TALKING APES: FACTS AND FISHES

Podcast transcript

These engaging and informative podcasts are suitable for years 7-10. Listen to experts discuss the latest scientific research regarding fish sentience, capabilities, and the commercial fishing industries.

PART I: FISH SENTIENCE, INTELLIGENCE, AND CULTURE. (18 MINUTES)

PART II: COMMERCIAL FISHING AND ENVIRONMENTAL IMPACTS. (10 MINUTES)

Interviewees include:

Dr. Jonathan Balcombe, Ethologist and author (USA);
Prof. Culum Brown, Behavioural Ecologist (AUS);
Dr. Cat Dorey, Scientific Advisor (AUS).

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TALKING APES FACTS AND FISHES

PART I: JONATHAN BALCOMBE AND CULUM BROWN

Narrator

Welcome to Talking APEs. In this episode and the next, we'll be diving into the watery world of fishes. This is Part I, where we'll learn about the capacities of fishes, and in Part II, we'll take a look at commercial industries.

We share this planet with a huge number of fishy individuals.

Yet a majority of people know very little about fishes. For example, did you know that some fishes use tools and have culture? Or that fishes aren't actually silent?

Two people who do know a lot about fishes are fish experts, Jonathan Balcombe and Culum Brown.

Professor Culum Brown is an expert on fish cognition and behaviour at Macquarie University. He explains why it's so important to learn about fishes.

Professor Culum Brown

There are so many reasons why fishes are important and why we have to learn about them. I mean, we interact with them in so many different ways. Whether it's through science, whether it's through fisheries, recreational or commercial, whether you keep pets or even if you're just interested in diversity in the world - fishes are really important in all of those contexts, and I would say, of most of the animals on the planet, fish are the ones we know least about, and ironically, they're probably the ones we have the most impact on.

Narrator

We asked Culum if people are generally surprised to learn about his work in researching and raising awareness about fishes.

Professor Culum Brown

Oh yes, I mean if people ask me what I do and I say I work on fish intelligence, they look at me like I've just landed from Mars or something. They're like 'what?' Working on fish is kind of weird, and fish behaviour, and even if I just say 'fish behaviour' people look at me like 'well don't they just swim around in circles?' Which is a really common belief, believe it or not. And then when I start telling them that I work on learning and memory and cognition, intelligence generally - they're absolutely shocked. Shocked, but fascinated. Because people just don't know enough about these things.

Narrator

It turns out that much of what we think we know about fishes is based on common misconceptions. Unfortunately for fishes, there are widespread myths about them being unintelligent and unsophisticated. But perhaps the most concerning is the common myth that fishes are so different from us that they must not feel pain in the same way that we do.

Professor Culum Brown

Well certainly the most important thing is that the reason you feel pain the way you do is because you inherited all those mechanisms from a fishy ancestor. So the reason you feel pain, the reason you get stressed and feel anxiety is because it all came, from an evolutionary perspective, from a fish.

Narrator

When it comes to pain, it's well established that fishes can physically detect pain through receptors in their skin. While this has been known for a long time, there's still debate about whether or not fishes actually suffer.

Professor Culum Brown

The question now is not whether you can detect the painful stimuli with those receptors, but how you deal with that information in a cognitive and in an emotional way…

Narrator

Culum describes this as 'emotional suffering', which is feelings of anxiety, stress or fear that something painful might happen again. For example, if a fish is chased by a predator in a particular place, the fish may be scared the next time they're in that place. Culum argues that there is a strong case that fishes do suffer in this way.

Professor Culum Brown

Fundamentally, what the argument is now about is: on the one side, the doubters say 'well humans feel pain and process emotional pain using this particular part of their brain, which is the cortex.' Doesn't matter what it's called, but the point is, humans do it this way. Everything outside of mammals doesn't have that part of the brain and therefore, they would argue, are incapable of having emotional or cognitive engagement with pain. And by the strict definition then, they can't be suffering. If you look at that argument on face value without any knowledge, it seems reasonable. But if I also said to you, well you know, fishes don't have lungs like humans do, therefore they can't breathe, that is the same argument but it's obviously wrong. And exactly the same logic applies to the argument they're making.

