

Fishes feigning death

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2007

Possums are not the only animals that “play possum”. Acting as though dead has been observed in insects, frogs, reptiles (especially snakes), birds (a lot of studies have been done on chickens), and mammals (squirrels, foxes, and, of course, possums). The behaviour is usually expressed when the animal is caught by a predator, or firmly grabbed by a person. The animal goes limp and apparently lifeless. It can be prodded without eliciting any reaction. Yet the animal has not fainted, because neurobiological recordings show that the brain of an animal feigning death is just as active as when fully conscious. And indeed, if the predator or person moves away, the animal “miraculously” revives and escapes.

To explain why this behaviour has evolved, it has often been pointed out that many predators stop mauling their prey when they can plainly see that it is dead, and in the ensuing moments of inattention, or if the greedy predator temporarily moves away to catch another victim, the faker might make good its escape. It is a reasonable explanation, but we still don't know if it is true. Predatory acts are hard to witness in nature, and those that involve death-feigning prey are harder still. Many researchers abstain from using the expression “death-feigning” – they say it implies a function that has not been proven. Instead they resort to the more clinical terms “tonic immobility”, “thanatosis”, or “animal hypnosis”.

Death feigning is not unknown in the fish world. Hereafter are a few examples.

Tonic immobility in sharks and other elasmobranches

Next time you get a chance, grab a shark, turn it onto its back, and restrain it by hand. Chances are that after a few seconds (usually less than a minute) the shark will go limp and start breathing smoothly and deeply. It will remain in this cataleptic state for several minutes. If left alone, the fish will eventually right itself and swim away. Such a response has been observed in many species of cartilaginous fish, such as the tiger shark, lemon shark, smooth dogfish, spiny dogfish, leopard shark, whitetip reef shark, blacktip reef shark, Caribbean reef shark, swellshark, sandbar shark, California round ray, shovelnose guitarfish, clearnose skate, cownose ray, and southern stingray.¹

Tonic immobility in sharks is such a reliable behaviour that it can be used as a form of anaesthesia, either in the field² or in aquaria,³ prior to minor surgery or gross examination. However, caution must be used in the case of some species that experience adverse effects when the tonic immobility is maintained for too long.⁴

Why sharks should go limp when they are inverted is unclear. The classical explanation of playing possum in front of a predator has been put forward, as has the notion that immobility during copulation (often a violent affair in sharks) might expedite things.

Tonic immobility in bony fishes

Many bony fishes also go limp when they are restrained on their backs: goldfish,⁵ trout, rudd, tench, brown bullhead, medaka, paradise fish, and topminnow, to name a few.⁶ Some anglers use this response to good effect: when removing a hook from a fish that is to be released, they invert the fish and tuck it under one arm, thereby quieting it. A lip grip can also immobilize some fishes.

Oscars (*Astronotus ocellatus*) are big predatory fish, but sometimes they appear downright wimpy. When stressed (when you clean their aquarium, for example), they seem to go into shock. They lie on their side, stop moving their fins, start to breathe more slowly and deeply, and lose colour. Maybe they simply become inactive to elude the attention of a perceived predator, but the fact that they remain motionless even when your hand nudges them suggests tonic immobility.⁷ Convict tangs, *Acanthurus triostegus*, show a similar behaviour in the field.⁸

A new way to induce tonic immobility

In 2005, researchers Rufus Wells, Heather McNeil and John MacDonald, from the University of Auckland in New Zealand, reported a new method for inducing tonic immobility in fish. When they inserted a tube into the buccal cavity and forced a vigorous flow of water through the gills, they observed that all fish from all of the 22 species they tested went limp and remained that way for as long as the flow of water was kept up (up to 32 h in one case). Revival was instantaneous once the flow was stopped, and the fish seemed none the worse for wear. The species included short-finned eels, kahawai, leather jackets, lowly trevally, blue maomao, epaulette shark, blue cod, sand flounder, rainbow trout, and slimy mackerel. No particular advantage for the fish comes to mind, but perhaps the technique could be used to calm fish down during live transport.⁹

Death-feigning as a hunting strategy

Some bestiaries from medieval times depict a fox lying on its side, its eyes closed, its lower jaw hanging open, looking dead. It is surrounded by scavenging birds. The next illustration shows the fox leaping up and catching one of the birds. The possibility that foxes would be cunning enough to sham death in order to lure birds within reach was originally dismissed as a folk tale, but in 1961 a Russian film-maker managed to record a fox in the act. A crow was the hapless victim.¹⁰

For a while this remained the only example of death-feigning as a confirmed hunting strategy in the animal world. Then in 1981 Ken McKaye published a paper on the predatory cichlid *Nimbochromis* (= *Haplochromis*) *livingstonii*. Diving in Lake Malawi, McKaye observed some *N. livingstonii* that were stationary with their abdomen on or near sand, and that then dropped onto their sides. In a variant behaviour, some *N. livingstonii* fell through the water column and landed onto their side. The fish then remained immobile for several minutes. Their colour pattern was blotchy and suggested a rotting carcass. Small inquisitive cichlids of other species often came near (a few going so far as to nip the “corpse”) and they were suddenly attacked by the deceitful predator. About a third of the death-feigning performances led to an attack, and about one-sixth of the attacks were successful. After an attack the predators moved away to other fish aggregations nearby and played dead again. On average, individual *N. livingstonii* feigned death 7 times per 30-minute watch.¹¹

