Scientists explore the evolution of animal homosexuality

May 2 2019, by Juanita Bawagan

Sphen and Magic, two male Gentoo penguins, recently made headlines when they ‘adopted’ an egg. Gentoos are closely related to Adélie penguins, the species Levick first observed in 1911. After the two penguins bonded and began creating

a nest, zookeepers at the Sea Life Sydney Aquarium decided to give them an egg that had been abandoned by a pair of heterosexual penguins in the group. On October 19, 2018, Baby Sphengic was born. Credit: Imperial College London

Imperial researchers are using a new approach to understand why same-sex behaviour is so common across the animal kingdom.

In 1910, a team of scientists set off on the Terra Nova Expedition to explore Antarctica. Among them was George Murray Levick, a zoologist and photographer who would be the first researcher to study the world's largest Adélie penguin colony. He chronicled the animals' daily activities in great detail.

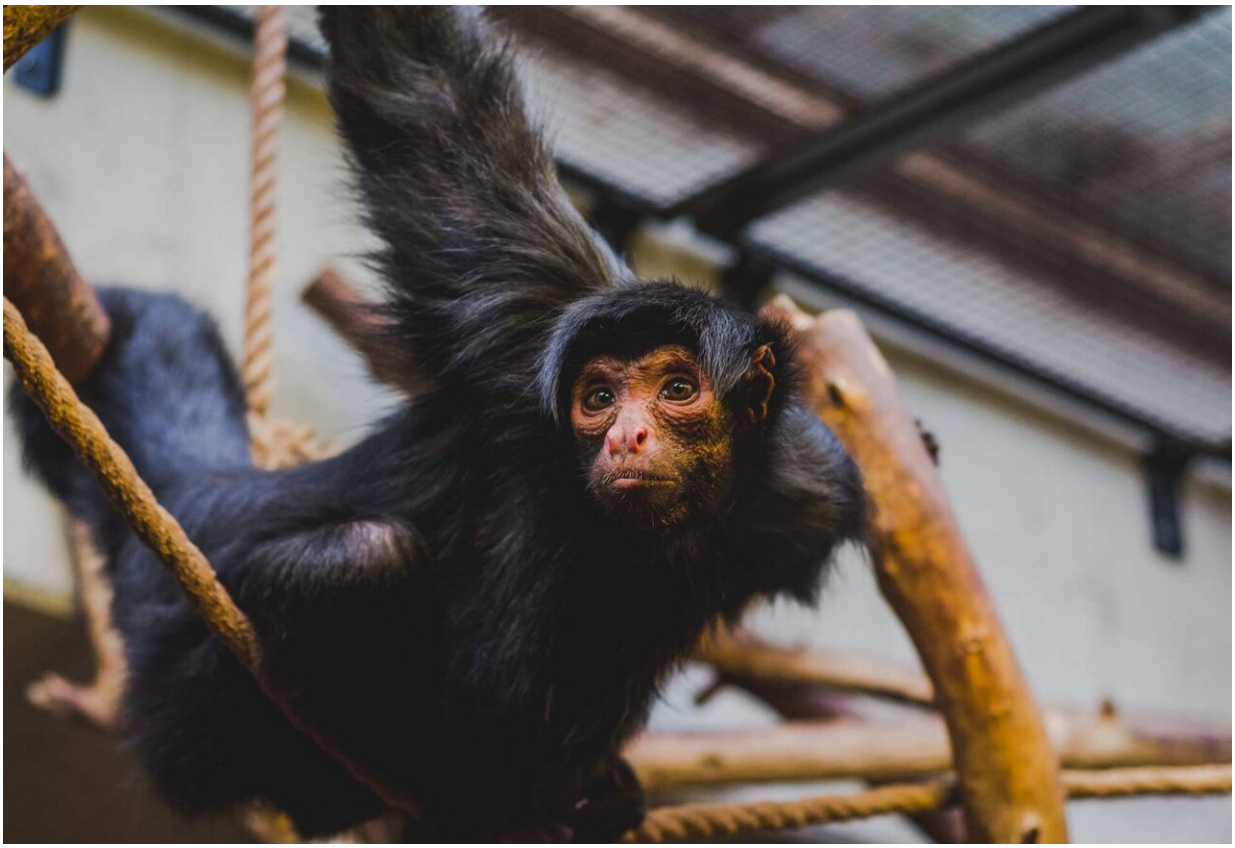
In his notebooks, he described their sexual behaviour, including sex between male birds. However, none of these notes would appear in Levick's published papers. Concerned by the graphic content, he only printed 100 copies of Sexual Habits of the Adélie Penguin to circulate privately. The last remaining copy was recently unearthed providing valuable insights into animal homosexuality research.

