# Population problems and questions for discussion

## The ethics of population studies

***What you need to keep in mind when you're researching populations***

A population study is a scientific investigation that looks at a group of individual plants or animals of the same species living in a given area or habitat.

Biologists, geographers, ecologists and psychologists might use population studies to find out how individuals from a certain species interact with one another and with the environment. For instance, a marine biologist who wants to find out how a species of fish is affected by water pollution might use a population study to find out how many of the fish live in a polluted area compared to a non-polluted area. They could also measure other demographics of the population, such as the birth rate, and monitor how those characteristics change over time.

Population studies like this can help us spot when a species is headed towards extinction or if it is under threat from a change to its environment. It can also help us understand the behaviour and life cycle of a species, for instance its migration or breeding habits.

***Research ethics***
All scientific research should be designed and carried out in a way that upholds basic ethical principles. These principles are agreed by governing bodies or communities; sometimes they are international agreements. They set out the responsibilities of researchers to their subjects, colleagues and society, and describe important values that all researchers should protect.

Throughout the 20th century, different people decided to set down the ethical principles that they believed scientists should uphold. One example of a set of principles is the Belmont Report, written by the National Commission for the Protection of Human Subjects of Behavioural Research in the US. Published in 1978, it took four years to produce. It describes the basic ethical principles for conducting research on human subjects, but its three key elements are useful for considering the ethics of all scientific research. They are:

Respect for persons:

- acknowledge autonomy
- protect those with diminished autonomy.

Beneficence:

- make efforts to secure the wellbeing of others
- do not harm
- maximise possible benefits and minimise possible harms.

Justice:

- burdens and benefits of research should be distributed fairly.

Other important sets of ethical principles and guidelines in scientific research on people include the various declarations of the United Nations on: Bioethics and Human Rights (2005); Human Genetic Data (2003); and the Human Genome and Human Rights (1997). The World Health Organisation (WHO) and Council for International Organizations of Medical Sciences (CIOMS) have also been involved in preparing ethical guidance for many years. In 2016, they jointly published the latest version of the International Guidelines for

Health-Related Research Involving Humans, which was first published in 1982. The latest document deals with issues such as fair research in resource-poor settings and the lack of research carried out in vulnerable groups.

To help researchers keep their work in line with ethical principles, many organisations produce their own sets of ethical guidelines, checklists of ‘dos and don’ts’ that set out the practical steps researchers should take to make sure that their research is ethical. Ethical guidelines protect the subjects of research, whether they are plants, animals or humans.

***How do ethics apply to me?***

If you are planning your own population study, you should spend some time thinking about the ethics of your research. Are there any parts of the study that may go against ethical principles? How could you change your plans to reduce the risk of this happening? Are there guidelines you could follow to help you design an ethical study?

Here are a few examples of how and why ethics are relevant to different population studies.

***Plants***

You might think that ethics are only relevant to studies involving animals and humans, but studies of plants can also raise ethical issues.

It is easier than ever before to travel around the world and to visit remote locations that would once have taken weeks to reach. This means more expeditions are being made, by more people, to the world’s wildernesses. Expeditions and fieldwork can help us to understand the natural world and to protect it; they often study rare or endangered species and can gather evidence to support conservation work. But fieldwork can also risk disrupting or damaging delicate habitats and plants.

Some studies might involve you collecting samples or plant specimens from the population you are researching, so that you can check that you have identified the plant properly in the field or study it in more detail in a laboratory. If this is not done responsibly it can damage plants or habitats and may even be against the law.

There are laws surrounding the transport of plants between different countries. The Convention on International Trade in Endangered Species (CITES) covers wild and endangered plants. Even in the UK, some wild plants are specially protected, making it an offence to pick or cut them without a licence. So, it is important to think carefully before taking a sample from a plant; a photograph of the plant might be a better way to record what it looks like.

***Animals***

The ethics of using animals in scientific research, particularly for experimentation, are often debated by the scientific community, the media, animal rights campaigners and the wider public. National laws exist in most countries to govern how animals are used in scientific research. In the UK research must comply with home office legislation and The National Centre for the Replacement, Refinement and Reduction of Animals in Research works to reduce the use of animals in research and ensure that if there is no alternative the research is ethically and scientifically justified.