Narrator

A majority of scientists now agree that an animal doesn't need a cortex in order to process pain. They also argue that emotional suffering plays an important role in survival, so it makes sense for fishes to be able to both detect and remember painful experiences, so they can avoid them in the future.

That brings us to another question: what else goes on in a fish's mind?

Professor Culum Brown

So the first thing to know about fish intelligence and the first myth we have to bust - and have done, mind you, we're talking about knowledge that is probably 80 years old now - fish have an excellent memory and we've known that for a really, really long time. And it's certainly no different to the memory of any other vertebrate. Whether it be a cat or your dog or a cow or a sheep or whatever. And in many ways, fish outperform lots and lots of different land-based animals, including rats and cats and dogs, in all sorts of tasks.

Narrator

Dr Jonathan Balcombe agrees, and has written a lot about fish intelligence. Jonathan is an ethologist, which is someone who studies animal behaviour. His book, *What a Fish Knows, (Scientific American / Farrar, 2017)* presents the latest scientific research in an accessible way, so that everyone can learn about the inner lives of fishes.

Dr Jonathan Balcombe

Fish are intelligent. They have minds, they think. They can be creative; they can problem-solve. They're well attuned to other fish and their surroundings. Let me give you an example of something that two different species do to interact. It's a cooperative hunting arrangement between groupers and moray eels. These are both predatory fish on reefs, and they work together, in tandem, to catch prey on the reef. Prey in this case usually being smaller fish. The way it works is the grouper invites the moray eel to go hunting with him or her, using a head shake signal, which is considered a referential gesture, because it has specific meaning. It's referring to - hence referential - it's referring to an event that will occur in a different space and time. That is to say in a few minutes on the reef we will try and catch fish together, and I'm signally my desire to do that with you. And if the moray eel is in the mood, they swim off together like a couple of old buddies - and they probably are old buddies. They probably have done it before, they know each other as individuals and they know how to work together. And then the way it works is because they have different hunting styles, their styles complement each other. So a moray eel can chase a fish into the reef if it tries to hide there, and if the fish escapes into open water, the grouper is waiting. And it's estimated that between the two, they catch up to five times as many fish when they work together than if they hunt individually. So you have referential signaling, which is a communication tool, and coordinated hunting. These are rare and very high level capacities in any animals. So we ought to be pretty impressed by that.

Narrator

Jonathan also discussed a relatively recent discovery in fish intelligence, in relation to a type of fish called a 'cleaner wrasse'.

Dr Jonathan Balcombe

I was going to mention the recent study which showed that cleaner wrasses have mirror self-recognition. That is to say, that when scientists put a gel, a coloured gel dot on the forehead in this case of a cleaner wrasse, and then put the - so the animal can't see the dot on themselves - and then put them in front of a mirror. The wrasse on seeing their reflection in the mirror, after getting used to what a mirror was, would try to remove the dot by say rubbing it on a stone on the bottom. That behaviour indicates passing the mirror self-recognition test and it shows that the fish is recognising the reflection in the mirror as themselves, not as another fish. And, ah, that's considered a very high level form of intelligence. It's only been demonstrated in a few other animals, including great apes, elephants, dolphins, and magpies. However, I do want to add, it's been demonstrated in ants as well. So, this is an example of how the mysteries of animal intelligence often confound us. And we so underestimate animals of all stripes, and they do much more than we used to think they did.

Narrator

Something else that has been underestimated is the use of tools. It was once thought that only humans were smart enough to use tools, but now we know that a wide range of animals also manipulate objects for their benefit.