But forays into animal homosexuality research long predate Levick, with observations published as far back as the 1700s and 1800s. More than 200 years later, research has moved past some of the taboos those early researchers faced and shown that homosexuality is much more common than previously thought.

Same-sex behaviour ranging from co-parenting to sex has been observed in over 1,000 species with likely many more as researchers begin to look for the behaviour explicitly. Homosexuality is widespread, with bisexuality even more prevalent across species.

Researchers are now going beyond just observing it though, with researchers at Imperial leading the way in unravelling how, and why, homosexuality is found across nature.

Case study: gentoo penguins



Spider monkeys are New World primate species for which homosexual behaviour has not been previously reported. In 2018, the first report of sex between males was recorded. “It’s interesting because there was this kind of premise that because Old World primates are more closely related to humans, you wouldn’t really see this type of behaviour in New World primates, but there they are,” says Clive. This suggests that homosexual activity is not a recent human construct, in cultural or even in evolutionary terms, but instead occurs along many branches on the tree of life. Credit: Shane Rounce via Unsplash

Overturning Darwin's paradox

With this behaviour seen across species from birds and insects to reptiles and mammals – including humans – researchers are trying to understand why.

In the past, homosexual behaviour was often ignored because it supposedly contradicted Darwin's theory of evolution. Scientists argued homosexuality was a sort of 'Darwinian paradox' because it involved sexual behaviour that was non-reproductive. Recent evidence however suggests homosexual behaviour could play important roles in reproduction and evolution.

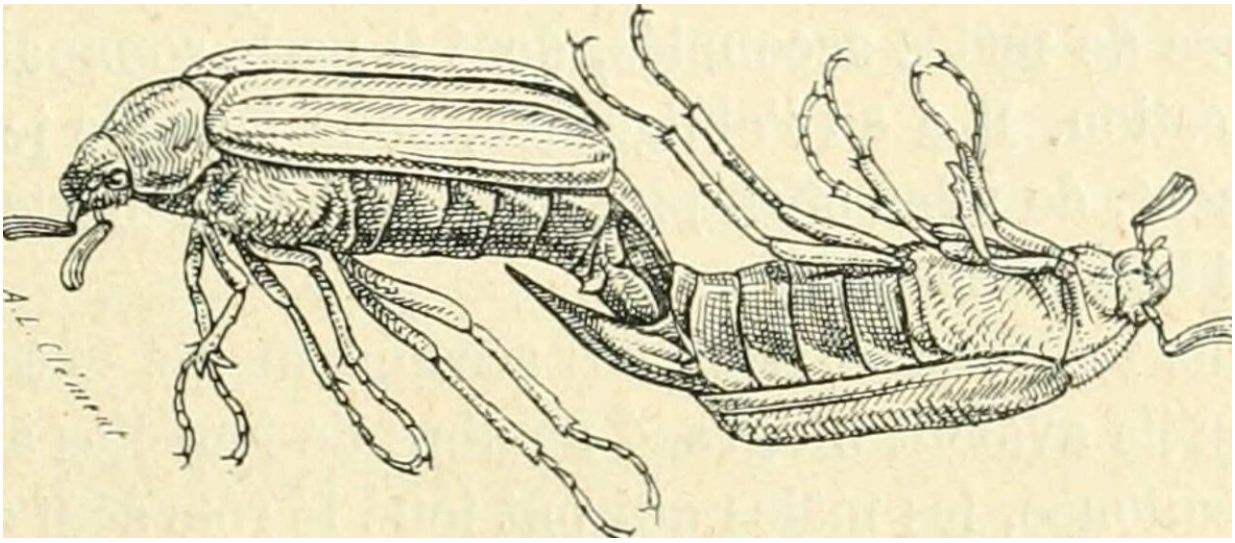
Among the researchers leading the way is Vincent Savolainen, Professor of Organismic Biology at Imperial. Savolainen is a world-renowned evolutionary biologist who approaches many of the same questions Darwin did, but from a contemporary perspective. Savolainen's contributions range from solving Darwin's "abominable mystery" of flowering plants to elucidating how great white sharks evolved to be super-predatory fast-swimmers.