In 2005, death feigning as a hunting strategy was reported in another cichlid, the yellow jacket *Parachromis friedrichsthalii*. Working with a population that lived in a cenote (a water-filled sinkhole) on the Yucatan Peninsula, Michael Tobler observed many individual *P. friedrichsthalii* that repeatedly turned over onto their sides at the bottom of the sinkhole and remained immobile for as long as 15 minutes. Twice, Tobler witnessed an attack on small mollies that came too close to the head of the pseudo-cadavers.¹²

The comb grouper *Mycteroperca acutirostris* may also be an actor, though in this case the behaviour should be called dying or illness feigning, rather than death feigning, because while lying on its side the fish occasionally undulates its body. In 1999, off the coast of southeastern Brazil, Fernando Gibran saw one juvenile comb grouper use this tactic to catch 5 small prey in 15 minutes. The behaviour must be uncommon, however, as only one juvenile out of 522 observed over 60 h of diving ever performed it. Perhaps the fish was truly sick, but not sick enough to refuse a passing snack.¹³

¹ Whitman, P.A., Marshall, J.A., and Keller, E.C.Jr., 1986, Tonic immobility in the smooth dogfish shark, *Mustelus canis* (Pisces, Carcharhinidae), *Copeia* 1986, 829-832; Watsky, M.A., and Gruber, S.H., 1990, Induction and duration of tonic immobility in the lemon shark, *Negaprion brevirostris*, *Fish Physiology and Biochemistry* 8, 207-210; Davie, P.S., Franklin, C.E., and Grigg, G.C., 1993, Blood pressure and heart rate during tonic immobility in the black tipped reef shark, *Carcharhinus melanoptera*, *Fish Physiology and Biochemistry* 12, 95-100; Henningsen, A.D., 1994, Tonic immobility in 12 elasmobranchs : Use as an aid in captive husbandry, *Zoo Biology* 13, 325-332.

² Heithaus, M.R., Dill, L.M., Marshall, G.J., and Buhleier, B., 2002, Habitat use and foraging behavior of tiger sharks (*Galeocerdo cuvier*) in a seagrass ecosystem, *Marine Biology* 140, 237-248; Holland, K.N., Wetherbee, B.M., owe, C.G., and Meyer, C.G., 1999, Movements of tiger sharks (*Galeocerdo cuvier*) in coastal Hawaiian waters, *Marine Biology* 134, 665-673; Watsky, M.A., and Gruber, S.H., 1990, Induction and duration of tonic immobility in the lemon shark, *Negaprion brevirostris*, *Fish Physiology and Biochemistry* 8, 207-210.

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- ³ Henningsen, A.D., 1994, Tonic immobility in 12 elasmobranchs : Use as an aid in captive husbandry, *Zoo Biology* 13, 325-332.
- ⁴ Murray, M.J., 2002, Fish surgery, *Seminars in avian and exotic pet medicine* 11, 246-257.
- ⁵ Richardson, E.J., Shumaker, M.J., and Harvey, E.R., 1977, The effects of stimulus presentation during cataleptic, restrained, and free swimming states on avoidance conditioning of goldfish (*Carassius auratus*), *The Psychological Record* 27, 63-75; Lefebvre, L., and Sabourin, M., 1977, Effects of spaced and massed repeated elicitation on tonic immobility in the goldfish (*Carassius auratus*), *Behavioral Biology* 21, 300-305.
- ⁶ See Table 2 in: Whitman, P.A., Marshall, J.A., and Keller, E.C.Jr., 1986, Tonic immobility in the smooth dogfish shark, *Mustelus canis* (Pisces, Carcharhinidae), *Copeia* 1986, 829-832.
- ⁷ I've seen my own oscars do this. For a more formal study, see: Crawford, F.T., 1977, Induction and duration of tonic immobility, *The Psychological Record* 27, 89-107.
- ⁸ Howe, J.C., 1991, Field observations of death feigning in the convict tang, *Acanthurus triostegus* (Linnaeus), with comments on the nocturnal color pattern in juvenile specimens, *Journal of Aquaculture and Aquatic Sciences* 6: 13-15.
- ⁹ Wells, R.M.G., McNeil, H., and MacDonald, J.A., 2005, Fish hypnosis: induction of an atonic immobility reflex, *Marine and Freshwater Behaviour and Physiology* 38, 71-78.
- ¹⁰ Page 82 in: Morris, D., 1990, *Animalwatching: A field guide to animal behaviour*, Jonathan Cape, London.
- ¹¹ McKaye, K.R., 1981, Field observation on death feigning: a unique hunting behavior by the predatory cichlid, *Haplochromis livingstonii*, of Lake Malawi, *Environmental Biology of Fishes* 6, 361-365. Another African cichlid, *Lamprologus lemairii*, from Lake Tanganyika, has been reported to do the same thing: Lucanus, O., 1998, Darwin's pond: Malawi and Tanganyika, *Tropical Fish Hobbyist* 47, 150-154.
- ¹² Tobler, M., 2005, Feigning death in the Central American cichlid *Parachromis friedrichsthalii*, *Journal of Fish Biology* 66, 877-881.
- ¹³ Gibran, F.Z., 2004, Dying or illness feigning : An unreported feeding tactic of the comb grouper *Mycteroperca acutirostris* (Serranidae) from the Southwest Atlantic, *Copeia* 2004, 403-405.