The Covid-19 pandemic has clear links to nature exploitation and destruction

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Summary

Some choices of local farmers and producers have high biodiversity footprints as they can lead to habitat degradation and loss. This, in turn, may lead to a decline in species richness, may alter ecosystem structure, wildlife behavior, and simultaneously increase proximity between human settlement and wildlife, creating a greater risk for the spread of zoonotic diseases. For example, the degradation of forests leads to pools of water directly exposed to sunlight, which increases their temperature, promoting conditions for mosquitoes like *Anopheles* which is a vector for malaria and other diseases. It is known that over 75% of emerging viruses in the past two decades have been zoonoses. Although the transmission pathways may not yet be fully understood, vital theories say that viruses are transmitted to humans via an intermediate host species which they are in close contact with or are infected directly through consumption.

Hunting and selling of bushmeat promotes zoonoses, but can serve as an important source of income in poor countries which in many cases rely on these meats as a main food source. There have also been several instances of emerging zoonotic diseases as a direct result of exotic pet trade in the past. Human livestock farming is another contributor to the emergence of new diseases by promoting antibiotic resistance in human pathogens.

The advance of humans into remote areas of the world, mainly because of new land exploitation, but also scientific expeditions or adventurism may contribute to the contraction of new threats. Coronaviruses are one of these "new zoonotic threats", but they have been known for many years. Belonging to the group of RNA viruses they can cause infections in the respiratory tract of humans. Scientists are currently researching whether the SARS-CoV-2 strain causing the coronavirus disease 2019 (=COVID-19) can cause long-term damage to the lung and to what extent already infected people are immune against the virus.

Hygiene and technical actions limit the risk for spread of new diseases, however, these resources may not be readily available to everybody especially in underdeveloped countries. With growing awareness and knowledge regarding these environmental issues it is crucial that changes are made even before restrictions due to COVID-19 are eased. For this purpose, a "Trans-National Marshall Plan for Nature" is needed. One strategy to reduce the likelihood for a new zoonotic virus to emerge can be to identify viruses in wildlife, study their biology and predict potential zoonotic properties and implement a worldwide early warning system to prevent outbreaks from becoming pandemics. For a market control of bushmeat stricter enforcement and implementation of laws by authorities are needed, however alternative affordable protein sources should also be available. Maybe the time has come to reduce the consumption of bushmeat drastically. This is a problem that needs attention on a global scale as the majority of countries who engage in illegal meat trading and consumption may not have the means or resources to implement affordable alternatives.

SARS-CoV-2 – the novel coronavirus, the current status of the pandemic and effects on human health

Coronaviruses have been known for many years and belong to the group of RNA viruses that can cause infections of the respiratory tract of humans. Parts of the viruses consist of membranes with spiked proteins, which look like a crown, hence the name "corona" (Liu, 2020). While most coronaviruses are not very harmful for humans, there are some exceptions which occurred more frequently in recent years. Horseshoe bats were identified as the natural reservoir for SARS-CoV which first emerged in 2002 in China and led to the first SARS-pandemic, causing the severe acute respiratory syndrome (Wang et al., 2006). In 2012 the MERS-CoV which probably first emerged in dromedaries in Saudi-Arabia led to the second coronavirus-related global outbreak causing the Middle East respiratory syndrome (Sharif-Yakan & Kanj, 2014). While both diseases caused less than 1000 deaths respectively, COVID-19 (coronavirus disease 2019) is the largest and due to the high contagiousness most dangerous coronavirus-related pandemic the world has ever seen. SARS-CoV-2 first emerged in Wuhan (China) at the end of 2019 and is believed to be a bat-borne coronavirus which infects cells in the lungs and can be lethal for people with compromised immune systems (Goodwin, 2020). Currently (22.05.2020) more than 5 million people have been infected with the novel coronavirus and more than 338.000 coronavirus-deaths have been recorded worldwide since the COVID-19 outbreak (Worldometers.info, 2020).

COVID-19 is a novel disease which has only recently emerged, thus little is known regarding exact impacts on human health. In countries like Italy and Spain over 10 % of all confirmed infected people died (in Austria currently – 22.05.2020 - 639 or 4.3 % out of 16402 infected people died) (Worldometers.info, 2020), the actual fatality rate of the disease is believed to be less than 1 % with a high proportion of the mortality percentage being elderly persons (>60). Most infected persons do not show any symptoms at all, which means that there may be many people which are not officially registered as COVID-19 patients. Scientists are currently researching whether SARS-CoV-2 can cause long-term damage to the lung and to what extent infected people are immune against the virus. Cases of recovered Asian persons that were allegedly infected with the virus again, have raised concerns amongst scientists (Hancocks et al., 2020), but it is not known how long immunity can remain active or if these reports are a result of imprecise testing.

