Searching for clues in the lagoon: Is marine gathering a reflection of our evolutionary past?

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Introduction

"I had never before seen children growing up in a state of nature and I made full use of the opportunity," wrote James Norman Hall about his visit to one of the Tuamotu (or Paumotu) Islands 90 years ago.

> In the afternoons we went swimming in the lagoon. There I saw them at their best and happiest, in an element as necessary and familiar to them as it is to their parents. It is always a pleasure to watch children at play in the water, but those Paumotuan youngsters with their natural grace at swimming and diving put one under an enchantment. Many of the boys had water glasses and small spears of their own and went far from shore, catching fish. They lay face down on the surface of the water, swimming easily, with a great economy of motion, turning their heads now and then for breath of air; and when they saw their prey they dived after it as skilfully as their fathers do and with nearly as much success. Seen against the bright floor of the lagoon, with swarms of brilliantly colored fish scattering before them, they seemed doubtfully human, the children of some forsaken merman rather than creatures who have need for air to breathe and solid earth to stand on (Hall, in Hall and Nordhoff 1921:31–32).

Hall wrote this at a time when life in the atolls almost entirely depended on the traditional use of local resources and when the men of the Tuamotu Islands had become legendary for their ability to dive for pearl oysters. He was not a researcher, but his delightful depiction is nevertheless a valuable piece of documentation of a life-style, which already at that time was in a process of change — nowadays, all pearl oysters and their pearls are cultivated. Like so many other travel writers of his era, Hall was fascinated by what the *boys* and *men* did in the water, paddling canoes, fishing, and diving. That the *women* also participated significantly in exploiting marine resources was not generally recognised until towards the end of the 20th century (e.g. see Malm 1999; Matthews 1995).

Nowadays, many researchers and most fisheries departments in Oceania are well aware of the fact that women's marine gathering is of importance in local communities and involves expertise well worth studying. The overall aim usually stated in such studies, as in my own (Malm 1999, 2007a-b, 2009), has been to challenge the prejudiced view of "picking shellfish" being something uninteresting or culturally insignificant. We can, for example, gain insights about the use of artefacts found by archaeologists or conditions for sustainable development, and of course information for discussing gender issues in the past and present.

In this article I wish to add a new dimension by suggesting that such studies can also be valuable for the debate about whether our ancestors, during one period in the biological evolution of our species, spent a considerable part of their time in an aquatic environment. Some of the speculation made by proponents of the so-called "aquatic ape hypothesis" could benefit from observations of what is still being done in Oceania's coastal waters. Of course, no people can be regarded as some kind of "living fossil", but it could be argued that certain aspects of Oceanian lifestyle provide us with a mirror of what a semi-aquatic lifestyle *might* have meant in the remote evolutionary past of our species. If there is doubt about whether organisms that were gathered in the nearshore marine environment were a significant resource (as food and raw-material), or whether our bodies are well suited for aquatic activities, then the best thing we can do is to study people who spend a considerable amount of time in the water searching for food. Due to its warm climate, reef-sheltered lagoons, high marine biodiversity, and often markedly sea-oriented lifestyle, the islands of Oceania would be among the best places for beginning such a quest.

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The gathering hypothesis

Rather than trapping, hunting or fishing with implements, gathering was the most ancient type of subsistence activity. Whereas gathering combined behavioural elements that must have existed in our non-human ancestors, the technique of bringing the obtained food from where it was found to another place where it was to be consumed and shared was a departure from the ape's way of picking and eating food on the spot with each weaned animal foraging for itself. Hunting, therefore, rather than a leading force, probably emerged later in human evolution from a technological and social base in gathering (Zihlman 1981:93–95; cf. Ardrey 1976).

In her "gathering hypothesis", Tanner (1987, 1994) argues that the implication of female chimpanzees using tools far more often than males do is that only those early hominids that were most nutritionally stressed — such as females who were pregnant, nursing or sharing with offspring — had need for gathering technology. According to her, females were very likely the first to use modified organic tools and unmodified stone tools for obtaining, carrying and opening plant materials, whereas the males either were engaged in plant foraging or small-animal predation without tools. She writes:

> Early gathering — characterized by invention of tools, development of skills, cognitive mapping of where to find desired plants and in what seasons, an understanding of which skill and tool was useful for obtaining which type of plant (for example, a fruit or nut high in a tree required different efforts and tools than an underground root), together with transmission of this knowledge to the next generation — helps us to comprehend how a series of incremental changes could forge the beginning of larger brains than among apes. Most significant, it helps us to understand how learning and cultural transmission came to be central to the way in which the human line developed (Tanner 1994:132).