Dr Jonathan Balcombe

… the definition of tool-use is widely applicable to a huge range of animals and fishes are just one of many examples. So fishes do all sorts of weird and wonderful things. They often use water as a tool, in the same way that we might hose down our driveway to get the sand off it or what have you, fishes do that kind of thing underwater all the time. They take gulps of water, they squirt out water, and blow away sand and detritus when they're looking for food. A classic example is archerfish. They actually squirt water out of the surface through the air, and hit insects - terrestrial insects - in the foliage above the water. Amazing skills. So again, using water as a tool. And we found that tuskfish in the Great Barrier Reef were using anvils underwater to smash open clams. And since that finding, it would be fair to say that six or seven other species of tuskfish from all around the world have been discovered doing this kind of behaviour regularly. It's just what they do. So there are middens of broken shells around some of these anvils they prefer to use in the wild. So I think it'd be fair to say that we had this naïve assumption as humans that tool-use was kind of unique to us, and then somebody thought, well you've got to have a history - where did it come from? Of course they looked at the primates. Now we realise that it's pretty much a universal thing. There's hardly a species left that hasn't been discovered using tools.

Narrator

Fishes have even been found using tools for communication, like tapping a pebble against glass to get someone's attention.

Contrary to the popular belief that fishes are silent, fishes actually have more ways of producing sounds than any other vertebrate group. To make noise, they can grate their teeth, rub their bones or gills together, vibrate their swim bladders, grunt, groan, chirp or even purr.

Dr Jonathan Balcombe

The other, one of my favourite fish facts, that I wanted to share involves farting by herrings. We don't usually think of fishes as having flatulence, but herrings actually have been found to release bubbles from their little rear ends, particularly at night. And it makes an audible sound, the playful scientists who studied this called it the Frequent Repetitive Ticks - I'll let you do the acronym for that. And with these sounds, they are conveying, communicating information about whether it's time to move somewhere else because it's getting dark and predators are going to come out. So it's sort of a collective communication system that they seem to use.

Narrator

Fishes have been found to cooperate in many situations, some of which come with a complicated set of social rules.

Dr Jonathan Balcombe

… The cleaner wrasse, which is a three or four-inch-long fish, a very small fish of reefs, is an incredible creature that has very complex relationships with so called 'client' fish. That is, fishes of many species that will line up to wait their turn to be serviced by the cleaner wrasse on the fish. The wrasses deliver a cleaning service, a little bit like a barber delivers a hair-cutting service, and the clients wait their turn and then they swim up to the station, where one or two or more cleaners will fuss over them, pluck parasites from their skin, remove sloughing skin and algae and the like. The clients will cooperate by opening their mouths and their gills. And the cleaners will go in there to inspect them and remove parasites. So it's a classic mutualism, it's a symbiosis - that is to say both kinds of fish benefit. The cleaners get food that they remove from their clients and the clients get a parasite-removal service and a spa treatment. So everybody's happy. And the cleaners are keeping track of these clients. They know how long it's been since they last visited and they have a number of intelligences that have been demonstrated.

Narrator

Studies have shown that cleaner wrasses can service thousands of clients each day, and remember long lists of individual clients. With such a great memory, it's fair to say that fishes can accumulate a lot of specialized information in their lifetimes.

Dr Jonathan Balcombe

… the new record for longevity in a vertebrate, that is the length of life, is now held by the Greenland shark. Individuals of which have been found to live - the maximum recorded is 392 years - which suggests that, sadly, that individual was caught in a fisherman's net apparently still alive and well and healthy - well, certainly alive and healthy - so we can assume that they can live to at least 400 years. That to me is a pretty stunning achievement. And you just have to wonder how much knowledge and experience a 400-year-old Greenland shark has accumulated over that lengthy life span.

Narrator

Much of the information that older fishes have accumulated is passed onto younger generations, as a form of cultural heritage. This kind of information can't be genetically inherited, but rather has to be learned from older fishes. For example, certain populations of fishes will often use the same migratory routes and breeding grounds for generations, based purely on social or cultural traditions.

Professor Culum Brown

So we know, for example, particularly with movement and migration, the locations of breeding and feeding grounds - these are really common contexts in which cultural or social information is really, really important. And in fact, one of the reasons why we think that fish populations are collapsing is because when we fish we take out the big individuals, and it's those big individuals that have that sort of cultural knowledge. So you'll notice that there are several papers, for example, that show that the breeding grounds of Atlantic cod and things like this has changed, and one of the reasons we think they've changed is because the cultural information has been lost from the population. They no longer know where the best places to breed and feed are. So that obviously superimposes a pressure on populations above and beyond the fishing pressure that we're already inducing, which is a double whammy effectively, in terms of the longevity and expectations and health of fish populations.