Hidden infections due to immunity

Many genes that cause an immune response also have functions outside the immune system. Therefore, it is not always clear why the remaining gene frequencies were chosen by natural selection, yet lead to differences in immune systems and immune responses in different but sometimes closely related species (Brinkworth et al., 2018). This evolutionary result can be observed within the family of hominoids or extended to the class of mammals or to the whole botanical and animal kingdoms.

Mobile genetic elements are a combination of transposable elements, retroelements and viruses. They make up about 50% of mammalian genomes and are a result of coevolution (Koonin et al., 2014). Complex mechanisms of our (partially) virus-mediated immune system generate a varying antibody or T-cell receptor diversity and result in immunological memory for external genetic elements (Broecker et al., 2019). Such variation might explain why humans respond so differently to infections.

Bats are considered a source of zoonosis (or even a vector) of the current COVID-19 pandemic, but also diseases like Rabies, Ebola or the SARS coronavirus. The immune system of bats is very different compared to other mammals, as it does not allow for pathogens to become dangerous. As a result bats are hosts for many viruses without becoming diseased and in return the viruses are exacerbating (Brooks et al., 2020).

These observations lead to the conclusion that our immune system has reached its current level of evolution through interactions with viruses, as well as other pathogens such as bacteria, fungi etc. Many of these encounters have been detected in the past, when hominids were considered a part of an "intact nature". It is plausible that smaller isolated populations of human ancestors would have been greatly affected by these zoonotic diseases which could have potentially even led to extinction, whereas others could adapt and pass on their genes.

Emerging zoonoses and the human driven destruction of natural habitats

The protection of natural habitats, such as forests, is important for safeguarding biodiversity and mitigating climate change. Recently another issue became the focus of attention because of the ongoing coronavirus pandemic: the association between human driven habitat loss and the emergence of zoonoses.

The exact mechanisms how degradation, destruction, and fragmentation of habitats may cause increased emergence of (new) zoonotic diseases is not fully understood yet. However, certain is, that human intrusion disrupts the fragile balance of existing ecosystems (Cascio et al., 2011). Deforestation, for instance due to logging, intensified agriculture, road building or increasing urbanization, is accompanied by alteration of the geological, hydrological and biological characteristics of an area (for example by replacing forest with plantations, grazing fields or suburban housing) (Cascio et al., 2011). These transformations have devastating consequences for wildlife and potentially also human populations. Habitat loss and fragmentation may lead to a decline in species richness (Jones et al., 2013), alterations in community structure (Zohdy et al., 2019) and wildlife migration, and simultaneously increases the exposure of people to novel pathogens (Jones et al., 2013). Ultimately, it is more likely for diseases to be transferred from wildlife to humans in deforested habitats (Auburn University, 2019).

The intensified contact between wildlife and humans is an important point for the emergence of zoonoses, and can be facilitated by different mechanisms. The expansion of agriculture for instance brings humans and livestock into closer proximity to wild animals and disease vectors, which may lead to the establishment of new transmission cycles. Livestock living in close proximity to wildlife facilitates pathogen spillover and may become an amplifying host in which pathogens can evolve and eventually become transmittable to humans (Jones et al., 2013). The alteration of ecosystems could create conditions which favour certain animals and result in an increased population density and therefore may lead to a more frequent contact with those animals (Cascio et al., 2011). Especially if wildlife species have adapted to landscapes shaped by agriculture and settlements (Jones et al., 2013), and if those species are hosts for potential or actual zoonotic agents (Cascio et al., 2011), they could become reservoirs for diseases in livestock and human (Jones et al., 2013) and the consequence would be an increase in human infections. In Brazil, for example, the resurgence of leishmaniasis was caused by an increased fox population after a forest was replaced with trees suitable for the paper industry (Cascio et al., 2011). Another example is the forest fragmentation in certain areas of North America, which was followed by an increased density of white-footed mouse, which is a host for the pathogen of Lyme disease (*Borrelia burgdorferi*), and a tick vector that simultaneously increased in abundance. This led to an elevated risk of Lyme disease in the region (Jones et al., 2013). In Australia deforestation and agricultural expansion was accompanied by changes in the location, size and structure of bat colonies and shifted their foraging to peri-urban fruit trees, because of a loss of their habitat. This has been associated with the emergence of bat-associated viruses (Hendra virus, Australian bat lyssavirus, and Menangle virus) caused by the increased contact with livestock and humans, and consequently a higher probability of pathogen spillover (Jones et al., 2013).