Population studies look at animals in their natural environment, not in a laboratory, but there may still be ethical issues to consider. To measure the size of a population (how many individual plants, animals or people there are in a given area) researchers usually count the number of individuals within a smaller sample area and then estimate the size of the full population using their sample. The challenge for researchers studying populations of animals is that many species are constantly on the move, which makes counting individuals accurately more difficult. It can also be hard to distinguish between different animals.

One way to estimate the size of a population of wild animals is to use the mark–release–recapture method. This method involves capturing a sample number of animals and marking them with, for instance, a tag, ring, tattoo or chip, before releasing them back into the population. By repeatedly trapping a number of

animals at random and counting the number of tagged animals in each sample, researchers can estimate the size of a population and monitor whether it is increasing or decreasing.

Advances in microchipping and ultralight materials mean that animals can now be tagged without hindering their movement, risking injury or even leaving a visible mark, but there are still concerns that capturing and handling animals for this purpose can cause physical discomfort and psychological distress.

Population studies often play an important role in monitoring, conserving and protecting the animals that they study, so using methods such as the mark–release–recapture method can be justified by the benefits they will bring to the whole population in the longer term. But when conducting ethical studies you should always seek to minimise the harm and maximise the benefits of your research, which may mean considering an alternative method for taking the measurements you need or investing time and money to improve the method that you are using, so as to reduce the risk of distressing the animals involved.

***Humans***

Human population studies provide vital information for medical and social research. They can help us to understand how our population is changing (for example, why in the UK we have an ageing population), the impact and spread of disease (such as in the ebola epidemics in West Africa and the Democratic Republic of Congo), or the relation between human populations and the natural resources that support them. However, if such studies do not follow ethical principles and guidelines there can be very serious consequences for both their subjects and researchers. So, it is essential that research institutions, societies and governments have detailed ethical guidelines for research involving human subjects.

The first requirement set down by the Belmont Report is that all subjects in a study must give ‘informed consent’ to take part in the research. This means that not only should individuals have a choice over whether or not to take part in a study, but that they must be able to make that judgement based on a good understanding of how the study will be conducted, its purpose, and the risks and benefits that may come from taking part.

This may seem a simple requirement: does a subject agree to take part or not? But population studies often involve large numbers of subjects who may be spread across a large geographical area, and often there are individuals of all ages and abilities involved. In these circumstances making sure all your subjects consent to your study freely, and with all the information they need to make the decision, can be a challenge.

Some groups of people, such as the very old or the very young, may not be able, or may find it hard, to make an informed decision. Language barriers and cultural differences can also make it difficult for researchers to communicate well with potential subjects. If a researcher is speaking to a subject via an interpreter for instance, it may be hard for them to know whether the individual has fully understood the nature of the study and their role in it.

Sometimes researchers may need to encourage subjects to volunteer; if they do, they may persuade a subject to take part or offer them an incentive, such as money. Researchers may regard this as necessary in order to deliver the longer-term benefit that their study will bring, but in some cases it might undermine an individual’s autonomy; there is a risk that a subject may be pressurised into taking part, or may agree without fully understanding the consequences.

## QUESTIONS FOR DISCUSSION

- Imagine you are planning an expedition to study rare carnivorous plants in the Amazon rainforest. What would be the potential harm and benefits of your expedition? What steps could you take to reduce the impact of the expedition on the environment?
- Imagine you are writing a set of guidelines for researchers who are studying human subjects. What guidelines would you include to make sure that a study supports the three ethical principles of autonomy, beneficence and justice?

- Can you think of an alternative to the mark–release–recapture method for measuring the size of a population of animals? Research other methods that ecologists use to monitor populations of animals and make a list of their pros and cons. Do you think there is one method that is more ethical than the others?

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## Cervical cancer vaccinations case study

In the UK, 12-year-old girls and boys are offered the vaccine – why? Read on and decide what you think about this population problem

***Background briefing***
Cervical cancer was once a common form of cancer. It is now less common in some countries due to the success of cervical screening programmes.