This would have meant that males as well as females learned about gathering while being carried around by their mothers as they were searching for food. Zihlman (1981:96–97) suggests that a primary ingredient of the early hominid's success in the *savannah* environment was the complementary nurturing roles of both sexes, a flexibility of behaviour of both males and females for opportunistically utilizing the full range of food sources so that the males also contributed to the gene pool by bringing food for nurturing the young, thereby investing in their kin (although not necessarily their own offspring). As we shall see, however, it is possible that a lot of the early gathering took place in *aquatic* environments.

Aquatic foraging in hominids

Hominid, or pre-human, fossils of the genus *Australopithecus* as well as early species of our own genus, *Homo,* have been found in places that once were the sites of rivers or lakes. For example, "Lucy," the most well known fossilised remains of an *Australopithecus afarensis,* were found among crab claws as well as crocodile and turtle eggs in former nearshore deposits (Verhaegen 1991:75). Of course, the hominids could have gone there for some reason other than gathering, and then drowned or were attacked by predators, finally to become fossilised in the sediments, but they might also have been foraging while wading or swimming.

It has been suggested that a number of modern humans' characteristics evolved in an evolutionary past where wading and swimming were important (for recent summaries of the evidence, see Gräslund 2005; Morgan 2008). Some examples are upright stance, reduced fur, the layer of subcutaneous fat (adipose tissue), fine hand-grasping ability (which could have been an adaptation for finding shells in muddy water), sheltered nostrils, voluntary breath control, the morphology of our kidneys, the number of erythrocytes per blood volume, and the diving reflex (described below). Such features may indicate that we are descendants of a primate that spent a considerable amount of its time searching for food in aquatic environments, perhaps even diving for it, during one phase in our evolution.

Exactly when or where this happened is a matter of debate. Some have suggested around 6 million years ago, when climatic changes in east Africa caused forests to retreat and savannahs and deserts to expand, a period from which we do not yet have (with absolute certainty) any fossils of a permanently bipedal hominid. Ellis (1991) writes that the African Rift Valley, including the Red Sea, might have provided a suitable combination of sea level and habitat changes for a group of apes to become geographically isolated in marine wetlands long enough to become more aquatically adapted through evolution, and that their adaptations later on might have been functional in allowing early hominids to enter the savannah ecosystem and outcompete other primates there. Thus, coastal areas and the savannah would *both* have their place in human evolution.

Others believe that this part of our evolution occurred 2 million years ago, or even later (and long after permanent bipedal walking had evolved), when sea levels were lower and *Homo* populations

had left Africa and spread along South Asian coasts (later to return to Africa). There they would have foraged in the sea, where invertebrates and other animals were rich in the omega-3 essential fatty acids known as DHA (docosahexaeonic acid) that provide excess energy and nutrients that are important for brain growth. From coastal habitats, the more aquatically adapted hominids could have spread along lakes and rivers farther inland (Broadhurst et al. 2002; Parkington 2006; Verhaegen and Munro 2002).

Semi-aquatic adaptations in animals

Before dismissing these scenarios as unreasonable, one ought to remember that a number of animal species have become adapted to an aquatic or semi-aquatic life after having lived on land in a remote past.

The marine iguanas (*Amblyrchynchus cristatus*) of the Galapagos Islands, for instance, are descendants of more terrestrial lizards (such as the green iguana, *Iguana iguana*) that probably were good at swimming but spent most of their time in trees and "rafted" on a tree that drifted over the sea from mainland South America. These lizards have become adapted to a semi-aquatic life on rocky seashores from where they climb down into the intertidal region or dive to do what could be described as marine grazing.

The ancestor of whales is believed to have been an antelope-like mammal that waded in India's wetlands some 30 million years ago (Thewissen et al. 2007). Compared to that, a wading ape becoming more and more, but certainly not fully, adapted to a life in shallow seas or possibly rivers and lakes, after some hundred thousand or perhaps a million years or more, is by no means biologically implausible (cf. Ellis 1991; Richards 1987:203–204).

