journey up the Belize River if the conditions were right. Pottery vessels may have been used for such transport, as they could be constructed to hold the five gallons of water necessary for such transport. Additional salt water could be carried as needed for replenishing the containers.

Fish Size as a Condition of Live Transport

Size would be an important element in determining whether animals could be transported alive. The size of the animal would be constrained by the container in which it was transported. Thus, smaller animals with strong ritual significance would have been the most likely candidates for live transport.

As previously noted, stingrays are animals with strong ritual significance to the Maya. Teeter (2001:72) found that stingrays were the most common species of fish recovered at Caracol. Most of the stingray remains recovered at Caracol were found in caches and deposits, indicating their high value as a ceremonial item. Stingray size can vary, so smaller animals would have been most likely to survive live transport.

In 2008, 52 stingray vertebrae were recovered in a cache deposit during the excavations of a plaza in front of Structure C21 at Caracol (Chase and Chase, 2008a). The vertebrae were photographed, with scale, as part of the archaeological investigation (Figure 2). Although the original vertebrae were not available for inspection, the photograph provided an opportunity to make a rough

Figure 2. Collection of 52 Sting Ray centra, taken from cache deposit, Caracol Belize. Photo by Dr. Arlen Chase and Dr. Diane Chase.

estimation of the size of the stingray for the purpose of determining if it was small enough to be transported alive as described. Based on the size and shape of the vertebrae, it was determined that the animal was most likely a member of the genus *Dasyatis*, which includes a number of stingray species found in Caribbean waters. The size of the stingray can be estimated using an allometric formula developed by Reitz et al (1987).

As used in zooarchaeology, allometric equations relate proportional changes between parts of an animal as size increases (Reitz et al, 1987). The skeletal elements of an animal scale allometrically with body size (Peters 1983). As described by Reitz, et al (1987), the scaling relationship can be predicted using the following formula:

$$log\ Y = log\ a + b(log\ x)$$

In this formula, *b* represents the slope of the line, *a* represents the *y* intercept, *x* represents the independent variable (skeletal measurement), and *y* represents the dependent variable (estimated body mass). Many vertebrate characteristics scale allometrically, but for this study the most useful was bio mass, or live body weight, and total length in relation to the measure of the most cranial vertebrae.

To estimate the standard length and live weight of the stingray recovered from Caracol, the height and width of the most cranial were measured. These data were correlated with data collected from similar species represented in the zoological collection at the Florida Museum of Natural History. The above allometric formula

Table 1. Results of allometric scaling to determine the size of an archaeological specimen (*Dasyatis* sp.) found at Caracol, Belize.

	Measurement (mm)	N=	R^2	Intercept a	Slope b	Estimate
Vht. vs. TL	4.67	16	0.53	2.4981972	0.4667100	646.51
Vht. vs. Bio (g)	4.67	16	0.9069503	1.0805382	3.1264508	1489.78
Vwd. vs TL	5.23	16	0.5307620	2.4577064	0.4936919	649.26
Vsd. vs. Bio (g)	5.23	16	0.8717668	0.8588430	3.2347913	1524.21

was used to calculate the estimated total length and weight of the stingray (Table 1).

These data indicate that the Caracol stingray was approximately 650 mm in length and weighed approximately 1500 grams. The accuracy of this prediction is based on the assumption that the vertebrae recovered from this deposit represent a single animal, and that the largest of the vertebrae recovered were also the most cranial. If these assumptions are correct, the stingray would have been small enough to have been carried alive from Caribbean waters to Caracol, providing adequate water quality was maintained throughout the journey.

Discussion

Zooarchaeology can tell us many things about the possibility of long-distance trade in the Maya world. At its most basic, the identification of faunal elements in areas far outside their natural geographic range is evidence of long distance transport and trade (Hamblin 1984). The recovery of marine fish remains and other marine fauna from Caracol and at other inland sites clearly illustrates that this long distance trade occurred, however, the methodology of how these items were transported is somewhat more obscure. The presence of reef fish, such as parrotfish, at coastal Maya sites suggests that fishing technology was sophisticated enough to support transport over water, some 55 km offshore in some cases, and to return with fish in usable condition for food (Wing and Hammond 1974). The presence of reef fish remains at inland sites such as Caracol (Teeter 2001), Lubantuun (Wing 1975), Cahal Pech (Powis et al. 1999) and others suggests that the ancient Maya had a strong demand for such fish; the ability to transport it long distances; and, the ability to preserve or otherwise keep it in good condition until it could arrive at the site of its intended use.

