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Homosexual selection. By: Douglas, Kate. New Scientist, 12/5/2009, Vol. 204 Issue 2737, p48-51, 4p; Abstract: The article discusses research on same-sex liaisons in the animal kingdom. It references a study by Marlene Zuk and Nathan Bailey, published in "Trends in Evolution and Ecology." Study authors suggest that same-sex sexual behavior is relevant to the evolution of species where it is common. They also describe the same-sex behavior traits in Oahu colony and Laysan albatross.; (*AN 46710962*)

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Homosexual selection

Gay behaviour is so common in nature it could be a neglected force in evolution

NOT long ago, the news was full of reports about two male Humboldt penguins at a zoo in Germany that adopted an egg, hatched it and reared the chick together. It seems like every time you turn around, the media spotlight has fallen on another example of same-sex liaisons in the animal kingdom.

In the past few years, the ubiquity of such behaviour has become apparent. This summer evolutionary biologists Marlene Zuk and Nathan Bailey from the University of California, Riverside, published a paper on the subject that included examples from dozens of species ranging from dung flies and woodpeckers to bison and macaques.

That is just the beginning of the story. The burning question is why same-sex behaviour would evolve at all when it runs counter to evolutionary principles. But does it? In fact there are many good reasons for same-sex sexual behaviour. What's more, Zuk and Bailey suggest that in a species where it is common, it is an important driving force in evolution.

Although terms such as homosexual, gay and transgender are commonly used by the mass media, and even by some ethologists, Bailey and Zuk believe you shouldn't extend these descriptors of human sexuality to animals. "It's not simply that they are burdened with the weight of social, moral and political implications, which can obscure objective scientific study," says Bailey. "The problem is that while we can observe the sexual behaviour of animals, we often have little inkling about what motivates it." Besides, as far as we know animals do not form sexual self-identities in the way humans do, he adds. That is why he and Zuk prefer to use the more objective term "same-sex sexual behaviour", which they define as behaviours found in two animals of the same sex that you would find in opposite-sex pairs during courtship, copulation or parenting.

Same-sex behaviour is not necessarily synonymous with same-sex preferences, which have been observed in only a handful of animals. In 2005, for example, Hans Van Gossum from the University of Antwerp in Belgium and colleagues found that damselflies kept in all-male groups subsequently preferred to court other males rather than females, though this preference could be reversed simply by housing them with females (Biological Letters, vol 1, p 268).

Neither can you necessarily infer anything about sexual orientation from same-sex behaviour. Orientation is tricky to establish because it requires information about the consistency of partner preferences over a long period of time. Examples are thin on the ground, either because they do not exist or because they have yet to be discovered. The most notable include some male bighorn sheep that have been observed to predominantly mount other males throughout their lives, and female Laysan albatrosses - more of which later.

Nevertheless, even narrowing the scope to sexual behaviours rather than preferences or orientation leaves a huge evolutionary puzzle. Why would individuals expend time and energy in activities that fail to increase reproductive success? Could the sheer numbers engaging in same-sex behaviour mean that it has survival benefits after all?

In 2008, Sara Lewis at Tufts University in Medford, Massachusetts, and colleagues decided to address this question (Journal of Evolutionary Biology, vol 22, p 60). Red flour beetles are a scourge of the pantry, but they are up to more in there than just infesting your food. Sexually receptive females locate males by homing in on airborne pheromones released by the males, but these same signals also occasionally attract other males. The mounting male clambers on top of his quarry and extrudes his genitals, sometimes transferring sperm to the hind end of his partner. Might these male-male copulations provide some benefit to the participants? The researchers designed an experiment to test three possibilities: that males establish social dominance by mounting other males, that males who mount other males gain practice for later sexual encounters with females, and finally, that mounting males transfer sperm onto the other males, who then inadvertently inseminate a female with it later on. Only this last idea stood up: they found that a small proportion of offspring were fathered by males who had never mated with the mothers but had mounted another male that had subsequently copulated with the female.

Other research groups have tested the evolutionary underpinnings of same-sex behaviour in different species and come up with a variety of explanations. Zuk and Bailey were intrigued by the idea that there might be common factors in these various theories. Their paper brings all the evidence together for the first time and concludes that there are many evolutionary origins of same-sex sexual behaviour (Trends in Evolution and Ecology, vol 24, p 439).

First, there are the adaptive hypotheses, which provide an explanation for same-sex behaviour that would boost the biological fitness of one or more of the individuals involved. For example, several species, including bottlenose dolphins, seem to use same-sex behaviours to promote social bonding. Others may have evolved them as a form of intrasexual conflict. Indirect insemination, as in the flour beetle, provides a third possible adaptive advantage. Then there is the practice hypothesis, that individuals are honing their skills for mating, which seems to hold good for male fruit flies at least.

Several other adaptive explanations have been invoked to explain same-sex behaviour in humans, including kin selection - helping to further the genes you share with close family members - and "over-dominance" - the idea that certain genes somehow increase fitness in individuals who possess a single copy of them but are associated with same-sex behaviour in people with two copies. Then there is "sexually antagonistic selection" - the idea that alleles promoting same-sex behaviour in men are favoured by selection because they increase the reproductive chances of their daughters.

