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Rewilding as a way of preserving ecosystem

Material for students



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Project office: Ks. Janusza 64, 01-452, Warsaw, Poland <http://odyssey.igf.edu.pl> edukacja@igf.edu.pl



Institute of Geophysics
Polish Academy of Sciences



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Introduction

Resolution

The best way to preserve an ecosystem is by rewilding.

Definitions

Trophic cascades

Predators feed on their prey. By doing so, predators can influence the abundance and behavior of prey. In other words, prey abundance can be reduced if there are predators nearby, or prey can hide or move further. When the influence of a predator on its prey is so large that it reduces the trophic level at another level of the food chain affecting the density and/or behavior of prey, ecologists call this interaction a *trophic cascade*.

For a long time, the prevailing ecological theory was the one stating that climate and local resources control species distribution and primary production in ecosystems - the level of organic ingredients in an ecosystem produced by plants and other photosynthetic organisms.

Since the world is rich in vegetation, the effect of unstoppable consumption of plants was considered an exception and was seen as a relatively insignificant factor. However, over the last half of the century, it has become quite clear that consumers play a very important role in ecosystems, even if wildlife is predominant in them.

The interesting part is that this effect, which is caused by the (excessive) consumption of plants, is tightly related to predators. When the ecosystem is rich in vegetation, predators are usually the ones who keep the herbivore population at an appropriate level. On the other hand, when the plants are over-consumed, the loss or relocation of predators are to blame for the expansion of pastures and the extinction of vegetation. This three-level trophic interaction, where predators work for the benefit of plants by controlling the herbivore population, is known as *atrophic cascade*.

Megafauna

In terrestrial zoology, the term megafauna (from Greek *μέγας* (large) and Latin *fauna* (animals)) refers to large or giant animals. Usually, the lower threshold is the weight of 44 kilograms. In scientific literature, this term usually refers to terrestrial mammals larger than humans which are not domesticated. It is especially associated with Pleistocene megafauna or extinct terrestrial animals that are considered archetypal for the last ice age, such as mammoths, most often larger than their modern relatives. As for the extant animals, megafauna includes elephants, giraffes, hippos, rhinos, cattle, etc. According to their diet, species of megafauna can be grouped into three categories: *mega herbivores* (e.g. elephants), *megacarnivores* (e.g. lions), *mega omnivores* (e.g. bears).

The Pleistocene

The Pleistocene epoch is part of the geological chronology. The name Pleistocene comes from the Greek words *pleistos* (most) and *ceno* (new). The Pleistocene follows the Pliocene epoch and precedes the Holocene epoch. In 2005, the International Commission on Stratigraphy (a body of the International Union of Geological Sciences) dated the Pleistocene to 1.81 million years ago and its end to 11,550 years before our time, with the end expressed in radiocarbon years. It covers most of the period of frequent glaciations, until the final cooling, called the Younger Dryas, which ends around 9,600 BP (around 11,550 calendar years ago). The mass extinction of large mammals (megafauna), which included mammoths, mastodons, tiger sabers, gliptodonts and land sloths, started at the end of the Pleistocene and continued into the Holocene. Mass extinctions were particularly severe in North America where native horses and camels disappeared. The end of the Pleistocene corresponds to the end of the Paleolithic age.

Rewilding

Loss, degradation or overexploitation of the environment and the natural habitat are the main causes of species extinction. Since the beginnings of human expansion (*Homo sapiens*), humans have overexploited vertebrates. The largest animals (megafauna) were extinct among the first, influencing the extinction of terrestrial megafauna during the late Pleistocene, and the ongoing extinction of large animals from terrestrial, marine and freshwater ecosystems. There is increasing evidence that this global wildlife loss, or defaunation, not only leads to the extinction of megafauna, but also leads to the disappearance of functions large animals had in ecosystems.

Rewilding, a novel approach to ecological restoration, has recently been proposed in order to restore these ecosystem functions. In the most general sense, the aim of rewilding is to restore natural processes in ecosystems. This most often involves the resettlement (reintroduction) of large wild species into endangered ecosystems, and in the case of species that were extinct in the past, the introduction of their closest phylogenetic relatives.

Many environmentalists agree that most of the world's ecosystems last functioned independently of the influence of modern humans before the so-called Pleistocene extinction – around 50,000-7,000 years ago. Globally, 97 genera of large animals (weighing over 44 kilograms), collectively referred to as megafauna, disappeared during this period. The cause of megafaunal extinction was man, or hunting by man, as well as climate change, or a combination of both.

Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and is adapted to them. This is why it is necessary to (re)introduce megafauna into endangered ecosystems and thus restore the natural relationships and functions that existed in them before the adverse influence of man.

