

Tool Use in Dolphins

BY JANET MANN

Female dolphins in Shark Bay have developed a foraging technique that they pass onto their daughters.

“Dodger has a sponge!” I shouted as we rushed to the side of the boat to look. After nearly tipping off the bow, I quickly snapped a photo of Dodger.

I had waited years for this moment. Fourteen years earlier I had observed Demi, Dodger’s mother, with a sponge at the age of 2 years. That observation, back in 1989, was the first time a young calf had ever been seen with a marine sponge. Four years before that the very first sponger known to science, Half-fluke, who was Dodger’s grandmother, was discovered by Dr Rachel Smolker.

Dodger’s mother and grandmother were critical to our discovery of sponging and how it was transmitted from generation to generation. Now Dodger helped fill in the gaps.

Half-fluke, Demi and Dodger were the first family of tool-users among any wild dolphin or whale, placing dolphins, once again, in the illustrious company of other “brainy” animals, such as primates, elephants and crows. But it isn’t just the fact of tool use that is intriguing. It is also how they learn the sponging technique.

Although many factors contribute to sponging, the primary cause of sponging is social learning. Social learning is the hallmark of culture so, by this definition, sponging is a cultural behaviour. By more stringent definitions of culture – that it must be “symbolic” or involve direct teaching or carry social meaning – sponging does not yet meet those criteria.

We do know that the method develops by copying the mother. But who copies their mothers and who does not? Can we better interpret the significance of sponging by understanding how and why this unique hunting method developed?

Back in 1985, during the early stages of our research in the eastern gulf of Shark Bay in Western Australia, Smolker discovered the sponging behaviour after a fisher told her about a dolphin with a “growth on its nose” and “half a tail”. She didn’t believe the fisher until she saw the dolphin herself, with a large yellow-orange growth on her beak and half a tail fluke. The growth



Photo: Janet Mann

suddenly changed shape and colour, prompting Smolker to take a closer look. The dolphin sported a basket marine sponge, and she named her “Half-fluke”.

It turned out there were a few more “spongers”, and to date we have documented 43 of them in a local population of over 1200 (about 600 range in our main study area at any given time). Nearly all of the spongers are female, but six males have also been known to carry sponges.

You may well ask: what is going on? Dolphins carrying sponges around?

A marine sponge is actually an animal, albeit a primitive one. After many years of trying to peer deeper into the 10-metre-deep channels where dolphins find, carry and use sponges, it has become relatively clear what they are doing.

Shark Bay, a UNEP World Heritage Site, is 13,000 km² of shallow sand flats and seagrass beds with some deeper channels and embayments. The channels, where sponging is the predominant foraging type and where virtually all sponging occurs, have a plethora of sponges, including basket sponges that sponging dolphins rely on. Sponges are filter feeders that rely on strong currents to provide enough nutrients, so they anchor themselves onto a bit of rock or shell substrate in the seafloor.

The dolphins tear the conical sponges from their anchor and wear them over their beak. They don’t grip the sponge with their teeth, but since dolphins are always moving they can keep sponges on their beaks with apparently little effort.

Most spongers spend half of the day using their sponge to ferret prey from the sea floor. They swim slowly along sandy habitats with a sponge on their beak, slightly and intermittently disturbing the seafloor. When fish are detected the dolphins drop the sponge, accelerate about 5–10 metres and then probe the seafloor with their beaks.

Occasionally rapid single breaths or leaps out of the water without the sponge are observed before the spongers return to

the same spot, indicating that prey may be burrowed in the sand. The dolphins then retrieve sponges and begin the search process again.

Spongers occasionally surface with small fish (<20 cm) that are rapidly swallowed whole. Field observations, photographs and sponge-carrying by human divers (with a sponge cupped over one hand) revealed that the prey are probably small bottom-dwelling fish (e.g. *Parapercis* spp.).

Dolphins search for up to 10 minutes for a sponge, transport sponges to foraging areas, and occasionally carry sponges in social groups for later use.

From genetic research, behavioural observations and long-term records, we know that most spongers come from a common matriline: a “Sponge Eve” if you will. We speculate that a female invented the method, possibly inadvertently, when she pushed a sponge around the sea floor and happened to scare up a fish. Such an occurrence would immediately reward pushing a sponge around, possibly evolving into the specialised hunting technique we see today.

This method may have been innovated more than once, since spongers in the eastern gulf come from a different maternal lineage to the eastern gulf, and at least one other species of dolphin, a hump-backed dolphin, has been observed with a sponge in north-east Australia.

In 17 cases the parentage of spongers is known, and all had sponging mothers. There are so few male spongers that we doubt that fathers have much influence on sponging behaviour. Furthermore, males have virtually nothing to do with rearing calves, and adult males rarely interact with calves in any context.

Sponging is clearly a tradition passed down by the mother. Of 19 offspring of known sex that were born to sponging mothers and survived to weaning, 91% of daughters and 25% of sons adopted sponging. In fact, all the males that do sponge were observed sponging only after weaning, but females pick up the behav-



The dolphins carry sponges like these to stir up the sand and any concealed fish. Photo: Janet Mann

our earlier when they are still dependent on their mothers.

Thus females are not only the primary tool-users but they are also more precocious in their tool use. The dramatic sex bias in the behaviour is obvious, begging the question: why don't males sponge?

