# What trade deals can teach us about the animal kingdom

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From Brexit to Donald Trump's first acts as US president, the news has

been full of discussion about trade agreements recently. But trade agreements aren't just relevant to human politics. Exchange of commodities happens in the animal world too, both within and between species. And by applying theories derived from human economics, we can understand why some animals behave as they do.

One example of trade between animals is the way some females exchange sex for a nice present. Among the *Pisaura mirabilis* spiders, females are much more likely to give in to a suitor if he brings her a nuptial gift: a tasty insect prey wrapped in spider silk. While the female is preoccupied unwrapping and eating the gift, the male can start mating with her. In the spider world it's usually a good idea for males to mate with females that are busy doing something else, like feeding, to avoid the female just eating him instead.

But it's cheaper for him to just bring her a fake gift: a piece of something inedible, such as a plant seed, also wrapped in silk. The nice wrapping often still convinces her to copulate. But she gives him a worse deal. As she spends less time preoccupied with the gift, he has much less time to insert his sex organs. The message to the males is clear: if you bring a more expensive present, you'll be paid with better sex.

Animal trade goes beyond mating pairs, however. Some biological systems can be understood as a marketplace where the concepts of supply and demand from economic theory govern the prices paid for traded commodities. This is the case at cleaning stations in the Great Barrier Reef, where cleaner fish, *Labroides dimidiatus*, provide their client fish with a parasite-removal service in return for the food reward that are the parasites.

Cleaner fish quickly learn to treat their more choosy customers to a better service. Some clients have small territories and therefore access to only one station, while others move about more and have more options

available. This means they can afford to shop around for the best deal and be choosy. Cleaners are sure to attend to these choosy clients first, happily making other clients wait around, as they learn that clients will accept the bad deal of waiting when having nowhere else to go to get de-bugged.

It also turns out that animal societies where individuals breed cooperatively can be viewed as biological market places.Many mammals are cooperative breeders, including meerkats and mongooses, as are some birds, fish and insects. Their social groups consist of a single breeding pair, or a single breeding dominant female, and a number of subordinate helpers.

Subordinates care for the offspring of the dominants, bring food and help defend against predators, all while agreeing to not breed themselves. Interestingly, subordinate helpers in these kinds of societies are all perfectly capable of reproducing, but they choose not to.

## Division of labour

One of the great questions in behavioural ecology is this: why do these helpers stay in the group and help someone else to reproduce? After all, evolution favours selfish strategies of passing on one's own genetic material. Biological market theory proposes that subordinates trade their services for the benefits of group membership. The amount of help they provide should then be affected by the supply and demand for help in the population.

Paper wasps, *Polistes dominula*, also live as cooperative breeders. In return for the hard work of building the nest and collecting food for the precious larvae babies of the dominant wasp, a subordinate receives the small chance of eventually becoming the dominant herself or perhaps sneaking in a few of her own eggs among the colony's brood. To show

that this exchange of behaviours is a biological market place, we need to show that changes in the supply and demand of helping behaviour affects the price subordinates pay for group membership.

In a new large field study in southern Spain, my colleagues and I tracked thousands of wasps from hundreds of nests over three months. We increased the supply of outside options available to subordinate wasps by freeing up suitable nesting spots and releasing extra potential nesting partners.

Subordinates now had more options available for leaving their current group and starting up new groups with others, allowing them to be more choosy as to which group to belong to. We found that changing the state of the market in this way clearly affected cooperative behaviour within groups: the subordinates foraged less for their group. Competition for help in the population had likely intensified, so the dominant breeders had to accept a worse deal to retain their subordinate trading partners.

Market theory is far from the only concept from economics that offer valuable insights into biological systems. In fact, Charles Darwin himself found inspiration in economics when formulating his theory of evolution. But if biologists can learn from the emerging properties of human markets, perhaps humans can also learn from the biological systems. For example, if we cut the ties to major trading partners, will this narrow down our options for trade? If so, we will end up having to accept worse deals. Which would be a pertinent lesson for today's politicians.

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