Many countries have also introduced vaccines that help protect against the disease. They do not prevent cervical cancer directly but protect against the human papillomavirus (HPV) viruses that cause them. Gardasil, the vaccine used in the UK, protects against four types of HPV, including two that cause over 70 per cent of all cervical cancer cases.

These viruses are common and are acquired through sexual activity. Sometimes HPV goes away on its own and most women who are infected will not go on to develop cervical cancer. For those that do, the disease is treatable.

***In the UK***
Most women diagnosed with cervical cancer in the UK will live for at least ten years. However, by offering the vaccine to girls at a young age free-of-charge, it is hoped that HPV transmission and cervical cancer can be prevented. Like other viruses, the circulation of HPV in the population depends on there being enough susceptible individuals to allow it to spread. Men can carry the virus too and, rarely, develop other types of HPV-related cancer, including genital cancers.

***Imagine…***
You're a 12-year-old girl deciding whether to get vaccinated for HPV. Currently it's up to the individual to decide whether or not to have the vaccination, not their parents.

- Would you get vaccinated?
- What are the implications for you personally if you decide not to get vaccinated?
- What are the implications for the wider population if you decide not to get vaccinated?
- Should boys be offered vaccination too? Why do you think they aren't? (Hint: think about the concept of herd immunity.)

# Antibiotic resistance case study

Why are our antibiotics not working? Read on and decide what you think about this population problem

***Background briefing***

The arms race between humans and bacteria encourages disease-causing bacteria to evolve to evade our defences: mainly, our drugs.

The discovery of antibiotics in the 20th century helped humans to fight deadly diseases like syphilis and gangrene, but the more we use them, the greater the pressure becomes for bacteria to evolve. Any genetic mutation that helps a bacterium beat a drug very quickly offers a selective advantage and spreads throughout the bacterial population as the cells without the mutation die off. Doctors are left with fewer treatment options for these drug-resistant strains, meaning that patients take longer to recover or are less likely to survive. Inappropriate use of antibiotics – including doctors prescribing the drugs unnecessarily and patients failing to completely eliminate infections by not finishing antibiotic courses – is making the problem worse by giving bacteria a chance to develop resistance.

To keep up with bacteria, drug companies need to develop entirely new classes of antibiotics or other drugs. But the drug discovery and approval process is lengthy, and there are few incentives to develop antibiotics because they start becoming ineffective within a couple of years so the pay-off may be limited.

***Worldwide***

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* bacteria. It is curable with a combination of antibiotics over a six-month course, though there are often complications. Among curable infectious diseases, it is the top killer.

The World Health Organization (WHO) estimates that, in 2017, over 446,000 people developed TB that was resistant to the two most powerful anti-TB drugs, rifampicin and isoniazid.

The WHO has outlined a target of reducing TB deaths by 90% and cut new cases by 80% between 2015 and 2030, but right now more than a third of global cases go undiagnosed, untreated or unreported.

Around 6 per cent of all cases of MDR-TB are considered extensively drug-resistant (XDR), meaning patients do not respond to at least four of the main anti-TB drugs – the first-line and some second-line drugs. Diagnosis can take three months.

***Eastern Europe***

This region has the highest rate of MDR-TB in the world. it accounts for 20 per cent of all new TB cases.

***India and China***

There are around 1 million new cases of TB reported in China every year. Globally, only India sees more new cases – around 2.7 million. Together, these two countries account for 36% of all new cases of TB. In China, there are 63,000 MDR-TB cases.

***United Kingdom***

More than 5,000 cases of TB are diagnosed each year. More than a third of cases are in London. Of the people tested for multi-drug resistance between 2007-2017, 3.1 per cent has MDR-TB, and there was one case of XDR-TB. There have been efforts to improve TB treatment and control, as well as success in reducing the rates, but the incidence of the disease in the UK is higher than in other western European countries including France, Germany, the Netherlands and the Scandinavian countries. Children in high-risk areas receive the BCG vaccination to protect against severe forms of TB.