This is why the Pleistocene ecosystems, and especially those of the late Pleistocene period, are considered to be the starting point for how ecosystems function without the influence of man, which is also the main measure of the ecological concept of rewilding, which should consolidate, revitalize and restore ecosystems to their initial state.

Rewilding is believed to have been first discussed by Dave Foreman in 1992, and its definition has evolved and changed several times. This evolution to a certain extent reflects the changing trends that have shaped conservation biology during the past decade. Scientific literature provides several frameworks for discussing rewilding, however, two approaches are dominant - Pleistocene rewilding and trophic rewilding.

Pleistocene Rewilding

Pleistocene rewilding is a term which refers to the restoration of ecological processes lost because of the late-Pleistocene megafaunal extinction. Josh Donlan and his associates (2005) drew the attention of their colleagues with this bold and ambitious approach to ecosystems preservation which includes taxonomic substitution or the reintroduction of proxy species from other continents to serve the functions of the extinct megafauna.

Trophic rewilding

Trophic rewilding is an approach that focuses on reactivating bottom-up trophic reactions. This approach is close to the Pleistocene rewilding - it rejects its historical benchmark related to the Pleistocene epoch, but retains its main theoretical assumptions: (1) megafaunal processes are important for the structure and functioning of ecosystems because they support overall biodiversity in different ways, especially through top-down trophic cascades, thus promoting environmental biodiversity; (2) rich megafauna has been common around the world and in different evolutionary epochs in the past, and as a result modern species assemblages have evolved and adapted to ecosystems rich in megafauna; (3) the disappearance of megafauna in the recent and distant past has led to changes in ecosystems and reduced biodiversity.

Introductory questions

1. What would happen if agricultural land which had been cultivated regularly for years would be left to its own devices? From the point of view of preserving biodiversity, would this be positive? Would it be acceptable for the local community and decision makers?
2. When should man intervene to prevent the extinction of species in the wilderness? What measures could be taken?
3. Is rewilding a sensible and sustainable goal? How can we determine and test this?
4. How would you feel if you knew that there are wolves in the area where you live?

Worksheet

Topic
Environmental preservation
Resolution
The best way to preserve an ecosystem is by rewilding.

Task 1.

The "Introduction" tab provided by the teacher contains a set of questions to help prepare arguments for the debate. On their basis, prepare a set of arguments and group them into those that are clearly PRO the resolution, AGAINST the resolution and those arguments that can be used by both sides. Enter them in the appropriate places in the table.

PRO	DEBATABLE	CON
<p>1. Today's species have evolved when the Earth was dominated by megafauna (large predators and herbivores), extinct mainly due to direct or indirect human influence. Therefore, it is necessary to introduce megafauna into the endangered ecosystems and renew the connections and functions that existed before the detrimental human action.</p> <p>2. Rewilding is a collective name for several ecological approaches offering a wide range of solutions for environmental problems we are faced with today.</p>		<p>1. Rewilding as a project is destined to fail. From the Pleistocene until today, ecosystems have changed immensely, and species have had enough time to adapt to the conditions with no megafauna, which disables plans for reviving past ecosystems.</p> <p>2. An insufficiently definite and imprecise definition brings confusion and contradicted views about the main goals and means of rewilding.</p> <p>3. Rewilding can have many undesired consequences for people; the relationship between humans and the wilderness has always been characterized by a series of paradoxes.</p>

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3. Every rewilding project can have a positive influence on local life habits and people's wellbeing.

4. Not only is it a novel and promising environmental concept, rewilding is somewhat of a narrative of hope.

4. Rewilding is the new Pandora's box of environmental preservation and can harm biodiversity.

FACTS FOR PROPER ARGUMENTATION

Below you will find Info cards, Story cards and Question cards. Read them carefully and analyse in order to formulate good arguments for the debate.