Apes have been observed wading in the wild when they need to, and some even forage in water. Western lowland gorillas (*Gorilla g. gorilla*) routinely wade into swamps in forest clearings, where they feed on aquatic herbs, and bonobos or pygmy chimpanzees (*Pan paniscus*) have been known to feed on aquatic plants for months at a time, repeatedly immersing themselves in water up to the shoulders during the process, and some appear to catch shrimp during bipedal wading (Kuliukas 2001:10–13).

The ability of contemporary primates to find food in water might reflect a behaviour that existed among our common ancestors. Perhaps some of these became foragers in lakes, rivers or coastal waters without becoming fully aquatic but what (at the most) ought to be conceived of as *semi*-aquatic hominids.

Evidence from studies on diving

In Oceania, it is seldom customary for women to do any deep diving. Diving for shells, sea cucumbers, black coral and with spear or spearguns for fish or octopi are tasks for men. Until quite recently, they have usually been carried out without any costly scuba equipment — only with goggles or a mask and sometimes a snorkel and flippers — within a depth of 15 metres. From Charles Stuart Ramsay's (1938:ch. 29) classic tale *Tin Can Island*, which is about Niuafo'ou, one of Tonga's northernmost islands, we learn about how men placed three or four fish traps baited with seaweed some 15 meters apart at a depth of 6–10 metres and that there were fishermen who were able to examine them — and pick out the fish, attaching them to a spear, a line or putting them in a basket — all in one dive without going up for air.

In her study of the effects of temperature and training on the human diving response, animal physiologist Erika Schagatay (1996) has found that facial receptors are involved in triggering a reflex in which there is a redistribution of the circulating blood by selective vasoconstriction and a lowering of the pulse rate. Diving bradycardia (reduction of the heart rate from baseline) can be trained, like apnea (breath-holding), and is thus an important part of the training of divers such as those among the Suku Laut, sea nomads of Indonesia who can hold their breath for up to four minutes and dive to a depth of 30 metres or more.

According to another study of sea nomads, Moken children in the Bay of Bengal have underwater vision twice as good as that of European children, achieved by heavy accommodation and concurrent pupil constriction underwater, a skill that can be trained but is found in marine animals such as seals and dolphins (Gislén 2003). Interestingly enough, well-trained Moken divers are able to block their nostrils by using their upper lips (Matsumoto 2009). Pearl-shell divers in the Tuamotu Islands also appear to have been able to do this (Williams 1962:513,521).

Basing her conclusion on the evidence of studies of the Suku Laut in particular, Schagatay (1996, Part IV:253) states that such studies "demonstrate that a semi-aquatic way of life is within the range of present-day human physiological adaptation."

The aquatic ape hypothesis

If human physiological adaptation makes a semi-aquatic way of life possible, we may ask ourselves if our species was even more aquatic in an evolutionary past. It is here worth considering the "aquatic ape hypothesis," which is an unfortunate misnomer because it really is (and always has been) about a *semi*-aquatic hominid.

This hypothesis was launched in 1960 by a prominent marine biologist, Sir Alister Hardy, who suggested that a branch of apes, at one time in the evolutionary history of mankind, "was forced by competition from life in the trees to feed on the seashores and to hunt for food, shell fish, sea-urchins, etc., in the shallow waters off the coast." The term "aquatic ape" was coined a few years later by Desmond Morris (1967). The hypothesis was then popularized by Elaine Morgan in a number of books (e.g. 1982, 1990, 1998, 2008) and later developed by other researchers. Hardy summarised his idea about how apes became aquatic in the following way:

> I suppose that they were forced into the water just as we have seen happen in so many other groups of terrestrial animals. I am imagining this happening in the warmer parts of the world, in the tropical seas where Man could stand being in the water for relatively long periods, that is, several hours at a stretch. I imagine him wading, at first perhaps still crouching, almost on all fours, groping about in the water, digging for shell fish, but becoming gradually more adept at swimming. Then, in time, I see him becoming more and more of an aquatic animal going farther out from the shore; I see him diving for shell fish, prising out worms, burrowing crabs and bivalves from the sands at the bottom of shallow seas, and breaking open sea-urchins, and then, with increasing skill, capturing fish with his hands (Hardy 1960).