Even historically, animals that live traditionally in close contact with humans such as rats and fleas have been accountable for the bubonic plague or the plague of Justinian (541-542 A.D.), the black death (1347-1352) and the great plague of London 1665 (Rosenwald, 2020).

Another point is the increase or decrease of biodiversity due to encroachments of settlements into natural ecosystems. On the one hand, in communities with low biodiversity, animals that act as disease vectors feed more frequently on primary reservoirs of certain pathogens, and in this way attain a higher pathogen prevalence, increasing the risk of pathogen spillover. On the other hand, intrusion into natural ecosystems, especially through human settlements and agriculture, generates the expansion of transition zones (ecotones) between natural habitats and human civilization. In such ecotones, species from different habitats come together (leading to higher biodiversity) providing an opportunity for disease spillover followed by genetic diversification and adaptation of pathogens (Jones et al., 2013). A recently published hypothesis (the co-evolution effect hypothesis by Zohdy et al., 2019) suggests that fragmented habitats can be seen as islands in which shifts in population structure among hosts obligate parasites and pathogens to act together and build “co-evolutionary engines”. Thus, pathogen diversification is accelerated and causes increasing pathogen genetic diversity across a degraded landscape. This results in an increase in the probability that a pathogen variant evolves which can avoid host immune defences and therefore has zoonotic potential (Zohdy et al., 2019).

Are degraded forests a potential source of diseases?

Besides the effect of species loss through habitat degradation, deforestation can change forests to mosquito breeding paradises. Deforestation of pristine forests for agricultural use is a huge driver of habitat loss and subsequently leads to species loss. However, a link between anthropogenic deforestation and the expansion of malaria has been shown (Austin et al., 2017). This can happen because degradation of forests has led to pools of water directly exposed to sunlight, which increases their temperature. New puddles form in the remaining wells left after tree removal and are likely less acidic as puddles inside a forest. These processes promote favorable breeding conditions for mosquitoes like *Anopheles* which is a vector for Malaria (causing 1 million deaths per year) and other diseases. Mosquitoes should not of course be demonized or reduced to their imago. Some mosquito larvae are detritus shredders in aquatic systems (Juliano, 2009). As decomposers they can be considered as important species in an aquatic system. Mosquito larvae of *Wyeomyia smithii* feed on different rotifer and protozoan species (Miller et al., 2002). Loss of mosquitoes could change the abundances of other species in these systems and could also lead to further species and functional loss in these communities. Despite the positive effects of mosquitoes on ecosystems, environmental conditions which increase mosquito populations should be avoided in order to reduce the potential for further spreading of the diseases they carry. While we are dealing with the COVID-19 pandemic and do whatever possible to contain it, we should be aware that we might be cultivating the next diseases in our backyard.

Bats – a natural reservoir for zoonotic diseases and their role in host shifts

In the scientific community it is known that more than 75% of emerging viruses in the past two decades have been zoonoses. Most of these diseases emerging from wildlife have been from bats and rodents (Mackenzie, 2005). Bats are a huge group in terms of mammalian species richness (about 20%) and distribution and there is a growing awareness that bats are the reservoir hosts for a number of zoonotic diseases (Calisher et al., 2006). In a study from 2013 (Anthony et al., 2013) the authors discovered 55 viruses from nine viral families (including Rhabdoviridae, Paramyxoviridae, Filoviridae and