Info card 1 Facts and data	Info card 2 Facts and data	Info card 3 Facts and data	Info card 4 Facts and data
<p>We need rewilding. Today's species evolved when Earth was dominated by megafauna (large predators and herbivores), which were largely exterminated by man, directly or indirectly. Therefore, it is necessary to inhabit the endangered ecosystems with megafauna and restore the relationships and functions that prevailed in them before the adverse human impact.</p> <p>The concept of rewilding relies on what we know about the functioning of ecosystems in the past, their functioning in the absence of human influence, or at least under lesser influence of humans.</p> <p>Many environmentalists agree that most of the world's ecosystems functioned independently of the influence of modern man before the so-called Pleistocene extinction - which took place around 50,000-7,000 years ago. Globally, 97 genera of large animals (weighing more than 44 kilograms), collectively referred to as megafauna, were extinct during this period! The extinction of megafauna was caused by humans, or more specifically uncontrolled hunting, as well as climate change - or, most likely, a combination of both.</p>	<p>Rewilding is a collective name for a number of environmental approaches that offer a range of solutions to the environmental problems we are faced with today.</p> <p>Rewilding is an ambitious alternative to the existing approaches to environmental conservation, and this term covers a range of ecosystem management ideas and practices. This term has several meanings. It is usually understood as the long-term maintenance or increase of biodiversity while reducing the impact of past and present human interventions through the restoration of species and ecological processes.</p> <p>The term rewilding came out of the collaboration between conservation biologist Michael Soule and environmental activist David Foreman in the late 1980s, which led to the creation of <i>The Wildlands Project</i> in North America. In this version of rewilding, the focus was on connecting the area and releasing keystone species into the wild - most important of which were wolves. This approach is called the 3Cs (core areas, corridors, and carnivores). Soule and his associates sought to set</p>	<p>Every rewilding project can have a positive influence on local life habits and people's wellbeing.</p> <p>Ecosystems management assessments cannot be made without taking into consideration the consequences to people. All areas that are candidates for rewilding are more or less under the influence of humans and have a history of use by humans. Accordingly, a rewilding project can affect local life habits and people's wellbeing. Social change can have a positive influence on ecosystems and vice versa, and characteristics of an ecosystem are often defined by human decisions focused on particular ecosystem resources and functions. Consideration of interactions between ecosystems and humans in decision making and communicating the benefits of wildlife to the wider community can encourage actions which benefit both ecosystems and human communities, increasing the acceptability and success of rewilding.</p> <p>Rewilding plays an important role due to its intangible contribution to nature and the values that biodiversity brings with it. An increasing number of scientific studies shows that exposure to green and natural</p>	<p>Not only is it a novel and promising environmental concept, rewilding is somewhat of a narrative of hope.</p> <p>Global changes caused by humans are increasingly affecting life on our planet, including the living conditions of humans themselves and the resources we depend on. Globally, according to the <i>Living Planet Index</i>, between 1970 and 2012, fish, mammal, and bird populations declined by 58% - between 36% and 38% in terrestrial and marine ecosystems and by 81% in freshwater ecosystems.</p> <p>The disappearance, degradation or overexploitation of the environment and habitat are the main causes of this plummet. From the very beginning of their expansion, humans (<i>Homo sapiens</i>) have overexploited vertebrates, and the largest animals were among the first to disappear, both the terrestrial megafauna during the Late Pleistocene, and the current ongoing extinction of large animals from terrestrial, marine and freshwater ecosystems.</p> <p>Rewilding, in the most general sense, tends to restore natural processes in ecosystems, most often focusing on the reintroduction of large wild species, and if it is an extinct</p>

