

Mostly Harmless: Sharks we have met

“While the massive environmental crisis of the Anthropocene may be a hyperobject that defies direct representation, it paradoxically calls for the creation of evidence, of perceptibility, of documents – the renderings of a fleeting world. What is needed are bodies of evidence for a transformation that is both so massive and so tiny, that is happening so fast and so slowly that no image or narrative can ever grasp its breadth. How can we start to sense what we only know abstractly? Producing such bodies of evidence seems like an impossibility – and at the same time, more necessary than ever.”

Eva Horn¹

MIKE PAULIN

The wall reaches almost to the surface above and dissolves into inky darkness below. It's festooned with branches and blobs, brightly coloured in shimmering sunlight. One might be forgiven for thinking that the inhabitants of this submarine forest are all plants. But I am a zoologist. I know that they are mostly animals, distant cousins echoing the forms of ancient ancestors who parted company more than half a billion years ago.

I am drifting two metres below the surface of a crystal clear Red Sea. Solitary fish wander among coral branches while myriad other fish meander in clouds in the open water adjacent to the reef. In the corner of my eye, the sea parts. As I turn, the meandering clouds condense into diverging schools, forming a halo around a blacktip reef shark patrolling the reef. *Carcharhinus melanopterus*. No claspers, it's a girl. To a zoologist she's one of us: a vertebrate. There are some differences, to be sure, but in the grand scheme of animal body design there's not much between us. These blacktips even give birth to live young.

The reef fish are not afraid. They know that she will not waste energy pursuing them. Only sick or injured fish need worry - for the moment. They step aside nonchalantly as the shark approaches. They send a message by moving off in a calm, orderly way, no sooner than necessary, “I see you, You can't catch me. See ya later.”

I'm not afraid, either. She's five foot and a bit with razor-sharp teeth. She's fast, agile and strong. But reef blacktips are afraid of divers. If I make a move she'll skitter away into the gloom. I hold my breath. She swims lazily by.

She must see me. I look her straight in the eye. Is there a hint of acknowledgement? A flicker of recognition of a fellow vertebrate, sharing organs and limbs, passions and senses? Subject to the same diseases, healed by the same means, warmed by the same sun, cooled by the same water? She slides gracefully past.

She's not aware of me. Not in the sense that I am aware of you – even though while I am writing this you are in a different place and you are in the future. I have some sense of what it is like to be you, somehow connected to my sense of what it is like to be me. I have a theory of mind. This girl seems unaware of me, but is she aware of herself? Does she have desires? Does she feel pain? Can she suffer? I am sure of this. Being a shark may not feel much like being a human, even a wet one with fins, but it surely feels like *something*.

Blacktip reef sharks have convergently evolved into a niche that is the marine equivalent to the terrestrial niche of jungle cats. These beautiful animals tend to be solitary, territorial hunters, feeding in low light at dawn and dusk. Their eyes shine in the dark because of a reflective layer at the back of the eye, giving the retina a second chance to grab passing photons. They are fast and highly manoeuvrable. Complex habitats such as coral reefs and jungles are cognitively demanding for predator and prey alike. They must detect and recognise animals that may be trying to hide from them or confuse them. Pursuit predation sculpts animals to be agile and smart. Sooner or later, a tasty animal is caught out with not enough information and not enough time. It makes a bad decision, runs the wrong way, and it's a goner. You are here, reading this, because your ancestors were better at gathering sense data, perceiving what matters, and making good decisions quickly while still unsure of the facts.

Blacktip reef sharks are fast, smart, agile vertebrates, just like us. Predictive perception and agile movement is our thing. It's what we do. Humans formalise this characteristic of our phylum by celebrating our fabulousness in the rituals of 'sport'. We worship those who are best at it. Little by little we become less inclined to ritualistically compete to the death. The gladiatorial dispatching of humans, big cats, or dolphins is generally considered repugnant these days, yet recreational killing of certain other fellow vertebrates, including sharks, remains popular.