Narrator

Fishes face all kinds of stresses from humans, on account of just how much we use them in everyday life.

Dr Jonathan Balcombe

It's so important that people learn about fishes and what they can do, and the fact that they're not just alive, they have lives. And that's because we have a pretty awful relationship with them as a whole. We kill anywhere from several hundred billion a year to possibly as many as one to two trillion a year. The numbers are just hard to imagine. If you lined every fish that we kill every year end to end, then they would reach from the Earth to the sun and back and you'd still have a couple of hundred billion left to spare. So the numbers are astronomical, literally, and we could do a lot better by them. The methods that we catch them and kill them - nets, hooks, trawlers - are pretty awful. Suffocation, crushing, bleeding to death - they're not nice ways to die. So we have a very, very troubled, problematic relationship with fish and I think one of the first steps to improving our relations with them is to understand them and know them better, and realise that they have lives that matter to them, not just to us.

Narrator

With so many individual fish being caught or farmed, it's extremely important that we learn as much as we can about the sentience and capacities of fishes.

Professor Culum Brown

Well I think it'd be fair to say that we've known that fish are probably just as intelligent as most other terrestrial animals for a really long time. And most of the literature that I talk to and refer to is way over 10 years old - some of it 20, 30 years old. Certainly the discovery of pain receptors in fishes - that was 16, 17 years ago. And not much has really changed in that time. So one of the big things that I'm really keen on is having that more widely broadcast. Things have shifted, especially in the last 20 years. We understand a lot more about how smart fish are, we understand how their pain reception works, that they have pain receptors, that they have all these emotional capabilities similar to the rest of the vertebrates. And one of the things that really is important about that is that we need to start treating fish in the same way as we do other animals. That's fundamentally the implications for all of this work.

PART II: CAT DOREY

Narrator

Welcome to Part II of our podcast about fishes. Now that we've learned about their capacities, we'll take a look at how fishes are used in commercial industries.

Dr Cat Dorey is an expert on commercial fish industries. She's been working on the topic for 16 years, advising various organisations and governments about fish, fisheries and aquaculture.

To start off, Cat explains just how much we engage with fishes in everyday life.

Dr Cat Dorey

Okay, so there are a lot of different ways we use or interact with fish. The first one, for example is, we use them as pets. They're actually the most common pet in terms of numbers, and they're also the third highest popular pet if you look at it in terms of the number of owners. So after dogs and cats, fish are the most popular pet for people. We interact with them through different types of recreation, so snorkelling and diving, but also through recreational fishing. So people just going out on the weekends with their fishing rods is another way to interact with fish. We use them in scientific research - people might be surprised to know that they're actually the third most commonly used research animal after rats and mice, so we do a whole variety of experiments in scientific research on fish. And I guess the biggest way we interact with fish is for our food and livelihoods.

Narrator

Fishes make up the vast majority of all animals killed for food. Although fishing has been around for a long time, the rise of technology means that commercial fishing and fish farming has developed to operate on a huge scale today.

Dr Cat Dorey

So individual fish - it's quite hard for us to figure out how many individual fish are caught, because all of the landings and the production are in terms of weight. But we have estimated that as many as around 2.3 trillion fish are killed each year by commercial fishing, and that's just the ones that are landed and officially reported. There's probably a whole lot more that are also caught as by-catch and then thrown away. We don't count what's caught in recreational fishing and some countries don't really count the artisanal catches - so the catches where small villages might just

be catching fish for their own families and they're not trading those fish. So, it's at least 2.3 trillion individual fish a year but probably considerably more. And then when you look at aquaculture that's probably another somewhere between 48 to 160 billion. So just to remind you that trillion is twelve zeros, and billion is nine zeros, so that's an awful lot of individual fish. And if you compare that - we also kill a lot of other animals to eat - every year we kill about 75 billion birds like chickens and mammals that we eat. So compare that to fish, it's a lot more fish that we kill and eat than other animals.