All of this may sound like pure fiction, but what Hardy wrote here is a fairly accurate description of what one can see in the lagoons and on the reefs of countless islands in Southeast Asia and Oceania. Although various aspects of the hypothesis have been criticised (e.g. Lowenstein and Zihlman 1980; Langdon 1997; Wind 1991), enough data have, according to others, piled up in recent years to give good reasons to take the hypothesis about human evolution in waterside habitats seriously and not just dismissing it with a comment that it is far-fetched. For example, some years ago two biological anthropologists wrote: "we insist that the AAH [aquatic ape hypothesis] take its place in the battery of possible functional scenarios for hominid divergence" (Groves and Cameron 2004:400).

In the absence of fossil data, what we can do in order to substantiate or discard such a hypothesis is to make comparisons of adaptations that we can study in our own and other still-existing species. Put simply, anatomical and physiological adaptations that work well in an aquatic environment are there as a result of an evolutionary process and then put to use because of cultural reasons that allow for a training of, for instance, the diving response. Whether such adaptations evolved in semi-aquatic conditions cannot be answered here, but it is an intriguing question that needs to be asked.

The case of *fāngota*

The cyclical tidal process in Tonga, where I have studied marine gathering, is so noticeable that the size of many islands could be said to depend entirely on whether it is high or low tide. In many places, lagoons are shallow enough walk or wade out to the reef during low tide, a period of six hours that can be spent searching for food. (For people from colder parts of the world, who find it difficult to imagine that one can spend several hours in the water around these islands, I might add that for myself, being a typical fair-skinned Scandinavian, the problem is not the temperature of the water or the air, but rather the burning sun.)

If it is low tide after a dark night, one is likely to see more gatherers than otherwise, because many of the desired animals may then still be out of their hiding places and be easy to find. There are two low and two high tides per 24 hours, falling about 50 minutes later every day. Sometimes the low tide is in the morning and the next one late in the evening. At other times it may be low tide around the middle of the day. The result is that for many Tongans, meal times vary with the tides.

Marine gathering, called *fāngota* in Tongan, is carried out by women and children who gather seaweed and invertebrates, do some simple spearing, and use certain trapping methods in the lagoon and on the reef. They may also participate in some types of group fishing when needed. Men fish with spears, hooks, nets and other traps. It is not common for men to gather any seafood by hand, except when they dive. Thus, when both groups exploit resources in the same zone, men generally engage in activities that involve the use of tools, while women and children use methods that are perceived as more simple and less demanding. By far, the most common of all types of marine exploitation carried out by women is marine gathering by hand or with a knife or simple spear. Anything edible that is found may be taken, including fish that hide among seaweed or in shallow pools where they can be picked up, speared or hit with a knife or stone.

When women and children go gathering in the lagoon, they usually do bring much equipment with them: a knife, a container, and if they plan to prise up rocks they bring a wooden stick or a metal bar. They may also bring along some coconut meat. The ideal is to be able to *fakamata*: spotting the protruding eyes or mouths of fish and invertebrates that bury themselves in the sand. If the desired

organisms cannot be sighted because the water is too rippled, a special technique, *fakatofu* (to make calm), is used. Coconut meat is chewed and spit out in a circle close to where one is standing, so that the surface becomes temporarily calm enough to provide a clear view.

Many molluscs, clams in particular, are actually gathered without having been previously seen. It is common to see gatherers not only move their hands over the bottom in order to feel a protruding shell, but they also search through the bottom with their feet, especially in seagrass where shells cannot be seen. This is called *moe, moe'i,* or *molomolo.* To try to find a shell with the hands is called *fāfā,* to catch or pick by hand is called *ala*. To dig for invertebrates that are hidden in the sand or mud by the beach at low tide is called *tā.*

In my studies on marine gathering in Tonga, I have documented how more than 230 folk taxa of seaweeds and marine invertebrates have been used for some 50 different purposes (Malm 1999, 2007a). From older children and women, younger children learn much at an early age: the names of seaweeds and animals that can be eaten, how to obtain and eat them, and which ones to avoid. There are households in Tonga where over 10 kilograms of shellfish is gathered each week to be eaten (e.g. Kunatuba and Uwate 1983), and for many people it is also an important source of income, especially as seafood and shellcrafts. Thus, in Tonga *fāngota* is important for survival as well as being a leisure activity.