<p>Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and it is adapted to them. In the Pleistocene era, populations of megaherbivores and large predators were much larger than they are today. This is why it is necessary to (re)introduce megafauna into endangered ecosystems and thus restore the natural relationships and functions that existed in them before the adverse influence of man. Pleistocene ecosystems, and especially those of the late Pleistocene period, are the starting point for how ecosystems function without the influence of man, which is also the main historical measure of the ecological concept of rewilding, which should consolidate, revitalize and restore ecosystems to their initial state. Megafaunal extinction led to the so-called "trophic cascades". In short, a trophic cascade can be described as follows: predators influence prey abundance and behavior; the abundance of prey can be reduced if there are predators nearby, or the prey can hide or move further away; when the influence of a predator on its prey is so large that it reduces the trophic level on another level of the food chain (which affects the population density of prey's prey, which is in our case vegetation), then this phenomenon is called the trophic cascade. According to trophic cascade theory, the plant world survives because higher trophic levels (large predators at the top of the food chain) control the abundance of</p>	<p>rewilding and biodiversity conservation as complementary goals. What is it about? From the 1920s to the present day, the area under aspen trees (<i>Populus tremuloides</i>), a key plant species in mountain forests in the western United States, has declined significantly and the average age of trees has increased. The disappearance of the aspen tree was associated with the disappearance of gray wolves (<i>Canus lupus</i>) from Yellowstone National Park (USA) between 1880 and 1920. Namely, due to the disappearance of wolves, the population of elk (<i>Cervus elaphus</i>) whose herds ruthlessly grazed on the vegetative shoots of aspen trees increased enormously. The reintroduction of wolves into Yellowstone is cited as the most prominent practical example of this approach - wolves have influenced the behavior and density of elk populations (decreased the population) and indirectly stimulated the growth and development of favorite elk prey, young aspen shoots, thus dramatically affecting the plant community structure in this vast area. Conservation biologist Josh Donlan expanded Soule's initial vision into a concept highly influential today, which envisions the revival of ecologically destroyed areas of North America through the restoration of Pleistocene megafauna. Donlan suggests that the ecological structure of ecosystems from the Pleistocene epoch, the structure that existed before the extinction of the</p>	<p>environments and spaces can reduce stress levels, promote positive emotions and cognitive functions, stimulate physical activity and promote social cohesion in humans. Above all, the wilderness experience provides an opportunity for ecotherapy and the promotion of psychological relaxation in children and adolescents, as well as for transformation and self-fulfillment in adults. Moreover, the pleasure that comes from knowing that certain species and ecosystems are in excellent condition can also be felt by people who are geographically far away from the rewilding location. The presence of charismatic and iconic species or natural landscapes can inspire spiritual, artistic and technological growth. Rewilding can encourage and motivate activities which are inextricably linked to nature such as, for example, bird watching. Attending and witnessing natural processes, such as migration of swallows or storks, promotes a sense of belonging and connection, which can form the basis for the narratives, rituals and ceremonies that shape cultural identities. The economic benefit is that it opens up space for a nature-based economy and alternative sources of income based on intangible contributions to nature (exercise and similar activities). Finally, occasional disturbances in nature can trigger innovation and change in socio-ecological systems. In other words, rewilding encourages thinking about different regulatory measures and</p>	<p>species, then on introducing their (taxonomically) closest relatives. In addition to being a new and promising environmental concept, rewilding is in itself somewhat of a narrative of hope, and is it expected to stop or at least slow down defaunation and prevent further disruption of biodiversity. Recently, states who signed the Convention on Biological Diversity have started a debate on strategies which should be implemented beyond 2020. The United Nations General Assembly recently made the next decade 2021-2030 "a decade of ecosystems restoration". It is rewilding that provides one of the possible directions to a vision in which "in 2050 biodiversity will be something that will be respected, preserved, restored and managed wisely, preserving ecosystem functions." Rewilding can provide new approaches to ecosystems restoration. After all, the <i>Aichi Biodiversity Target 15</i> document, which predicts that 15% of degraded ecosystems will be restored by 2020, could be reviewed by marking rewilding as the main approach in ecological restoration, especially given the 2030 global targets set by the UN General Assembly.</p>
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herbivore populations, thus indirectly controlling the negative impact that herbivores have on plant populations. Therefore, the world remains green owing to a three-member trophic interaction, where predators control grazers, as these would otherwise consume plants and eliminate much of the vegetation. With the extinction of large predators and megaherbivores from the Pleistocene period, the vegetation structure also changed, and during that process the natural habitats of many smaller animals, which also became extinct, disappeared.

megafauna, should be the main indicator for the restoration of destroyed ecosystems, and this can only be achieved by introducing (inhabiting) surrogates of species that were extinct near the end of the Pleistocene. For example, an African or Asian elephant and lion could be settled instead of extinct species, such as the American mastodon (*Mastodon americanum*) and the American lion (*Panthera atrox*). The European approach to rewilding is mainly focused on re-establishing large herbivores communities (or their closest taxonomic relatives) - cattle, horses, feral pigs, beaver and bison - who graze and brush plant vegetation, this way restoring or creating complex and numerous species-rich ecosystems in areas previously used for agriculture or forestry. In this version, rewilding may include the release of captive animals into the wild, as well as the return (reintroduction) of endangered species.

solutions based on nature, which concern climate, air quality, etc.