Coronaviridae) isolated only from the Indian Flying Fox (*Pteropus giganteus*).The host-shift from bat to human has remained a mystery until now since most bat populations roost in tropical forests or caves and there is no frequent contact with humans (Han et al., 2015). One popular theory is that viruses are transmitted to humans via an intermediate host which is in close contact. Fruit bats, for instance, contaminate fruits with their saliva and urine which are consumed by pigs, horses and other intermediate hosts (Chua, 2000). Another theory suggests that humans became infected with bat-borne viruses by consuming bat meat ("bushmeat", see next section). Epidemiologists showed that the Ebola haemorrhagic fever, which re-emerged in 2007 in the Democratic Republic of Congo (DRC), was associated with the consumption of fruit bats (Leroy et al., 2009). Bats provide unique niches for many viruses to co-evolve with and they have been proposed as the natural reservoirs causing severe diseases in humans such as SARS-CoV in Asia, MERS-CoV in Middle East and the recent ongoing pandemic SARS-CoV2. Although the transmission mechanics are not yet understood, the increase of human activities by destroying and overlapping the natural habitats of bats will undoubtedly increase in direct or indirect host shifts from bat viruses to humans.

The impact of illegal bushmeat markets on the spread of diseases

For about 30 years now, the bushmeat issue has become increasingly stressed upon. Bushmeat is the killing of wild animals for human consumption. The bushmeat trade is now taking on extreme scales. There are illegal meat markets all over the world, which are served through unknown distribution channels. Airports are regarded as trans-shipment centres and it has become a billion-dollar business. For example, more than 270 tonnes of bushmeat are smuggled annually via the airport in Paris (Keddy, 2017).

In Asia and Africa, the consumption of bushmeat goes back a very long time and was always a part of most human societies. It is an important protein source for rural communities where farming domesticated animals is too expensive or impractical. As the distribution channels are unknown no one can say how much bushmeat is consumed in total; estimates by conservationists predict beyond six million tons for Amazonas and the Congo basin (Actman, 2019). The most "popular" hunted animals are bats, rats, snakes, small animals, slow breeding species like monkeys (Brunette 2020) and many more including species that are already endangered or close to extinction. Hunting and selling bushmeat can also serve as an important source of income. In Europe bushmeat can be sold at much higher prices compared to the country of its origin, a fact that drives the extensive trading processes.

As described above, wild animals are a reservoir for different pathogens and contact with them may facilitate the emergence of zoonotic diseases. Most threatened are the people who are exposed to the body fluids of the animals, like hunters or consumers. This is especially true if the meat is not prepared properly; the meat is regularly served dried or smoked only. In addition, the markets where the meat is sold often have insufficient hygiene conditions (e.g. no freezers), providing pathogens with ideal environments for replication (Engel, 2012).

Banning bushmeat markets could be a fast solution: As many people depend on bushmeat as their main food source, however, such markets would simply continue as black markets. Possible alternative solutions could be to educate people about the consequences of bushmeat consumption, improve hygiene conditions at the markets and develop additional sources of protein. Only a combination of measures can likely reduce bushmeat hunt, trade, and consumption.

Is meat consumption generally responsible for zoonotic diseases (in the past and future) and posing a threat to humanity?

With the ongoing COVID-19 pandemic the role of bushmeat consumption, wild animal exploitation and their possible link to zoonotic diseases is called into question more and more, as described above. Pathogens also arise from modern livestock farms and not only from wild animals, which is widely known but often disregarded in this discussion. We keep many domesticated animals, such as poultry, pigs or cattle in dense and cramped conditions and these species are susceptible hosts for pathogens or viruses (Slingenbergh et al., 2004). Diseases which are circulating the earth nowadays, originated in livestock farming, due to the high possibility of spillover events with humans occurring there (Webster et al., 1992). A good example are the ongoing outbreaks of avian influenza H5N1, which is highly lethal for humans. H5N1 caused an epidemic in 2004/05 in Asian countries but is still present today in various countries around the world (Slingenbergh et al., 2004). An important point which should not be set aside, especially regarding the spread of zoonotic diseases is, that human livestock farming not only causes new diseases to emerge but also impedes to fight them by promoting antibiotic resistance in human pathogens. The European Center for Disease Prevention and Control (ECDC) published a study which estimated >620.000 infections with antibiotic-resistant bacteria leading to an estimated number of >32.000 deaths only in the year 2015 (Cassini et al., 2015). Another alarming issue is that the main source of human pathogens are non-human animal sources (zoonotic pathogens, 60% of all human pathogens) (Anthony et al., 2013). One could easily imagine that a pathogen host switch is only a matter of time. Revising our current food consumption behavior of animal products can help reduce the risk for spreading diseases.