Swimming before walking

Well worth mentioning here is, also, that by following the others while going *fāngota,* Tongans become acquainted with the sea in their earliest childhood. When I asked my informants how they learned to swim, they often looked at me in surprise and asked what I meant or simply answered "I have always been swimming" or "I just did it." Swimming seemed to be so natural for them that they did not see it as resulting from a particular learning process. McKern (n.d.:681) states that Tongans "not infrequently … learned to swim at the same time they were learning to walk." This may have sounded strange at the time he wrote it (in the 1920s), and I cannot claim having seen anything like that in Tonga, although I have seen women carrying infants in one arm while gathering in the lagoon, but his statement may very well be correct. Today it is well-known that infants that have been exposed to water enjoy swimming and even hold their breath while putting their head under water, and "baby-swimming" is now encouraged in many Western countries. For a comparison, it can be noted that the children among the Suku Laut of Indonesia, as stated by Schagatay (1996,Part IV:252), swim *before* they can walk and, from the age of six, even contribute to the economy by diving.

Every time I went to a beach for a picnic with my Tongan friends, the first thing that the children did was to run down to the water with their clothes on, without any one seeming to worry much about them going there without any adult to accompany them. Accidents do happen in Tonga as anywhere else, but the water is usually warm and some older children are usually around. Like all other Polynesians, Tongan children are above all socialised by playing in mixed age-groups. A lagoon is a marvellous playground where they learn important things at the same time as they have fun, and swimming is an excellent example. In school they may be given further instructions about how to make the proper limb movements, but to most Polynesians learning how to swim seems to be as natural as learning how to walk or talk properly. The extent to which they continue to practice swimming as they grow up varies, however. As a result of laws originally imposed by missionaries, women always wear clothes (e.g. long skirts) in the sea, making it difficult for them to swim. Most women gather by just walking, sitting or lying down in shallow water. One finds more experienced swimmers among men, not least because diving and harpooning are men's asks.

Conclusions

Contemporary marine gathering in Tonga and elsewhere in Oceania involves far more than just bending down to pick up shells. A number of methods are used for spotting and finding animals, and for poisoning, catching or picking them up. Marine gathering also fills several functions: obtaining food for oneself and relatives and friends, meeting others in or by the lagoon, simply relaxing and having some fun — for example, in learning how to swim — and earning money by selling seafood and shellcrafts. It is not only an important aspect of food provision but also of social life in the islands. Similar patterns of subsistence are found among many hunters and gatherers in terrestrial as well as aquatic search for food.

It has been argued that by studying how organisms of a marine environment are gathered and used by people who have a sea-oriented lifestyle, light can be thrown on human adaptation in a cultural as well as biological sense. Such studies cannot prove anything about our evolutionary past, but I do argue that they can be valuable for generating or discussing hypotheses about evolution, such as whether our own species might have passed through parts of its evolution in waterside habitats.

Before we know more about when and where our hominid ancestors *might* have made a transition from a terrestrial to more aquatic search for food, we ought to be very careful about stating that it just meant wading close to the beach, and that they could not have spent a considerable amount of time in the water or that they would not have been able to find food of much nutritional value. Such an environment would not in any way demand less intelligence for survival than a life in terrestrial habitats. The fatty acids of molluscs and other near-shore animals might even have been important for evolving larger brains in hominids.

A water-oriented hominid lifestyle could very well have had a lot in common with what we still can see people doing in coastal areas of the tropics, where the water is warm and there is considerable biodiversity. Tongan marine gathering often takes place in areas as wide and varied as many land areas where people (or apes) gather their food. As for the occasional argument that predators such as sharks or crocodiles would have made semi-aquatic foraging unthinkable, it might suffice to say that a lot of the wading and diving that people actually do in the marine environment of Oceania or (with hand-held nets) in the rivers of Papua New Guinea is then also impossible.

In the long run, as our knowledge of human evolution proceeds, a "semi-aquatic ape hypothesis" may prove to be untenable. If it does, marine gathering still needs to be studied for ethno-archaeological purposes, among other reasons, because it has certainly been important in many societies from early pre-historic times, not only in Oceania. If at least some aspects of the hypothesis should be found to deserve further consideration, marine gathering is not only a matter of producing food and raw materials — it might then reflect the very activity that made us human.

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