Info card 5 Facts and data	Info card 6 Facts and data	Info card 7 Facts and data	Info card 8 Facts and data
<p>Rewilding as a project is destined to fail. From the Pleistocene until today, ecosystems have changed immensely, and species have had enough time to adapt to the conditions with no megafauna, which disables plans for reviving past ecosystems.</p> <p>There is no doubt that many ecosystems need protection. However, when it comes to the increasingly discussed new concept - rewilding, there is a danger that existing ecosystems, which still manage to persevere and survive, will get into even worse condition due to the incautious introduction of new species, and that the relationships developed in them will be disrupted.</p> <p>There are several reasons for concern. In the last 13,000 years, since the Pleistocene extinction, an ecosystem planned for rewilding has had enough time to change and adapt to the absence of megafauna, which is exactly what happened.</p> <p>The global climate has changed and many species have survived, finding their ecological balance with other species, potentially stopping any plans to restore past ecosystems. Therefore, introduced species cannot respond properly to today's environment since they are not adapted to</p>	<p>An insufficiently definite and imprecise definition brings confusion and contradicted views about the main goals and means of rewilding.</p> <p>Rewilding primarily concerned the restoration of self-regulated ecosystems, with a strong emphasis on the role of predators in top-down ecosystem control. Today, the focus is on introducing or reintroducing species as a way of restoring ecosystem functioning through the enhancement of natural processes that are presumed to have existed before ecosystems were altered and rearranged by man through various interventions. We want to indicate that there is no consensus on what rewilding is and what it is not, which puts us at risk because we cannot clearly understand the goals of rewilding, nor can we clearly see the benefits it brings or foresee its potentially adverse consequences.</p> <p>We also want to point out the limitations to the main ecological assumption behind the concept of rewilding, which is top-down ecosystem control. Namely, ecological systems and relationships within them are dynamic, and species in ecosystems are in an ongoing process of evolution, which makes it difficult to predict with certainty the consequences of introducing new species.</p>	<p>Rewilding can have many undesired consequences for people; the relationship between humans and the wilderness has always been characterized by a series of paradoxes.</p> <p>Rewilding may pose a threat to people and human infrastructure. Conflicts between people and wild animals - for example, because herbivores destroyed crops or because large predators killed cattle - are becoming more frequent and more serious in those areas where animals have been reintroduced or in areas where former abundance of wild populations has been recovered.</p> <p>In addition, rewilding can cause controversy and resistance in humans if it leads to significant changes in areas rich in tradition and cultural and natural heritage. Namely, rewilding can affect the aesthetic impression of an area, as well as a sense of connection and belonging to a local area, and may cause discomfort to the local population due to removal of traces of human history, its connection with the land and its "traditional flora and fauna".</p> <p>Generally speaking, the connection between humans and the wilderness is characterized and has always been characterized by a number of paradoxes. For the prehistoric man, the wilderness paradox was reflected in the fact that it was at the same time a "constant threat to</p>	<p>Rewilding is "the new Pandora's box of environmental preservation" and can harm biodiversity.</p> <p>At the moment, data on explicit attempts of rewilding are scarce, and scientific sources mainly consist of essays and articles that put forward the views and personal opinions of researchers. The most controversial aspect of rewilding, as many critics of the concept point out, is that it is a "new Pandora's box in environmental conservation" which can harm biodiversity, and that particular danger lies in the spread of exotic species in ecosystems which they have never inhabited before. The biggest problem is not that lost interactions in an ecosystem may not be restored, but the biggest problem is the risk that some new, unwanted interactions will emerge. Experience tells us that there are numerous examples indicating the extent of this risk. Many species have taken on new and unpredictable ecological roles and niches after inhabiting new areas, which often led the existence of local native species to a tragic outcome. In fact, around half of the introduced vertebrate species became pests!</p> <p>If proponents of rewilding plan to ignore these lessons, it is highly likely that native populations will continue to disappear. An age-old ecological process cannot be</p>