Savolainen explains: "I tackle big evolutionary biology questions. It doesn't really matter what organism, at the end of the day it's all about how genes have evolved either to produce a species or a new behaviour."

The overarching aim of his lab can be summed up with the saying: "Nothing in biology makes sense except in the light of evolution."

Savolainen has turned this philosophy to 'Darwin's paradox'. In 2016, Savolainen started some work on animal homosexuality, beginning with a chapter on the Evolution of Homosexuality. Since then, he has assembled a collaborative team of researchers to examine the question through field work, genomic sequencing and new theoretical models.

Case study: spider monkeys



In 1896, French entomologist Henri Gadeau de Kerville published one of the first scientific illustrations of animal homosexuality. His drawing depicted two male scarab beetles copulating and was part of a wave of descriptions of same-sex behaviour in insects that set the stage for animal observations in the 1900s. Credit: Bulletin de la Société entomologique de France (1896)

Into the wild

On Imperial's Silwood Park campus, Savolainen's Ph.D. student Jackson Clive is spending some of his final days in the lab before he heads out for field work. It will be his second of many months-long trips to observe rhesus macaques in the wild. Female homosexuality has been well studied in Japanese macaques, but Clive's research would examine how homosexual behaviour differs in males and across environments.

These trips are intense in many ways besides the physical challenges of

the bush.

Clive explains: "Behavioural studies take a long time especially for these unpredictable and infrequent behaviours, which includes almost all sexual behaviours. You have to do a lot of sitting around and watching while also being quite alert. It takes quite a lot of effort to recognize these individual primates. In one social group I have to recognize 120 males individually."

Before beginning his Ph.D. research, Clive was studying a family of mountain gorillas in East Africa. He noticed mounting between male gorillas, though that was not the main focus of his research at the time.

"It's just wherever you look. I can give you papers on beetles, spiders, flies, fish, flamingos, geese, bison, deer, gibbons, bats – loads of bats, bats get up to all sorts," he says. "The list is endless."

It's early days for the Imperial research team. Recording homosexual behaviour in the wild and collecting blood samples are the first steps for Clive; the next is sequencing DNA to search for connections between the behaviour and genetic markers.

Case study: scarab beetles

This eastern Australian bat species lives in large groups but are segregated by sex outside of breeding season. As such, many bats are likely ‘seasonally bisexual’. Males and females have been observed in sexual and affectionate same-sex behaviour. The acts are characterized by wrapping their large wings around each other, licking and grooming, and nuzzling their heads in each other’s chests. Credit: Thomas Lipke via Unsplash

Beyond the 'gay gene'

What does animal homosexuality look like biologically? It's hard to say.

In 1993 there was a media frenzy over the discovery of the 'gay gene'. This idea stemmed from a study showing a correlation between genetic marker Xq28 and male homosexuality, although there were statistical uncertainties about some of the findings.

Scientists have successfully modelled other complex or polygenic traits like height. There is not a single 'tall' or 'short'. Instead, height is determined by changes across hundreds of genes in combination with environmental factors.

To understand what gives rise to complex traits and behaviours, researchers must identify where the genetic changes take place and what underlying processes are driving them. Then they can see what this should look like in the real world.The biological and hereditary factors of homosexuality are most certainly not tied to a single gene. Researchers aren't searching for one genetic marker or one cause but a combination of factors that give rise to certain behaviours under specific circumstances.