Emergence of zoonotic diseases due to increasing popularity of exotic pets

According to Warwick et al. (2012) the most significant zoonoses issue is a result of the importation, trade and keeping of exotic pets. Any animal which is non-native and non-domesticated may be considered an exotic pet (Warwick et al. 2012). Especially the trade of exotic and often illegally wild-caught species poses a large risk of spreading diseases across the globe while simultaneously destabilizing ecosystems and threatening species (Lockwood et al., 2019; Sollund, 2017). However, the trading of such animals is largely unregulated, which is thought to pose an undefined risk to public health (Smith et al., 2012). Wild-caught animals generally show a higher chance for carrying diseases, for example hantaviruses, lymphocytic choriomeningitis or rabies (see Smith et al., 2012; Warwick et al., 2012). The wild-caught animals are often sold as pets or kept near captive breeds while awaiting sale, thus facilitating the spread of diseases (Smith et al., 2012). There have been several instances of emerging zoonotic diseases as a direct result of exotic pet trade in the past. In the USA, cases of salmonellosis in humans strongly correlate with reptile pet ownership (Chomel et al., 2007; Warwick et al., 2012). A ban on small turtles as pets, following the finding that those were responsible for about 14 % of human salmonellosis in the US, resulted in a 77 % reduction in the disease (Mermin et al., 2004). Thus, the question is, how can the increasing demand for exotic and endangered pets be controlled? A study by Moorhouse et al. (2016) found that informing potential buyers of the dangers these exotic pet species pose can significantly reduce their interest in acquiring one. However, the information provided to potential buyers seemed to play an important role. While information about diseases or legality had a strong impact on the potential buyers' decision, information about animal welfare or conservational aspects did not significantly impact the decision to purchase an exotic pet. While this shows a large concern among buyers for potential health risks, it also demonstrates a need for further education on the importance of conservation.

Contribution of international trade to biodiversity loss and spread of zoonotic diseases

A majority of the world's supply chains occur in countries rich in biodiversity. International trade contributes to 30% of species threats worldwide and approximately 7,000 threatened animal species from the International Union for Conservation of Nature Red List have been linked to more than 15,000 commodities produced in 187 countries e.g. tea, coffee, palm oil (Lenzen et al., 2012). In today's increasingly globalized economy, world markets, value chains and consumer demands continue to shape choices made by local producers i.e. farmers, foresters, fishermen and miners (IDDRI 2016). Some of these choices consequentially have high biodiversity footprints as they lead to habitat degradation, local species extinctions and in some cases, wildlife moving closer to human populations. Increased proximity between human settlement and wildlife has created a greater opportunity for the spread of zoonotic diseases (Scott, 2020). Additionally, studies have found correlations between biodiversity disturbances through ecological alteration and emergence and spread of zoonotic diseases. This is because a decrease in host diversity or species richness increases the probability of disease and its transmission to humans (Patil et al., 2017), as also described above. According to the National Academy of Sciences, at least 65 percent of recent major disease outbreaks have zoonotic origins. As international trade, travel and movement of animals increase, zoonotic diseases can emerge anywhere and spread rapidly around the globe (Keusch et al., 2009). There is a need to design and improve cross-sectoral policies that aim to reduce local biodiversity threats by not only focusing on local producers who directly degrade and destroy habitats but also traders and consumers who benefit from the 'degradation and destruction' (Lenzen et al., 2012; IDDRI 2016). Although COVID-19 has created more challenges in international trade, it may also provide opportunities for new global reflections and development of potential policy responses that holistically advocate for biodiversity conservation in relation to international trade.

Can we predict and prevent the next big pandemic?

The need of strategies to reduce the likelihood of the emergence of new zoonotic viruses and to become better prepared, is inevitable. One aspect can be to screen and identify viruses in wildlife and to identify the ones with potential for zoonotic outbreaks before they become a pandemic (Gruber, 2017). This is for example done by the PREDICT project using a worldwide collaboration in 35 countries in Asia and Africa, which is led by the One Health Institute at the School of Veterinary Medicine at the University of California in Davis.

By collecting blood and tissue samples from humans and wildlife from across the world, this project has identified hundreds of viruses with zoonotic potential. The important goal is to detect where harmful viruses can be found. This information enables identification of countries with a high risk for viral spillover from animals to humans and provides a chance for politicians to develop strategies to address these specific threats. Especially risk countries should invest in health-care resources, because the need of trained personnel to detect and monitor zoonotic outbreaks is obvious. However, global funds should be made available to those countries that struggle to provide such resources, as the effects of a pandemic can be felt worldwide, as we are just experiencing.