<p>it. For example, elephants, whose introduction is proposed, do not possess the thick fur of their Pleistocene ancestors, and cannot cope with the cruel winters of the American plains. The second species also "nominated" as a candidate for rewilding, camels, had previously been colonized in North America, but it soon turned out that today's environment was not hospitable to them.</p> <p>Another scenario, also unfavorable, is possible - the introduced species are so successful that they can disrupt existing food chains and start pushing out native species by taking over their resources and territories, which would ultimately lead to a decrease in biodiversity.</p> <p>In addition, newcomers can also bring along exotic parasites and diseases, which would have unforeseeable negative effects on existing species. Not only is it debatable how introduced organisms will interact with native species, it is also a question how they will interact with all other organisms. For example, Eurasian horses have never encountered an African cheetah before, since they lived in geographically very distant locations. Therefore, it is unknown how these two species will cope with each other, as interactions between them have never been the subject of research, and it could reasonably be expected that surprising and unexpected behaviors might occur under new circumstances.</p>	<p>There are numerous failed examples of introductions or reintroductions, examples of when introductions or reintroductions caused unexpected negative consequence. This is also a financially very expensive undertaking, which is not negligible. Therefore, we need to be cautious and to shed light on and better understand the many unknowns of wildlife, as well as all the possible outcomes, especially environmental ones.</p> <p>When it comes to the restoration (renewal) of an ecological epoch, one of the biggest problems is that we do not know to what extent an ecosystem should be restored. This issue is crucial for determining the goals of individual rewilding projects. Therefore, it is necessary for paleontologists to provide more information on what ecosystems were really like in the distant past. Fossil remains provide a limited set of information, which are often scarce in some areas. Due to the fact that we are much more familiar with the structure of ecosystems from the not-so-distant past, it may be better to focus rewilding projects on the state of ecosystems from those periods rather than the Pleistocene. In that sense, the introduction of wolves into Yellowstone Park is often highlighted as a successful example of rewilding - and wolves have been absent from this area for just around a century.</p> <p>On the other hand, Pleistocene rewilding projects focus on periods of the past which date back more than 100 centuries ago.</p>	<p>human life and livelihood", and the perception of modern man is also contradictory - on the one hand "nature is a potentially dangerous, alienating and challenging place", but it is also "a potentially peaceful refuge to relax and conveniently enjoy".</p> <p>Probably the biggest obstacle to rewilding is that it is very difficult to convince people that there is nothing problematic about living near elephants or lions, which can harm their crops, pets, and even humans themselves. Even though ecotourism would bring income to the local community, the feeling of lack of security for the locals would be too high a price for rewilding.</p> <p>Throughout history, humans have been in a state of war with predators. Lion killers were heroes in Greek mythology. Shepherds bred large and aggressive dogs to deal with wolf and bear attacks in the Pyrenees, Carpathians or elsewhere. Landowners in Britain tried to exterminate foxes, hawks and badgers every way they could. In the US, a federal agency (the Department of the Interior) hired hundreds of agents to hunt, trap and poison wolves, cougars, coyotes, eagles, and many other smaller predators. Alaska and Canada rewarded those who kill seals and sea lions, and the reason was "improving fishing".</p> <p>It needs to be noted that rewilding comes with high costs. Starting a rewilding project requires securing the land for it, which means the construction of miles and miles</p>	<p>replicated onto today's state. Therefore, we have little reason to believe that it makes sense to inhabit many large animals and to expect that this would start processes similar to those of the late Pleistocene. Moreover, ecological consequences in the form of unwanted ecological interactions with native species could extend across whole continents in ways that are difficult to predict.</p> <p>Pandora opened the box and set evils free, but she also found Elpis, the spirit of hope. Biodiversity faces numerous threats on the brink of the sixth major mass extinction. The evils of catching, spreading invasive species, destroying natural habitats and climate change demand hard work, vigilance and creativity of scientists, environmentalists and policy makers and decision makers.</p> <p>And we hope that our efforts will stem from precise and detailed ecological theories and that they will offer sustainable solutions for biodiversity conservation - not just an opportunity to enjoy the scenery roamed by large wild beasts.</p>
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	<p>The question is whether this period is too long - because during this time interval many species have been able to evolve and adapt to the absence of Pleistocene-era megafauna. We consider the approach of taxonomic substitution to be too ambitious and dangerous, using phylogenetically related species from other continents or biogeographic regions to perform the functions of extinct megafauna. We are probably dealing with an absurd concept devised by a small group of conservation biologists who have little understanding of the practical consequences and policy of animal translocation.</p>	<p>of fencing that could stop the expansion of, for example, elephants and lions, including the substantial costs of transporting animals from their country of origin to the American continent. Since the Pleistocene rewilding would be too expensive, many suggest it is better to invest money in the preservation of the megafauna in its natural area of distribution. This would provide income from ecotourism for locals in these mostly underdeveloped countries.</p>	
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Stories	Stories
<p>Danger Arrange these threats in ascending order of deadliness: wolves, vending machines, cows, domestic dogs and toothpicks. I will save you the trouble: they have been ordered already. The number of deaths known to have been caused by wolves in North America during the twenty-first century is one: if averaged out, that would be 0.08 per year. The average number of people killed in the US by vending machines is 2.2 (people sometimes rock them to try to extract their drinks, with predictable results). Cows kill some twenty people in the US, dogs thirty-one. Over the past century, swallowing toothpicks caused the deaths of around 170 Americans a year. Though there are sixty thousand wolves in North America, the risk of being killed by one is almost nonexistent. If you find that hard to believe, you are not alone, and not to blame. For centuries we have terrified ourselves with tales of the lethal threat wolves present to humankind, and the unending war being fought with equal vigor on both sides. In reality, wolves are exceedingly afraid of people and in almost all circumstances avoid us. (Source: George Monbiot, <i>Feral – Rewilding the land, sea and human life, Penguin, 2013</i>)</p> <p>Trafalgar Square When Trafalgar Square was excavated in the nineteenth century, presumably to build Nelson’s column, the river gravels the builders exposed were found to be crammed with hippopotamus bones; these beasts wallowed, a little over 100,000 years ago, where tourists and pigeons cluster today. The same excavations – and those conducted in the square in the twentieth century – also revealed the bones of straight-tusked elephants, giant deer, giant aurochs and lions. Lions raised their heads where the monument now stands long before Sir Edwin Landseer got to work. They were larger than those now living in Africa but probably members of the same species. They hunted reindeer across the frozen waste of Europe, and survived in Britain until 11,000 years ago: the beginning of the Mesolithic, when humans returned to the land after their long absence. Spotted hyenas (also still living in Africa) survived in Europe until roughly the same time (their fossilized faeces have been found in Trafalgar Square).</p>	<p>Wolves at Yellowstone Yellowstone National Park (mainly within the US state of Wyoming) covers 898,000 hectares of mountain habitats, grassland, and forest. Humans have lived in the region for at least 11,000 years, and although it was declared a national park in 1872 various forms of intervention continued. Most of the pre-Columbian fauna survived in the park, but wolves were eradicated in the early twentieth century. From the 1960s onward there was discussion about reintroducing the species because of concerns about the impact of the increasing populations of elk <i>Cervus Canadensis</i>, and reintroduction took place from 1995–1996. Subsequent research on growth of aspen, willow, and cottonwood in recent years suggests that wolves have initiated a restructuring of northern Yellowstone’s ecosystems via improved recruitment of woody browse species. Concurrent with the declining elk population, the bison population has been increasing on the northern range. Wolves may be allowing the bison population to increase through a decrease of interspecific competition with lower elk numbers. Increases in beaver have also been seen, likely due, at least in part, to the resurgence of willow communities since wolf introduction. (Source: Lorimer, Jamie and Sandom, Chris and Jepson, Paul and Doughty, Christopher E. and Barua, Maan and Kirby, Keith, <i>Rewilding: Science, Practice, and Politics, Annual Review of Environment and Resources, Vol. 40, pp. 39-62, 2015.</i>)</p> <p>An astonishing fact We live in a zoologically impoverished world, from which all the hugest, and fiercest, and strangest forms have recently disappeared: and it is, no doubt, a much better world... Yet it is surely a marvelous fact... this sudden dying out of so many large mammalia, not in one place only but over half the land surface of the globe. (Alfred Russel Wallace, 1876) Source: John Terborgh, James A. Estes (eds.) <i>Trophic cascades: predators, prey, and the changing dynamics of nature, Island Press, 2010, Washington, DC</i></p> <p>War against predators Humans have been waging war against predators since the dawn of history. Lion slayers were heroes of Greek mythology. Shepherds bred large, aggressive dogs to fend off wolves and bears in the Pyrenees, Carpathians, and elsewhere. Gamekeepers were hired</p>