PhD student Tom Versluys is studying human mate attraction. Credit: Imperial College London

To create models of homosexuality, Savolainen recruited Ewan Flintham as a Ph.D. student in evolutionary biology at Imperial. Flintham previously worked on models for speciation— the formation of new and distinct species in the course of evolution—as well as sexual behaviour in fruit flies.

He says: "We have the capacity to model complex behaviours and pull on massive amounts of data. However, creating a complex model isn't beneficial unless it is modelling a useful concept."

The bisexual advantage

There are many theories about why homosexuality is important for reproduction and evolution. Savolainen has outlined some leading models. One is the "bisexual advantage" model where animals with a more fluid sexuality are more likely to reproduce. Savolainen's lab looks at a range of sexual behaviours from strict heterosexuality to homosexuality. Bisexuality may be "an evolutionary optimum phenotype in many species, including humans," according to Savolainen's review.

Other models consider whether a gene is beneficial for a specific sex. For example, if the gene were 'feminizing' in the sense that it would lead to females having more offspring so it would be passed on in spite of being disadvantageous for a male's own reproduction, i.e. being homosexual. Meanwhile, others posit that homosexuality could also play a role in evolution through co-parenting or helping to raise relatives' offspring. These explanations are not exclusive of one another, and it is

likely that a combination of factors are important for the evolution of homosexuality.

With these new models, researchers can test many theories in combination and vary the data inputs accordingly. The "golden standard" would use the original genetic and behavioural data from the macaque field work and fit them to different theories to see how each could be applied to other populations and animals.

The primates Savolainen's lab is currently studying are of course closely related to humans. Studying non-human primates is helpful because it provides clearer data and separates the behaviour from culture while at the same time offering new insights on human sexuality and evolution.

Case study: grey headed flying boxes

A human connection

Ph.D. student Tom Versluys is looking directly at humans, specifically by studying mate choice in couples. His previous research examined how body-to-limb ratio makes men more attractive. In Savolainen's lab, he's taking a broader and more technical approach. He will create 3-D face models of couples to compare shape, structure, and proportions. Ultimately, the project will combine questionnaires, facial modelling and genetic sequencing to examine similarities between couples and investigate whether mate-choice decisions are being driven by considerations of biological or social compatibility.

Importantly, this will include exploration of homosexual partners in the hope of understanding different mate-choice strategies in reproductive and non-reproductive contexts. Versluys is currently recruiting heterosexual and homosexual couples among Imperial students and staff for his research. If you would like to know how similar you and your

partner are (or would just like 3-D models of your faces), please get in touch with him at tmv3318@ic.ac.uk.

Reframing homosexuality

Versluys says: "Homosexuality is still something that's not always well understood among the scientific community and maybe even more poorly understood among the general population. It's currently being reframed, in our lab and elsewhere, as a normal behaviour rather than something that's abhorrent or problematic."

The hope is that as homosexuality is better understood, research will dispel people's misconceptions. However, many of the historical cultural challenges persist. And despite the acknowledgement of how widespread homosexuality is in nature, researchers have to contend with a dearth of research that should have been built up over decades.

Savolainen explains: "It's still risky and unusual research that is difficult to support through traditional funding routes. We're looking for organizations or individuals that believe in this research and are willing to take that risk."

More information: Ewan O. Flintham et al. Interactions between the sexual identity of the nervous system and the social environment mediate lifespan in Drosophila melanogaster, *Proceedings of the Royal Society B: Biological Sciences* (2018). DOI: 10.1098/rspb.2018.1450

Vincent Savolainen et al. Evolution of Homosexuality, *Encyclopedia of Evolutionary Psychological Science* (2017). DOI: 10.1007/978-3-319-16999-6_3403-1

Thomas M. M. Versluys et al. The influence of leg-to-body ratio, arm-to-body ratio and intra-limb ratio on male human attractiveness, *Royal*

Society Open Science (2018). DOI: 10.1098/rsos.171790