There are also various non-adaptive explanations. Mistaken identity could indeed be one cause. Van Gossum's damselflies exemplify another idea, known as the prisoner effect, in which depriving individuals of interaction with the opposite sex prompts them to mate with members of their own sex. Then there is the evolutionary by-product hypothesis - selection for some other independent trait, such as high sexual responsiveness, might make individuals more likely to participate in same-sex sexual behaviour. It has also been suggested that same-sex behaviours appear when organisms are imperfectly adapted to their environment.

Even without further investigation of these hypotheses there is enough evidence to conclude that same-sex sexual behaviour has a wide variety of origins. Zuk and Bailey were also struck by the idea that evolutionary biologists have been missing an important piece of the puzzle. Regardless of why same-sex behaviour exists, if it is common enough, it is likely to affect social interactions within a population, change the behaviour of other individuals, and even nudge the evolution of other traits in a different direction. "Researchers have not studied the evolutionary consequences of same-sex behaviour, but we found some tantalising examples that suggest it might be worthwhile to do so," says Bailey.

Take the desert locust, famous for forming dense, apocalyptic swarms. In the midst of this orgiastic chaos, males are sometimes mounted by other males, and so miss the opportunity to copulate with females or simply to feed. However, they can minimise the chances of this happening by releasing large amounts of a pheromone called phenylacetonitrile. The mere possibility of same-sex sexual behaviour, for whatever reason, might have favoured the evolution of males that release lots of phenylacetonitrile at just the right moment to ward off other males and prevent same-sex mounting.

Then there is the example of the common toad. A male toad has to be persuasive to get a female to mate with him - in fact, he has to squeeze the eggs right out of her before he can fertilise them. Males accomplish this feat by embracing the object of their affection in a tight mating "hug" called amplexus. They are evidently not very good at telling females apart from males since they sometimes mistakenly climb onto other males. When this happens, the hapless victim pipes up with a special chirp, only used in this context, which prompts the clasping male to release his vice-like grip. "It would be worth investigating further whether this special 'get off me' chirp owes its existence to the presence of same-sex mounting in this species," says Bailey.

Here are two small examples of physical traits that may have been shaped by same-sex behaviour. If Bailey and Zuk are correct, this could be the tip of the iceberg. They point out that in theory, there are many ways in which same-sex sexual behaviour could affect the evolutionary trajectory of a species. By definition it alters the social environment of a population of animals. Since an individual's social environment affects its success in terms of survival and reproduction, you might expect such changes to influence the speed or direction of evolutionary change.

Take the Laysan albatross. These large, graceful seabirds establish breeding colonies on islands in the Hawaiian archipelago, and recently it emerged that in the Oahu colony over 30 per cent of the nesting pairs consist of two females. Female-female pairings have been observed in other birds, such as California gulls and roseate terns, but never at quite such a high rate. What's more, Lindsay Young from the University of Hawaii found that many of the albatross female-female pairs remain faithful over several years. They engage in mutual preening and even occasionally copulation, and, like female-male pairs, each year they raise a single chick. Both females will have laid a fertilised egg and randomly shunted one aside (Biology Letters, vol 4, p 323).

Changing evolution

The fact that female same-sex bonds accounted for nearly a third of the breeding pairs in the Oahu colony makes for interesting population dynamics, according to Bailey and Zuk, and it prompts the question of what evolutionary consequences the colony might experience as a result. For instance, in colonies where females without a mate remain single, the male gains little by straying from his female partner. Even if he did fertilise the egg of a non-paired female it would not survive as it takes two adults to raise a single chick. In the Oahu colony, though, males that mate with females outside their long-term pair bond might gain an edge over those that do not. "So one evolutionary consequence to keep an eye out for in Laysan albatross populations that have high rates of female-female pairs is the evolution of males that spend more time copulating with females to whom they are not permanently bonded," says Bailey.

From the female perspective there are possible evolutionary consequences too. Consider the procedure for deciding which of the two eggs in a female-female partnership is incubated. It appears to be random: in a population with only opposite-sex pairs, females never need to distinguish their own eggs, so the ability to do so is unlikely to have evolved. But imagine if a genetic mutation arose in one member of a female-female pair that enabled her to distinguish her egg from that laid by her partner, says Bailey. "The mutation would probably spread through the population and tip the dynamics of female-female relationships more towards conflict rather than cooperation."

All this is hypothetical since same-sex behaviour has not been studied from this angle before. Nevertheless, there is no doubt that the prevalence of female-female pairs in the Oahu colony changes the costs and benefits of traits such as extra-pair copulations for males and egg recognition for females. What's more, Bailey points out that the evolutionary consequences might reverberate way beyond this colony. That is because the excess of females in Oahu is a consequence of females having migrated in from elsewhere. By adopting same-sex parenting behaviour, female Laysan albatrosses could escape colonies with dwindling resources and reproduce even when the sex ratio in their adoptive colony is biased against them.

Whether or not same-sex behaviour is an important factor in evolution remains to be seen. "Given its persistence in species in many different animal groups, including humans, viewing it as an evolutionary force in its own right promises to provide a much richer understanding of the evolution of reproductive behaviour," Bailey says. He suggests we could make some fascinating comparisons. Might male-male copulation in species as diverse as flour beetles and dolphins have similar, even predictable, evolutionary consequences? More daringly, could understanding the evolutionary consequences of same-sex interactions in animals help us understand our own evolution?

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By Kate Douglas

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