(Source: **George Monbiot, *Feral – Rewilding the land, sea and human life*, Penguin, 2013**)

Rewilding The Tundra: The Pleistocene Park In Siberia

The North-East Scientific Station and Pleistocene Park are scientific organizations located in northern Siberia, 5 km from the town of Chersky (Yakutia). The North-East Scientific Station was established in 1977 and has become one of the world's largest Arctic research stations.

Pleistocene Park is a major initiative that includes an attempt to restore the mammoth steppe ecosystem, which was dominant in the Arctic in the late Pleistocene. The initiative requires replacement of the current unproductive northern ecosystems by highly productive pastures, which have both a high animal density and a high rate of biocycling. The idea is that during the Pleistocene the collective behavior of millions of competitive herbivores maintained the grasslands.

In the winter, the animals ate the grasses that grew the previous summer. Their activity stimulated plant productivity by fertilizing the soil with their dung; they trampled down moss and woody species, preventing these plants from gaining a foothold.

Experiments with animal reintroductions began in 1988. Currently, Pleistocene Park consists of an enclosed area of 16,000 hectares that is home to five major herbivore species: bison, musk ox, moose, horses, and reindeer, although the bison have not done as well as the other species. The aim is to increase the herbivore density until it is sufficient to influence the vegetation and soil. As the animal density increases, so the fenced boundary will be expanded. There is an ultimate goal of acclimatizing Siberian tigers should the herbivores become sufficiently abundant.

(Source: **Lorimer, Jamie and Sandom, Chris and Jepson, Paul and Doughty, Christopher E. and Barua, Maan and Kirby, Keith, *Rewilding: Science, Practice, and Politics* (November 2015). *Annual Review of Environment and Resources*, Vol. 40, pp. 39-62, 2015.**)

by the great estates of Britain to eradicate foxes, goshawks, and badgers. In the United States, an agency of the federal government, the Biological Survey (later the U.S. Department of the Interior), hired hundreds of predator control agents to shoot, trap, and poison wolves, cougars, coyotes, eagles, and a host of lesser predators. Bounties and culls have been used in Alaska and Canada to control seals and sea lions in the name of fishery management. An almost endless list of such measures could be compiled.