Asking how this justified would make you...well... a spoil-sport. However, if there was an argument it would presumably be along the lines that sharks have small brains and don't have the parts of the brain required for self-awareness. You might argue that killing sharks can be justified on the basis that if they don't know that they are alive then who cares if they die? I want to stop you right there. Sharks don't have small brains. Their brains are exactly the right size, and just like yours. Yes, I'm looking at you.

Science has a long tradition of finding ways to demonstrate that 'we' are superior to 'them', and brain size comparison has been a popular indoor sport for a long time. When we compare brain-body weight ratios among vertebrates, sharks are at the bottom. By this measure they are indeed the dumbest animals on Earth.

Humans, by the way, don't have the largest brains – elephants and many whales and dolphins have larger brains than us. We don't even have the largest brains relative to our body size. That would be a shrew, a tiny animal that looks like a cartoon mouse. If you think that sharks are stupid because they have relatively small brains for the size of their body, think again.

Nervous systems are complicated and expensive, which is why most organisms don't have them, and why organisms that need them make them as small as possible. By analogy, computer chips are energy-hungry. The best smartphone is not the one with the biggest computer chip but the one with the smallest chip that does the job. If you don't need a smartphone then you're better off without one.

Reef sharks are specialised for pursuit, but their prey are not specialised for escape. This reflects the simple fact that it's possible to make a living by chasing things, but not by running away from things. Shark brains and shark bodies co-evolved for agility in the ocean. Oil – shark liver oil – makes sharks weightless in water but much heavier in air.² If shark brains and bodies were weighed in water, where they co-evolved to perform, then sharks would have the largest brain-body weight ratio of any vertebrate, including you. But wait, there's more. The physics of drag in seawater favours larger body sizes for faster pursuit, providing an additional advantage for sharks to have heavier bodies. Despite the advantages of smaller brain-body weight ratios in their specialist niche, many sharks have larger brain-body weight ratios than similarly-sized reptiles and birds.

Out of the water and on the boat, my fellow scientists and I continue on our way. Our drift dive along the reef wall was just for fun, a break from our long days and evenings in the Eilat marine laboratory. Our real mission for the day is to find *Iago Omanensis*, a diminutive, squishy shark that lives in permanent darkness, deep below the surface in the Gulf of Aqaba. These animals occupy a niche that resembles the niche in which nervous systems first evolved.

Animals were in darkness before nervous systems evolved because they could not 'see'. *Iago* deals with the darkness using an electric field sense to detect other animals and a vestibular or balance sense to orient themselves in the world.³ We think that the first nervous systems dealt with the darkness in the same way. This is a model of the foundational brain: a mechanism that combines a sense of self with a sense of others.

Now here is the rub. Despite specialising into a uniformly dark, featureless habitat where it has lived for millions of years, *Iago*, like all sharks, has a brain just like yours and mine. A vertebrate brain. The old story about human brains having extra "layers" and components built on top of an ancient "reptilian" brain just isn't true. There are differences, to be sure, but our nervous systems are much more alike than our bodies. A shark brain differs from a human brain much like a mouse body differs from a human body. Things are different sizes, shifted, stretched, squished and bent, but it's all there.

As to my close encounter with the blacktip: was she self-aware? Was she aware of me and just not letting on? I know that human brains are capable of self-awareness. Indeed, as Descartes famously pointed out, this is the *only* thing I can be sure of. It is a leap of faith to infer that anything else exists. I believe not only that other humans exist but that they also are self-aware. Indeed, I believe that this is why brains evolved, as predictive models of self in relation to others, necessary machinery for the evolution of pursuit predation as a lifestyle in late Pre-Cambrian ecosystems. The implication is that consciousness has deep evolutionary roots, is a feature of all vertebrates, and perhaps of other kinds of animals too.

