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How zoonotic diseases and human interactions with nature are linked

Grundschule, Sekundarstufe

The COVID-19 pandemic has focused attention on the fact that most infectious diseases originate from animals. According to experts, more of these diseases can be expected in future. The reasons for this lie in human interaction with nature.

Gehört zu:

Unterrichtsvorschlag: Viruses, animals and people (GS)
Unterrichtsvorschlag: What does coronavirus etc. have to do with human intervention in nature? (SEK)

The novel coronavirus causing COVID-19 is believed to have originated in bats. COVID-19 is thus a zoonotic disease (zoonosis). This is the name given to infectious diseases that can be transmitted from animals to humans and vice versa. Many other well-known diseases are zoonoses, including Ebola, swine flu, rabies, malaria and plague.

Another topic being discussed in connection with the COVID-19 pandemic is that human destruction of the natural environment is conducive to the spread of new diseases.

As a result of the coronavirus, there is now also increased public awareness of the illegal trade in animals, including endangered species, at uncontrolled and unregulated so-called "wet markets" (wildlife markets) in East Asia and other parts of the world. Such species include pangolins, for example: although the pangolin trade was banned in 2017, they continue to be sold for human consumption and for their scales, which are used in Traditional Chinese Medicine (TCM).

At these wildlife markets, many different species of animal are kept, transported and slaughtered in overcrowded and highly unsanitary conditions. One of these markets in the Chinese city of Wuhan has been discussed as the possible source of the current pandemic, although this is still unproven.

Although it is not yet known exactly how the coronavirus was transmitted to humans, conditions such as those at wildlife markets are a risk factor. In general, new zoonotic diseases are most likely to spread when humans come into close contact with animals, which may be carriers of zoonotic diseases. In February, China reacted by closing the markets selling wild animals for human consumption until further notice.

More interventions in nature increases the risk

Zoonotic diseases pose a major threat, as the COVID-19 pandemic shows. Many other diseases that originate from animals also have major social and economic impacts.

Recent major outbreaks of diseases such as SARS, MERS and Ebola incurred costs in the billions. The 2002-2004 SARS epidemic led to 774 deaths. The COVID-19 pandemic has already cost the world economy heavily and will have significant further impacts.

At the same time, the risk of new zoonotic diseases spreading is going up. The change and destruction of natural habitats, human encroachment on these habitats, biodiversity decline and close human contact with host animals encourage outbreaks of disease. This negative trend is continuing and is reaching regions that were previously minimally affected or not at all.

With a growing world population, humans engage in large-scale conversion of natural habitats to agricultural land and settlement areas. These changes are happening on a vast scale. Around 80 per cent of all the Earth's ecosystems already show clear evidence of human influences in varying degrees.

How is a virus passed from animals to humans?

Zoonotic diseases originate from certain animal species in which the respective pathogens circulate under natural conditions. These animal populations are known as "reservoirs". At first, the disease pathogen – a virus, for example – multiplies solely within the population of these animals. Depending on the pathogen, individual animals may become sick and die or develop resistance. Some may become infected without displaying symptoms.

There is a vast number of pathogens circulating in animal populations. An estimated 3,200 coronaviruses are known to exist in bats and flying foxes alone.

Pathogens can be transmitted directly to humans, for example through direct skin contact or bites. Or they can be transmitted indirectly by vectors such as mosquitoes and lice, which come into contact with an infected animal first and then with a human. Consumption of raw animal products can also result in disease transmission.

Sometimes, reverse zoonosis can occur; this means that diseases are transmitted in the opposite direction, from humans to animals. Gorillas and other great apes, for example, are highly vulnerable to infectious diseases that affect humans. However, in animals, the effects of these diseases are often more severe and can be fatal.

Some zoonotic disease pathogens are transmitted from person to person after they have jumped species from animal to human. The novel coronavirus is an example of this.

One reason why new zoonotic diseases emerge again and again is the fact that pathogens can change – they mutate, in other words. Coronaviruses, for example, mutate very easily.

Viruses multiply by penetrating into the cells of a specific host. Structures present on the surface of the virus act as a "key" that fit and unlock the host cell. The cell is then "reprogrammed" to produce copies of the virus. As the copies are produced, mistakes can occur and the virus mutates. The mutation may produce a key that fits the cells of an entirely different host species.

Mutations are random, and mutations that enable a virus to be transmitted to humans are uncommon. However, when it does happen, it can have serious consequences. The virus can then infect human cells and multiply in humans. And in some cases, the new disease that emerges is transmitted from human to human.

Are there different types of coronavirus?

The novel coronavirus has been spreading since late 2019. The virus, known as SARS-CoV-2, caused a new infectious disease called COVID-19. SARS stands for "severe acute respiratory syndrome".

Coronaviruses were first discovered in the 1960s. The coronavirus family includes a variety of disease pathogens which infect mammals, rodents and birds. Several coronaviruses have jumped species and have adapted to infect humans. Although small in number, these diverse pathogens cause around a third of common colds, as well as diarrhoeal diseases.

As well as relatively harmless pathogens, there have been other coronaviruses, besides the novel SARS-CoV-2, that in the past posed very serious risks to human health. In 2002, SARS-CoV claimed almost 1,000 lives. And in 2012, the MERS-CoV (Middle East Respiratory Syndrome Coronavirus) spread across the Middle East causing deaths as well.

What do we know about the novel coronavirus?

The scientific community currently suggests that the novel coronavirus originated in bats. According to findings, a bat appears to have been the source of the pandemic.

However, it is unlikely that the virus was transmitted directly from bats to humans. The virus may have passed through an intermediate animal host before being transmitted to humans, although this is unclear at this stage.