The close interconnection throughout the world, whether by road, railway or air travel, leads consequently to a very rapid spread of viruses. People are so closely connected that new diseases can quickly turn into a pandemic. Identification and collection of microbes of wild animals as well as those of livestock is essential to reveal viruses that are already shared by animals and humans. Nathan Wolfe, Visiting Professor in Human Biology at Stanford University initiated the Global Viral Forecasting Initiative (GVFI), a program in which experts from all over the world collaborate to determine the transmission mode of identified infectious agents, which could serve as an important hint to launch successful tactics for blocking pandemic outbreaks (Wolfe, 2009). To that end, a worldwide early warning system should be implemented, needed to avoid and halt local and epidemic outbreaks before a pandemic situation emerges.

Possible solutions - Transform society into more green one

The main priorities during any global pandemic are to prevent further spread and secure human health and safety. The COVID-19 pandemic has led to a large economic shutdown and social human isolation, which in turn has brought more awareness to some noticeable environmental issues (Corlett et al., 2020). In order for humans to thrive on the planet we must find a way to utilise resources in a balanced manner with the natural environment because health and quality of life depends drastically on the health of the environment (Streimikiene, 2015). There have been noticeable environmental changes due to actions taken during COVID-19 such as reduced air pollution (warming gases) (Anjum, 2020), push for bans on wildlife trade (Block & Amundson, 2020), raised awareness of human environmental impacts on wildlife (Vidal, 2020) etc.

With growing awareness and knowledge regarding these environmental issues it is crucial that aims of transitional development and changes are made even before restrictions due to COVID-19 are fully eased. While positive environmental changes occur during the COVID-19 pandemic they can be just as easily reversed if people do not take the opportunity to change and learn (Anjum, 2020). It is now important to maintain and strengthen the positive trend after the crisis. For this purpose, a trans-national Marshall Plan for Nature is needed. Throughout this pandemic we have seen that technology for efficient communication is readily available which could lead to the transition to a “work from home” lifestyle and can reduce long distance travel for meetings or work commutes. With the aid of new technologies and methods we can also begin to implement alternative agricultural practices such as hydroponics to give an example that can provide certain plant-based foods year round rather than seasonally which can also help reduce importing and exporting of these foods (Malik et al., 2018).

Other concerns during this pandemic are the trade and consumption of exotic/wild animals (see above). Shutting down this trade may seem like the most obvious answer, however, many of these markets thrive in underdeveloped or poor countries which in many cases rely on these meats as a main food source. Stricter enforcement and implementation of laws by authorities are indeed needed to curb illegal wildlife trade and consumption. However, alternative affordable protein sources should also be available as many cannot afford domestic meats. This is a problem that needs attention on a global scale as the majority of countries who engage in illegal meat trading and consumption may not have the means or resources to implement affordable alternatives (Mainka & Trivedi, 2002).

Future perspectives – life on earth after a “green transition” towards a sustainable society

To pose a far too simple question – is the human society ready for a green transition? We got some insight from a larger public survey among 1000 Austrians, which was undertaken end of April, still at the peak of the pandemic in Europe (see Appendix below). The result clearly shows three aspects: (1) There was a lack of public knowledge regarding zoonoses and their relationship with nature. (2) The Austrian population trusts scientific expertise when informed about this relationship. And (3) More than 80% would urge the EU to use the current crisis to develop and implement a Europe-wide protection plan to protect nature and reduce habitat loss. This is a clear result suggesting that the Austrian society is voting for starting a green transition urgently.

Host shift of parasites resulting in new diseases is a natural phenomenon, but zoonoses could be reduced by measures outlined above, also by actions that result in the conservation of habitats and modified land use. The risk of newly emerging pandemics might then be reduced, but will always be there. The complexity of an evolving nature, ecosystems and species interactions must be taken in account in the progress of human society. A “green society” in 2050 might use renewable energy sources, have halted the climate crisis and have found ways for smart food production, including technical advances for highly productive agriculture on the one hand, and biodiversity-promoting traditional agriculture on the other hand. The COVID-19 crisis has demonstrated the fragility of our societies and our economical systems. But it also provides an opportunity for improving local, regional, national, European and global efforts to mitigate the pressing climate and environmental crisis and to stop the exploitation of nature. Biological research and knowledge will play an important part in achieving this goal.

