Who Ate the First Oyster?

Like many people, I love the ocean. There is something that seems to strike at a primitive chord when I sit and watch waves crashing on a beach and maybe something even greater while on a small boat in deep water, feeling the power of swells effortlessly rock the craft. A couple of years ago, while fishing for tuna and skipjack off of Bali, in Indonesia, I was struck once again by humankinds connectivity with, and dependency on, the marine environment. And its certainly true that we as a species love the marine environment. Even today more than fifty percent of all people living in the United States live in "coastal" areas, and worldwide some 39 percent of all humans live within 100 kilometres of a coast, a reality that can readily be seen when viewing an image of Earth from Space at night.

As a species we humans are highly dependant on a diversity of marine resources for food. It really is a remarkable thing when one thinks about it. As a global species, we rely heavily on marine resources yet have not, through this dependency, changed our morphology to any great extent. In this regard, we humans are an exceptional mammal in more ways than the obvious. Almost every other mammal which is significantly dependant on the marine environment for its food resources has been forced by the rigours of this environment to evolve* a suitable morphology that allows it to enter and successfully interact with this harsh world. Even, as in the case of humans and our ancestors, when an animals interaction is only coastal in nature, the demands of the near-shore environment have forced the evolution of morphological characters that tend to compromise the animals terrestrial lifestyle in one way or another. A classic example is the genus *Enhydra* which includes all sea-otters. As anyone who has visited the Pacific Northwest coast can testify, these remarkable, tool-using animals spend much of their time floating on their backs enjoying the occasional rock-cracked crustacean. Sea otters are a type of mustelid, related to badgers, weasels and river otters, but because of their extreme adaptations to life in a marine environment sea otters have, in the past, even been wrongly linked with the pinnipeds, which include seals and sea lions. But near weasels they are, and their adaptation to a coastal marine environment is predictably extreme. Large webbed feet are the most obvious example of such an adaptation, but the thick muscular tail, heavy layer of sub-cutaneous body fat and waterproof fur coat are all part of the marine adaptations possessed by *Enhydra* that allow it to access food in the near shore environment.

But many readers of this essay will be familiar with the so-called "Aquatic Ape" hypothesis, the seminal ideas for which were first put forward in 1923 by Max Westerhofer, who suggested that many of modern humans morphological features pointed to an aquatic origin. The Aquatic Ape hypothesis was later, in 1956, synthesized by the British marine biologist Sir Alister Hardy. But the real champion of the theory, and the person who carried the Aquatic Ape hypothesis into the popular arena, was Elaine Morgan in a series of popular books and articles. I must here stress that it is not the intent of this essay to debate this hypothesis, but many readers will have heard about it and it would be irresponsible not to address it, even in brief, in the interest of completeness. I must also show all my cards, so to speak, and state that I am a fairly vociferous opponent of this hypothesis for reasons to be explained later. In brief, however, the Aquatic Ape hypothesis puts forward the idea that at an early phase of hominoid evolution (around 5 million years ago according to Morgan), the

proto-hominins went through an aquatic dependant stage of evolution where, through the stresses of this lifestyle, many of the characters apparently unique to living humans evolved. The Aquatic ape hypothesis as supported by Morgan points to such features felt to be unique to humans, particularly in all being found in one animal. These include bipedalism, our near nakedness, our body fat distribution, our elongated lower limbs, which are in fact good for swimming, voluntary breath control, the diving response, where the human heart rate may be reduced by more than three-quarters during sustained submersion, the comfort of newborn humans in water, the gross fatness of our young at birth as compared to those of other ape offspring who are born skinny, and even our large brains.

Supporters of the Aquatic Ape hypothesis have, both deservedly and undeservedly, become the "bad boys (and girls)" of paleoanthropology. Aquatic Ape propagandists have a hard time getting a place at the podium of most scientific meetings and usually (rightly) cry foul at the outright rejection of their manuscripts, typically citing personality clashes as opposed to *bona-fide* scientific reasoning behind most rejections. Having been on the organizing committees of symposia (one that in fact had an Aquatic Ape section), it may well be that rejection is in part due to the style of presentation of many of its proponents. But to be fair to myself and my colleagues, for the most part we find the Aquatic Ape theory simply too broad in its scope to be considered a scientific hypothesis: one might call it an "umbrella" hypothesis. Umbrella hypotheses typically try to lump a variety of characteristics (the absence of hair, fat distribution etc.in the case of the Aquatic Ape) under one single overarching evolutionary adaptive breakthrough. Umbrella hypotheses are usually extremely hard to disprove as they are generally easily communicable, simple ideas that are comprised of a large variety of component ideas, some testable and some not.