(Sources: TB Alliance, Public Health England, NHS Choices)

***Imagine...***
You're a doctor in a country where TB infections have reached crisis levels. Although it was once treatable, now no patients respond to the first-line medications available.

- How should these patients be treated?
- How could you – and your patients – help to slow the development of resistant bacteria?
- How can drug companies be encouraged to develop new treatments?
- What role could better diagnostic tests play in reducing resistance?
- Should antibiotic use be restricted?

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# Birth control case study

What do you do when you've got soaring populations and ageing populations? Read on and decide what you think about this population problem

***Background briefing***
Many low- and middle-income countries are struggling with soaring populations, and throughout the world, people are living longer.

***Kenya***
In Kenya rapid population growth since the 1950s has put pressure on resources such as land for farming, water and healthcare. Use of contraception increased from below 10 per cent in 1978 to 59 per cent in 2018, contributing to a reduction in the average number of children per mother from eight to five. However, over 3 million Kenyans do not have enough food to eat and over a quarter of children under 5 are chronically malnourished.

***China***
China's one-child policy, introduced in 1979, prevented hundreds of millions of births by withdrawing benefits and imposing fines on couples who had more than one child. The policy went against traditions favouring large families and may have led to some women undergoing unwanted abortions or sterilisation. Most abortions during this time were of female fetuses. There are now fewer women than men in China, and single-child families have produced fewer working-age adults to support the older generation. In recent years, China relaxed its policy.

***France***
France adopted a pro-natal policy for the first half of the 20th century – the 'Code de la famille' – which offered strong incentives for having a three-child family, including cash payments for new mothers and reduced taxes. This resulted in a shift towards women having two children, on average, by the 1970s, after a period of decline, in which almost half had one or none.

***Imagine...***
A government struggling to cope with overpopulation decides it will only offer housing benefit to those of childbearing age if they agree to use birth control.

- Do you think this is a good idea? Why or why not?
- What are the implications for current and future populations?
- Can you think of any alternatives for dealing with overpopulation?

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## Genetic modification case study

Are genetically modified crops a good or a bad thing? Read on and decide for yourself about this population problem

***Background briefing***
Many scientists claim that genetically modified (GM) crops will contribute to feeding a larger population more sustainably, though anti-GM campaigners disagree. Over 10% of the world's arable land is now used to farm GM crops.

There is no clear evidence that the risks associated with eating GM foods are greater than for non-GM foods. However, concerns are not just related to consumer safety, but also to the effects of GM crops on agricultural ecosystems. For example, crops designed to resist pests could mean that the pests evolve more quickly in response. There are also concerns about modified genes jumping into wild crops, creating problem plants. But researchers argue this could only happen in close relatives of the crops.

***North and South America***
In the USA, where 46% of crops are genetically modified, a type of pest-resistant GM corn was removed from sale in 2000 because it was thought that the bacterial genes it contained might cause allergies. However, there was never any hard evidence of a link. Meanwhile, 61% of Brazil's crops and 64% of Argentina's are GM crops. These three countries are the three biggest producers of GM crops, together

***Europe***
GM crops are grown in a few countries, with only Portugal using more than 10% of its arable land for GM varieties. This is partly due to the perception among some consumers that GM foods are unnatural and potentially unsafe. There is also suspicion surrounding the companies that make them.

However, in the UK at least, concern about GM foods may be waning. In a 2018 Food Standards Agency survey, 23% of people were concerned about GM foods – less than were concerned about food poisoning, chemicals such as lead in food and food additives.

***Africa***
Plantings of GM food crops are small by comparison to other regions. Whilst South Africa and Sudan have embraced several varieties, and particularly pest-resistant Bt cotton, leaders in many other countries remain indecisive. There is mistrust of the companies that sell GM products and resistance to switching from traditional crops.

***Imagine...***
Scientists engineer a new type of Cavendish banana that is resistant to Panama disease.

- Would you be happy to eat GM bananas? Why or why not?
- What are the benefits and risks for farmers, for consumers and to biodiversity of switching to the GM crop?
- Who owns these new varieties? Who should own them?

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