Male offspring nurse for 3-4 years and then spend less and less time with their mothers as they age. As a calf, sons share some behavioural traits with their mothers, but these become less pronounced with age, whereas mother-daughter similarity increases with age.

By the late juvenile period (8 years and older), a son will rarely associate with his mum. By this time he has usually developed strong bonds with other young males, although some of these bonds are still labile. By his teens these bonds have strengthened into what Richard Connor of the University of Massachusetts-Dartmouth calls an “alliance”.

Alliances of males consistently cooperate to sequester individual fertile females during the breeding season (September–January) and keep other males away from those females. Males range widely in search of females and possibly to avoid battles with other alliances.

The size of an alliance can range from two to 14 males. Although males within an alliance probably compete for matings, fierce competition is reserved for males in opposing alliances.

We currently believe that the social and

ecological demands of being an alliance member prohibit the use of sponging, which demands extensive effort, a high degree of specialisation and would limit a male's range and access to females.

The story is not finished, however. Three adult male spongers are currently part of a seven-member alliance. We will soon know whether they can balance the demands of sponging with that of alliance membership.

In contrast daughters continue to associate with their mums well past weaning, and may benefit from following their mothers' tradition. Although sponger females spend 23% more time hunting than other females and lead a solitary lifestyle (spongers are alone 83% of their time compared with 49% for non-sponger females), the calving success of spongers is at least as high as that of other females, suggesting that even with harder work and less social time they are doing well.

A sponging female produces a surviving calf every 6.4 years, but non-spongers produce surviving calves every 7.6 years on average. Although the difference is not statistically significant, the pattern at least suggests that spongers are doing no worse.

Spongers get virtually 100% of their diet from hunting with sponges. Thus there is probably some energetic benefit to sponging despite the fact that spongers hunt so much, take deeper dives and dive for longer than other females.

This diving pattern would make it more



Photo: Ewa Krzyszczyk

difficult for female spongers to look after their calves, who have not achieved adult diving competence for several years. Calves born to spongers often wait for their mothers at the surface, which is a vulnerable place for a young calf in Shark Bay.

Over the past 25 years we have found that daughters are more likely to adopt their mother's foraging behaviour than sons. For example, five females currently beach themselves to catch mullet or garfish just north of our main study area. This behaviour is also passed down from mother to daughter.

It could be that the diversity of prey and habitat in Shark Bay has favoured a diversity of hunting tactics. Given that female dolphins nurse their calves for an average of 4 years, food is likely to be the limiting factor for female reproduction. For males, access to females limits their reproductive output. As a consequence, females focus on hunting and solving ecological problems, while males focus on solving social problems, such as developing and maintaining good relations within and between alliances.

If sponging is so effective, why don't other females start using sponges? We suspect that it takes a long time to develop the method, so calves and juveniles are unlikely to suddenly adopt this unique foraging tactic without continued exposure during the first years of life.

Furthermore, sponging requires a commitment to living in channels where one can both find sponges and the appropriate prey. Sponges would be ineffective in seagrass beds, for example, because any prey disturbed by the sponge could quickly hide again. In contrast, prey would be quite visible once disturbed from the sandy channels.

Sponging is the predominant foraging tactic for females in the channels. We suspect that sponging has allowed them to more effectively access prey in channel habitats compared with non-tool users, thus exploiting an otherwise unused niche. The use of sponges allows the dolphins to access partially buried prey that would be difficult or costly to find and extract otherwise.

The sex bias in learning and using tools is more striking than any found in non-human animals. Chimpanzee females learn to fish for termites earlier and more effectively than males, but all members of the population engage in termite fishing and tool

use. Here we find that tool use is predominantly female, a finding that conflicts with most stereotypes of the sexes.

People often ask if this means that female dolphins are smarter than males. Although tempted to say "of course", this is not what I believe. Both sexes have large brains and both use their intelligence in social and ecological contexts. All the political manoeuvring among males is likely to be cognitively demanding, just as it would be for females to outmanoeuvre those males.

While males may have no need for tool use since they can catch what they need with very effective jaws, females must eat 50% more to support themselves and their offspring. This places a premium on becoming the best hunter one can be, including the use of tools.

Obviously most dolphins in Shark Bay and elsewhere do not use tools, so we cannot argue that tool use was important in the evolution of dolphin brains. Their streamlined bodies betray them. But, given that dolphins evolved large brains they can use their impressive skills in interesting ways to solve ecological problems, including tool use. Similarly, human brains became big long before we developed elaborate tools or technology, even though we are the quintessential tool-users.

It was April 2005, and Demi's youngest daughter, Dash, just began sponging – months earlier than any calf we had seen. She was only 15 months old.

Demi, Dodger and Dash can still be found, mostly foraging alone with sponges on, but are often just a few hundred metres apart. Although we consider them solitary, their movements suggest they know exactly where their kin are. Periodically they join up and swim together. Occasionally they leave the channels to socialise with non-spongers.

During this past winter the males were after Demi again. In July, seven males surrounded her, including three male spongers, all vying for her attention. Dodger, now 10 years old, will soon be old enough to breed. If she has a daughter she will no doubt carry on the tool-using tradition that graces the waters of Shark Bay.

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