In short, although attractive and intriguing (one cannot help but conjure a pleasant vision of australopithecines wading through mangrove swamps picking up tasty titbits from the shallows five million years ago), the Aquatic Ape hypothesis is clearly a model in need of some severe refinement, as for the most part it is contrary to most biological *and* paleontological evidence. As a few cases in point, the fossil record of early hominins show that we are not descendant from terrestrial quadrupedal apes, but from climbing and or brachiating apes living in tropical to sub-tropical woodlands, leading to the hypothesis that an arboreal origins of bipedalism is far more probable. The elongated lower limb that so differentiates our genus from that of the early australopithecines and other apes, does not appear in the fossil record until after 2.5 million years ago, well short of the 5 to 6 million year hypothesized point of origin of the supposed aquatic behaviour. In fact, adaptive aspects of our post-cranial morphology have evolved at different times throughout our evolution. Voluntary breath control, where we, like many marine mammals, can exercise control of our breathing independent from our gait may well be a simple factor of being bipedal, because our thorax and upper limbs are not involved in breathing. The comfort of our newborns in water is not so surprising for a creature that has just spent nine months immersed in a fluid, and certainly other nonhuman mammals respond the same way. Other core arguments of the aquatic ape hypothesis, such as our relative nakedness and subcutaneous body fat don't stand up to close scrutiny. We are in fact only slightly less hairy than our close relatives the chimpanzees and gorillas, who are themselves much less hairy than other mammals (humans have finer and shorter hairs which gives us the appearance of being naked). And all other semi-aquatic mammals,

like the sea otter, retain their dense hairiness. It is only completely aquatic mammals that have lost all of their hair. Without going on and on, in a case by case refutation which would be better served elsewhere, even our distribution of body fat is not like that of an insulated marine mammal, it's distribution is patchy and is not positioned in places efficient for protecting against heat loss in an aquatic environment.

But it is undeniable that we humans are in some ways closely linked to the marine environment and this seems to go a long way back into our history. Certainly, early hominins such as *Homo erectus* must have had the capability of crossing water and possibly even substantial distances of ocean. Intriguing new evidence from the island of Flores in east Indonesia suggests that *Homo erectus* had crossed the deep, 25km wide channel as early as 900,000 years ago to reach the island and leave behind stone tools. This crossing would have certainly required some form of rafting as it is unlikely that they could have swum that distance. More convincing and obvious evidence of humans conducting early oceanic crossing is the occupation of Australia sometime between 40 and 60 thousand years ago. Using any of a number of island hopping routes, the shortest rafted distance into Australia requires approximately a 65 kilometre ocean crossing. But these are only tentative if not superficial interactions with the marine environment, "real" interaction must take the form of utilization of the abundant resources of the oceans such as shellfish.

So that leads me to answer the age-old dinner party question - who ate the first oyster? For that we have to return to Africa. The contenders for oldest oyster eaters lie at the extremes of the African continent. In the year 2000 scientists studying deposits in Eritrea in northern Africa, revealed the discovery of hand axes and obsidian flakes embedded in reef deposits where oysters, clams and crabs were found, indicating the probability that the makers of the tools were utilizing the marine environment around 125,000 years ago. It is however, important to note that hand axes are not typically associated with such a late date (although there are later variants), rather being linked to the Acheulean culture which went extinct around 250,000 years ago in Africa thus there may be some problems with his date. The stronger evidence for early oyster eating comes from closer to home, here in the Cape of South Africa. At Klasies River Cave in shell middens in, and at, the mouth of the shelter dated to around 115,000 years ago, there is definitive evidence of anatomically modern humans subsisting on a wide variety of coastal marine foods, largely limpets and abalone but including rare oysters. Regardless of where it happened, the change in behaviour that allowed humans access to this remarkably rich resource that had almost no terrestrially based competitors probably almost single handedly ensured the success of the human species.

Whether these early humans were fishing or not remains an open question. Certainly in sites of this age around the coast of southern Africa there are the remains of fish but we don't know whether these are scavenged from the beach, or harpooned or netted in a more sophisticated demonstration of human culture. Recent evidence from the Blombos Cave, also on the Cape coast of South Africa, dates to more than 70,000 years before present and shows the use of bone points that may, or may not have been hafted for use as fishing spears. It is not until much later, approaching 8000 – 10,000 years ago that we see the widespread use of bone harpoons for spearing fish and weights indicating the use of nets for fishing by humans.

And finally, as your mother always told you, eating seafood realy is good for you. Iodine, zinc, copper, iron and critical long-chain polyunsaturated fats are all "brain-foods" of which their provision in the developmental stages of the human brain are critical. They are all, of course, found in abundance in marine foods but in much lower quantities in terrestrial sources such as eggs, animal fat and meat. So seafood has the potential to grow strong brains and perhaps assisted the evolution of our modern human brain. As an interesting aside, iodine deficiency is the worlds most common nutritionally related disease, affecting almost one-sixth of the worlds population and affecting non-coastal dwellers in far higher percentages than coastal people. This is the reason that the Great Lakes region of the United States was once called the "goiter belt". Being inland, with low levels of iodine to begin with, glaciers had washed most of the natural iodine away creating a tendency for the disease goiter among Great Lakes populations, caused by the swelling of the thyroid gland in the neck in its attempt to capture more iodine.

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*As I write this essay using words such as "forced" and "allows", I am very much aware of the dangers of presenting evolution in either natural or animal form as having some form of will or direction, but at the same time I can't bring myself to write this essay in completely bland terms that give no "colour" to the process. So I'm going to work on the assumption that not only does the reader know better, but they accept that I also know better but am choosing to use these terms anyway. Please no hate mail from colleagues in evolutionary biology.