Since blacktip reef sharks have brains just like mine, I have little doubt that they are capable of self-awareness and sensing awareness in others. This ability, which psychologists and philosophers call "theory of mind" should emerge whenever there is a selective advantage in being able to

predict behaviour of other agents. Blacktip reef sharks may not have learned or evolved predictive models of human divers as agents because there's no obvious selective advantage in doing this, and we haven't been meeting like this long enough for it to happen. Perhaps she doesn't know I exist, after all... Sigh.

Here's the bottom line: If you think that it is OK to kill sharks because they have small brains, because they are stupid, because they can't suffer, because they don't even know that they are alive, then I think that you are mistaken. Being a shark feels like being *something*.

Mike Paulin, Ravensbourne, July 2018

DAVID GREEN

Last year my son, Louis, and I went to visit my sister on Cape Cod along the coast of Massachusetts. One hot summer day she took us to the Chatham Fish Market to get lunch and to see the small fishing boats queued up, decks laden, each waiting patiently for their turn to offload their catch. This is apparently something tourists love to do. Perhaps it offers a primal thrill, like watching a lifeless caribou carried into your village after a successful hunt, knowing that at least for today enough food has been secured. Surfeit for now.

On this day, the catch seemed to consist almost entirely of one species of fish – *Squalus acanthias* – a kind of small shark. Boat by boat, load by load, we watched the countless tangles of limp adult bodies, intermingled with what appeared to be spontaneous abortions of live young still attached to yoke sacks, slide and tumble into huge plastic boxes being bucketed with ice by workers in white boots between cascades.



Figures 1-3. David Green, *Lullament*, 2018, Single Channel Video with sound (stills from video)

Watching this process, I suddenly felt like a haruspex staring into the ocean's twisted viscera: mesmerised; stupefied; divinatory, and as an eater of fish fully implicated in yet another gesture of the Anthropocene sublime.

It is worthy of note that the particular species of shark piled on their decks that day has the longest known gestation period of any animal (18 to 24 months). They give birth to live young and have very small litters (about 7 at a time). "The spiny dogfish (*squalus acanthias*) is among the slowest-growing, latest maturing and longest lived of shark species. Males mature at around 11 years of age while females mature at around 18 - 21 years of age. This ancient species of animal is estimated to live to up to 100 years, with Pacific animals growing slower, larger and living longer than Atlantic animals."⁴ Spiny dogfish are known to travel and hunt together in same-sex, same-age, cohorts.

The species is particularly vulnerable to overfishing because of this late maturity, slow gestation, and small birth rate. Although they once made up the largest population of sharks in the world their numbers have collapsed world-wide, with the Atlantic population currently calculated to be less than 5 percent of its number in pre-modern times.

In an effort to save significant shipping costs to Europe and other markets (where they love eating the little shark so much they eradicated their own local populations) last year US east coast fisheries launched a concerted media blitz to try to convince North Americans to eat the flesh of the little long-lived shark. Even my beloved National Public Radio has cheerfully taken part in the effort.⁵

Traditionally dumped as by-catch by US east coast fisheries, it is ironic that despite a cataclysmic decline in population the "spurdog" now seems to represent a significant proportion of remaining biomass for area fisherman to bring to market. Their re-education strategy is two pronged: it not only aims to groom US consumers towards dogfish as 'real good eatin' but in an exquisitely Goebbels-like gesture, local fisheries point their remaining fingers at 'exploding populations' of *squalus acanthias* as the 'smoking gun' in the case of the missing coastal fish stock – so it is only right that their numbers be controlled, and in the usual way, by human appetite.⁶

Something drives us to find ever more elegant ways to dispatch, disassemble, repackage, and bring to market what we could never possess as surely as we seem to think we do when we transform another lifeform or landform into numbers on a ledger.

The bodies of these spiny dogfish cascading on a summer day in July 2017 are documented in a single channel video called, *Lullament* (2018) that played in the Art and Ocean Exhibition at the Skinner Annex in July 2018.

David Green, Beijing, September 2018

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