Narrator

This significant number of fishes are either caught from the wild, in what is commonly referred to as 'wild capture', or farmed in fish farms.

Dr Cat Dorey

So, wild capture is basically fishing. It's taking, going to rivers or ponds or lakes or out into the ocean, and using different ways to catch fish and pull them out of the water... There are many different methods to how we can catch fish. Broadly it tends to be either using some kind of fishing line and hook, or some kind of net, but within those categories there's a lot of different ways to do it.

Narrator

You might have heard of some of these methods, which include pole-and-line, long-line fishing, bottom trawling and purse-seining. Each of these methods pose serious animal welfare issues, for both the trillions of targeted individuals and those unintentionally caught. For example, some fishes may be pursued to exhaustion, suffocate or suffer from decompression when they are raised from deep water. Others may be crushed under the weight of other fishes in nets. Fishes caught on hooks, which may pierce their faces or bodies, are often left for hours, unable to escape other predators.

In addition to these welfare issues, wild capture also poses significant environmental concerns.

Dr Cat Dorey

So the three main impacts on the environment from fishing are first of all over-fishing of the target species. The fish that we want to take, we just take too many of them and the populations just can't reproduce fast enough to replace the fish that we take. We also take a lot of fish and other marine species that we don't want. So it's sometimes called by-catch. But it's basically everything from small juvenile fish that are too small to sell, to fish species that people don't want to eat, to things like sea turtles, sea birds, dolphins, anything else that swims in the sea can get killed by fishing. And the last one is fishing methods that use trawl nets that drag them along the sea bed. That destroys anything that might be on the sea bed, so that can be sponges and corals and crustaceans – anything living on the sea bed can get crushed and killed by bottom-trawling.

Narrator

Even as wild populations decline, the global demand for fish is still growing. To keep up with this demand, industries have turned to fish farming, which is also called aquaculture. Today, more fish are produced through aquaculture for human consumption than those that are caught through wild capture.

Dr Cat Dorey

Aquaculture basically includes all kinds of farming that happens in the water. So that's farming of fish, but it's also farming of things like seaweed. So here we're talking specifically about farming fish. And there's a lot different ways to farm fish, like there are a lot of different ways to catch them out of the ocean. So some fish are farmed on land - so that might be in large ponds or channels that have been created near rivers. And the water is usually supplied by a river or a stream. Or it could be in a large cage or kind of like a large net in a bay or an estuary or out at sea.

The main problem with aquaculture from the perspective of fish is the particularly intensive commercial production, because they're very focused on just producing massive numbers of fish to eat and they're not very concerned with the welfare and the lives of the fish. So fish are often grown in a situation which is very, very different to how they would live in the wild. It's hard for them to express their normal behaviours. Some of the key issues with farming is overcrowding, because farms want to produce as much fish as they can, they tend to try and grow as many fish in a small area as they can. And that's a very stressful situation for fish, particularly those that don't like to live so close to other fish. It means that there tends to be less oxygen in the water, there's a lot more waste – so waste from uneaten food, or waste from fish poo. And when fish are stressed, they can be very aggressive so they can fight each other so fish get injured more easily and they can also get depressed. We've recently discovered that fish get depressed just like human beings do when they're put into a constantly stressful situation. And there are fish that just give up on life and will float near the top of a cage and not eat properly and they barely grow, because they're in an extremely depressed situation.

Narrator

In terms of environmental impacts, aquaculture produces a huge amount of waste and can contaminate local water systems. Fish farms are also often responsible for disease and parasite outbreaks, which can spread to wild fish populations. Additionally, some farms rely on capturing juvenile fish from the wild to put into aquaculture, or alternatively, use wild caught fish to feed farmed fishes.

Unfortunately, these industries have almost no rules or regulations about fish welfare. Fish are even excluded from the definition of 'animal' under the animal protection laws in some Australian states. The result of all this is that fish are often entirely unprotected.

What do you think? Does our treatment of fish in commercial industries reflect what we know about them?