Some studies indicate that pangolins may have been the intermediate host. Although all pangolin species are endangered, some critically, and trade in all eight pangolin species was prohibited in 2017, these mammals are still traded and sold in China. Their meat is considered a delicacy in Asia and their scales continue to be used in Traditional Chinese Medicine.

A wet market – the Huanan Seafood Wholesale Market – in the Chinese city of Wuhan has been suggested multiple times as a possible source of the COVID-19 pandemic. Although this is not confirmed at this stage, the market provides an example of the type of conditions that are highly conducive to the outbreak of zoonotic diseases. Multiple species that would never normally come into contact in the wild are present at the market. Up to 40 different species of livestock and wild animals are traded and slaughtered in overcrowded and highly unsanitary conditions.

What encourages the spread of zoonotic diseases?

The risk of zoonotic disease transmission is linked to our human activities and encroachment on the natural environment. By creating more interfaces between humans and animals, this results in new pathways for pathogens to pass between species.

The types of intervention that damage ecosystems include forest clearance, habitat fragmentation, construction of infrastructure, mining, oil and gas production, pollution, logging, changes in drainage, flooding and tourism. The loss of wild animal populations also damages ecosystems as it disrupts many ecological processes.

When humans encroach on nature, contact with wild animals also increases. This creates more opportunities for pathogens to be transmitted from animals to humans or vice versa. Furthermore, human intervention in natural habitats brings species into contact that would never normally encounter each other in the wild. In addition, humans spread monocultures, which cause species loss and a decline in biodiversity. At the same time, less specialised animal species which are able to adapt to the changed environmental conditions move into the now vacant ecological niches. They reproduce at high rates, and so do their pathogens.

Food production conditions, including intensive livestock farming, are also a factor in zoonotic disease transmission. Various flu viruses circulate in pigs, for example. Livestock and products of animal origin are often transported over long distances nowadays. Keeping a large number of animals of the same species in overcrowded conditions is highly conducive to the rapid spread of infectious diseases.

Global mobility and the trade (legal and illegal) in wildlife also encourage the transmission and spread of zoonotic diseases. Both infected animals and humans travel long distances, and our interconnected world is conducive to human-human transmission.

The consumption of wild meat also creates opportunities for the emergence of zoonotic diseases. However, this only affects a small percentage of the population and certain regions of the world.

What are the potential solutions?

The conservation of intact ecosystems and their typical biodiversity can reduce the emergence of infectious

diseases in general.

Considerable efforts are already underway at various levels to protect nature and biodiversity.

One example is the Convention on Biological Diversity which entered into force in 1993 and has been signed by over 190 countries. It is the most comprehensive international agreement on the protection and sustainable use of ecosystems and the species occurring in them. In 2021 at the 15th meeting of the Conference of the Parties, a global biodiversity framework with clear goals up to 2050 will be adopted. This framework will serve as a guideline for future action. Germany is advocating ambitious decisions that will verifiably halt biodiversity loss and therefore help to better prevent the risk of zoonoses and potential pandemics.

If China were to make the temporary closure of its wet markets permanent, this would be a major step forward as it would encourage other countries, such as Vietnam, to follow suit. Such a step would put considerable pressure on other countries to take resolute action. A ban by China and other Asian countries on the use of endangered species such as pangolins in traditional medicine would be another significant step.

Due to the wide-scale degradation of the environment, efforts are also underway to restore natural ecosystems. The United Nations, for example, has designated 2021-2030 the Decade on Ecosystem Restoration. Buffer zones can improve the protection of ecosystems that are still intact.

In order to reduce the risk of pandemics, ecosystems in the remaining natural habitats must be preserved as far as possible. This means no extraction of timber and no removal of animals or plants from their natural environment. Habitats should not become fragmented or be converted to agricultural land. Exemptions should apply to local indigenous communities: their traditional forms of land use should be maintained.

The trade in wildlife for human consumption must end. Again, exemptions should apply to indigenous and local communities that rely on wildlife as a source of protein, or to cases where the culling of wildlife is necessary for species conservation. The latter applies, for example, to wild boar in Germany. The international community must do more to curb the illegal trade in wildlife. Better control and regulation of the legal, sustainable wildlife trade are also required. Hygiene standards in the trade in pet and animals from breeding facilities need to be improved.

What can I do?

Everyone should observe basic rules of hygiene around wild and domestic animals. We should also show more consideration in our behaviour nature – both in our own neighbourhood and when on vacation.

We can also help to end species and habitat loss worldwide through the everyday choices we make as consumers. By buying organic products, for example, we can help maintain biological diversity. We should avoid products from intensive livestock farming and monocultures, as well as products linked to the destruction of natural habitats, such as rainforest clearance. These include certain meat products and non-certified tropical timber.

When buying exotic wild animals, consumers should check the origin and conservation status of the species concerned and choose captive-bred animals from certified breeders, not ones that were captured in the wild. Tourists should refrain from buying and importing live animals as souvenirs. On safari and wildlife tours, tourists should comply with distance rules in order to protect the animals and themselves. For example, a minimum 7-metre rule applies on guided treks to watch mountain gorillas.

Further reading

Tom Evans, Sarah Olson, James Watson, Kim Gruetzmacher, Mathieu Pruvot, Stacy Jupiter, Stephanie

Wang, Tom Clements and Katie Jung: Links between ecological integrity, emerging infectious diseases originating from wildlife, and other aspects of human health – an overview of the literature https://www.wcs.org/get-involved/updates/wcs-issues-report-on-links-between-ecological-integrity-and-human-health [https://www.wcs.org/get-involved/updates/wcs-issues-report-on-links-between-ecological-integrity-and-human-health]

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Unterrichtsvorschläge

Viruses, animals and people - GS (PDF - 85 KB)
What does coronavirus etc. have to do with human intervention in nature? - SK (PDF - 0 B)

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