Comments and acknowledgements

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Appendix – Interview survey data

Implementation: 28.04-29.04.2020; number of persons interviewed (online interviews, two questions): 1000 - representative for the Austrian population; age > 16 years to ultimo, quotas are based on age, gender and province. The interviewees correspond in their composition, in quoted and unquoted characteristics, to the Austrian population aged 16 and higher. Slight deviations were corrected by a representative weighting. This agreement within the limits of statistical accuracy (statistical fluctuation margin: +/-3.16 %) is a necessary condition for the results to be generalised.

Short summary public survey:

B1: *Denken Sie, dass die Zerstörung natürlicher Lebensräume (zB die Abholzung des Regenwaldes, Aussterben einzelner Tierarten, Urbanisierung) und der damit einhergehende Verlust der Artenvielfalt im Zusammenhang mit dem Ausbruch der Corona Pandemie steht?* Bei dieser Frage gehen die Meinungen der österreichischen Bevölkerung stark auseinander. 44,5% glauben, dass die Coronakrise im Zusammenhang mit der Biodiversitätskrise stehen und 55,5% halten dies für unwahrscheinlich.

Translation: *Do you think that the destruction of natural habitats (e.g., deforestation, extinction of animal species, urbanisation) and the resulting loss of biodiversity is related to the outbreak of the corona pandemic?* The opinion of the Austrian population differs greatly on this question. 44.5% believe that the corona crisis is related to the biodiversity crisis and 55.5% think this is unlikely.

B2: *Forschungen haben ergeben, dass die Zerstörung natürlicher Lebensräume das Ausbrechen von Pandemien begünstigt, da automatisch mehr Kontakt von Tieren mit Menschen entsteht. Was denken Sie, soll die EU die aktuelle Krise nutzen um einen europaweiten Plan (wie von diversen NGOs gefordert) zum Schutz der Natur und der Reduktion des Lebensraumverlusts auszuarbeiten und umzusetzen?* Im Vergleich zu der vorherigen Frage B1sind sich der Großteil der befragten Bevölkerung hier sehr einig. Stolze 80,7 % denken, dass die EU die Gelegenheit nutzen soll einen europaweiten Naturschutzplan zu kreieren. Nur 19,3% finden einen Naturschutzplan weniger bis nicht sinnvoll.

Translation: *Research has shown that the destruction of natural habitats favours the outbreak of pandemics, as more contact between animals and humans automatically occurs. What do you think, should the EU use the current crisis to develop and implement a Europe-wide plan (as demanded by various NGOs) to protect nature and reduce habitat loss?* Compared to the previous question B1, the majority of the population surveyed is very much in agreement here. A remarkable 80.7% think that the EU should take the opportunity to create a Europe-wide conservation plan. Only 19.3% think that a nature conservation plan makes little or no sense.

Raw data of survey:

b1: Denken Sie, dass die Zerstörung natürlicher Lebensräume (zB die Abholzung des Regenwaldes, Aussterben einzelner Tierarten, Urbanisierung) und der damit einhergehende Verlust der Artenvielfalt im Zusammenhang mit dem Ausbruch der Corona Pandemie steht?			
N = 1023	%	N	%
Kann ich mir auf jeden Fall vorstellen		201	19,6
Kann ich mir bedingt vorstellen		254	24,8
Glaube ich weniger		317	31
Glaube ich nicht		251	24,5

Mean:	2.6041
Std. Deviation:	1.0602
Variance:	1.1239
Minimum:	1
Maximum:	4
Sum:	2664
N:	1023
Missing(s):	0

b2: Wissenschaftliche Forschungen haben ergeben, dass die Zerstörung natürlicher Lebensräume das Ausbrechen von Pandemien begünstigt, da automatisch mehr Kontakt von Tieren mit Menschen entsteht. Was denken Sie, soll die EU die aktuelle Krise nutzen um einen europaweiten Plan (wie von diversen NGOs gefordert) zum Schutz der Natur und der Reduktion des Lebensraumverlusts auszuarbeiten und umzusetzen?			
N = 1023	%	N	%
Auf jeden Fall		468	45,7
Eher doch		358	35
Weniger		123	12
Nicht wirklich		74	7,2

Mean:	1.8074
Std. Deviation:	0.9115
Variance:	0.8308
Minimum:	1
Maximum:	4
Sum:	1849
N:	1023
Missing(s):	0

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