Coastal trade has been linked to the emergence of strong northern polities such as Chichen Itza during A.D. 950-1200, after the collapse of major urban centers in the southern lowlands (Finamore 2010). Other scholars, (Andrews 1990, 2003; Cobos 2004) see this emergence as being much earlier, but still linked to coastal trade. It should be noted that even in the south, coastal trading centers such as Marco Gonzalez (Graham and Pendergast 1989), Mojo Cay (McKillop 2004b) and others remained thriving after the collapse. Lamanai, an inland site located on the New River, appeared to survive the lowland collapse, perhaps because of its association with the trading port of Marco Gonzalez. Caracol shows evidence of occupation through at least 900 AD (Chase and Chase 2007, 2008b) in conjunction with a continuation of the importation of fish and other marine items. Thus, marine trade items were maintained at least through the Terminal Classic Period.

It is likely that most of the marine fish transported to Caracol were preserved through filleting, salting, drying, or some other method and were transported with other trade goods through the usual networks of coastal and inland river trade. However, the recovery of cranial and vertebral fish remains from inland sites such as Caracol suggests that at least some fish were not butchered and prepared for inland sale on the

coast. Some species of ritual significance or those desired as luxury food items may have been transported alive to the site. It has been suggested that this could be accomplished in canoes partly filled with water, but it also could have occurred in pottery vessels that would easily have held smaller animals of ritual significance, such as stingrays, or with animals of great beauty, such as parrotfish. Modern husbandry practices suggest these species could have survived an inland trip if transported in conditions that allowed for adequate water exchanges and minimized stress.

Fish with enhanced value, or animals of value for ritual purposes would have been the strongest candidates for live importation. Colorful fish or those with iridescent scales might have had value to ancient Maya elite based on their beauty. Iridescence was particularly valued by the Maya. Houston et al. (2009: 49) notes that the Maya were attracted to the iridescent feathers of the quetzal and the hummingbird, and that the fragility and limited availability of these feathers may have added to their appeal. The mirror-like iridescence of the snapper and barracuda, or the turquoise and jade colors of the parrotfish, apparent only as long as the animal was alive, may have held a similar attraction, thus making them worth the considerable cost and energy required to procure them from the coast.

Marine animals may also have been transported alive to inland sites for ritual purposes. Particular species with strong ritual connotations, such as stingrays, might have been valuable offerings for a particular ceremony or burial. Maxwell (2000) has argued that toxic marine animals, such as stingrays, might have held great significance as ritual objects. Maxwell proposed that the toxic state of stingray spines and other marine organisms (such as puffer fish, sponges, and coral) found in ceremonial connotations at Tikal made the objects more valuable for ritual purposes. Maxwell suggests that the dangerous aspects of these species, coupled with the possible physical effects of exposure to their toxins, would have enhanced the ritual experience of the participants and, possibly, increased the value of their sacrifice. Transporting these animals alive to ceremonial sites would have enhanced their value, as their venom would have remained fully potent and intact. Small stingrays, which can survive for many days in shallow brackish water conditions, could possibly be transported in ceramic vessels as suggested by Schele and Freidel (1990:200).

The use of such methods could explain the recovery of what appear to be the remains of entire organisms from caches such as those recovered at Caracol (Chase and Chase 2008a). The transportation of live animals over great distances would have been costly in terms of labor and equipment. While it is unlikely that such effort would be expended on everyday food items for the population at large, it may have been appropriate for items that were reserved for special ritual events or as particular luxury food items for the elite.

Salted and dried for food, or carefully carried inland for ceremonial uses, fish and other marine resources were of great importance to the Maya. The use of marine resources by inland Maya communities was possible only through the utilization of complex economic and transportation networks. Based on this preliminary study, it is suggested that there were multiple modes of transport for marine animals, and that future research on the use and transport of live marine resources is warranted.

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