(Source: **John Terborgh, James A. Estes (eds.) *Trophic cascades: predators, prey, and the changing dynamics of nature*, Island Press, 2010, Washington, DC**)

Question card 1	Question card 2	Question card 3	Question card 4
<p>Question: Is composition of species, or their "distribution of forces" in the Pleistocene really the goal we should be aiming for when it comes to ecosystem restoration? How can man, as the one most responsible for the disappearance of animals, restore ecosystems to their proper condition?</p>	<p>Question: Do you think that the current state of ecosystems is satisfactory, and whether maintaining the current state is actually destined to failure? Can we say that today's species have adapted if we know that some of them disappear every day?</p>	<p>Question: What exactly is rewilding? Is it Pleistocene rewilding, trophic rewilding, or passive rewilding? How can we evaluate its value if it is often unclear what is meant by this environmental approach?</p>	<p>Question: Can any environmental approach have foreseeable consequences? Isn't ecology, as a relatively young discipline, constantly developing and reconfiguring - why should we expect rewilding to have a unique definition?</p>
Question card 5	Question card 6	Question card 7	Question card 8
<p>Question: How can we persuade people to accept the reintroduction of large carnivores and is it realistic to expect them to overcome the innate fears they have of them? Could we even expect decision makers and citizens to agree to invest large sums of money into such an expensive and yet uncertain environmental experiment?</p>	<p>Question: Do you think that more needs to be invested in environmental protection and that for the sake of more important goals, we need to put aside a cost-benefit analysis and be more patient with environmental protection? Do you think that people's prejudice and fears of many species are unfounded and that they should somehow be reduced?</p>	<p>Question: What guarantees that reintroduced species will not start to behave differently than we predicted - for example, that they will not become parasites or harmful invasive species? Is rewilding just a utopia, aimed at calming our conscience from over-destroying the living world?</p>	<p>Question: Should we allow species continue to go extinct at high speed, or should we take more radical environmental measures such as rewilding? Should we still take risks, since current environmental measures have not given satisfactory results?</p>

The project has been funded with the support of European Commission within ERASMUS+ program



Prepare arguments for the discussion. One group of students prepares arguments supporting the resolution, the other one has contradictory arguments. Use the proposed scheme.

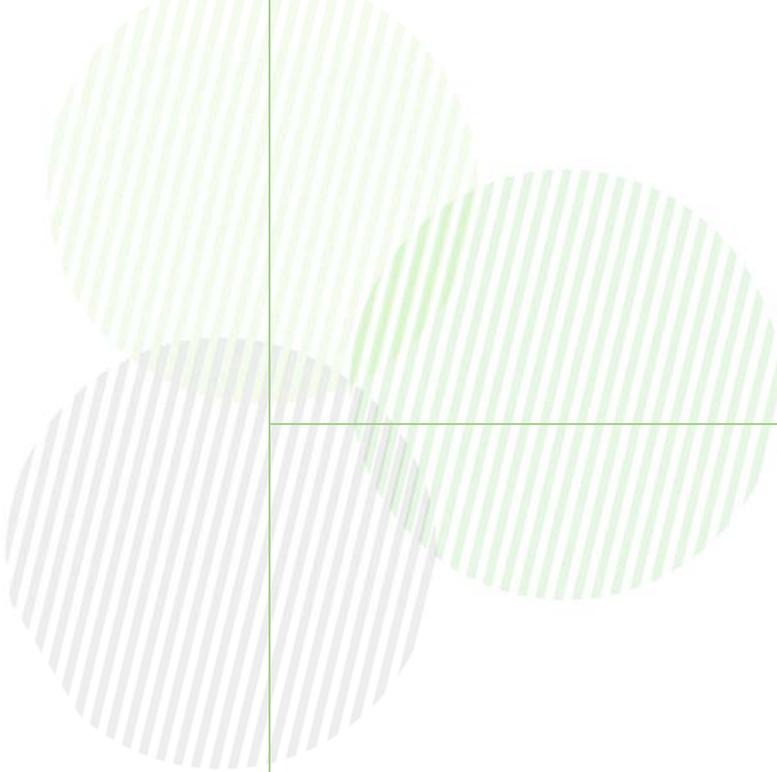
ARGUMENT NO. 1.

Argument	Foreseen rebuttals of the other group	Answers to rebuttals

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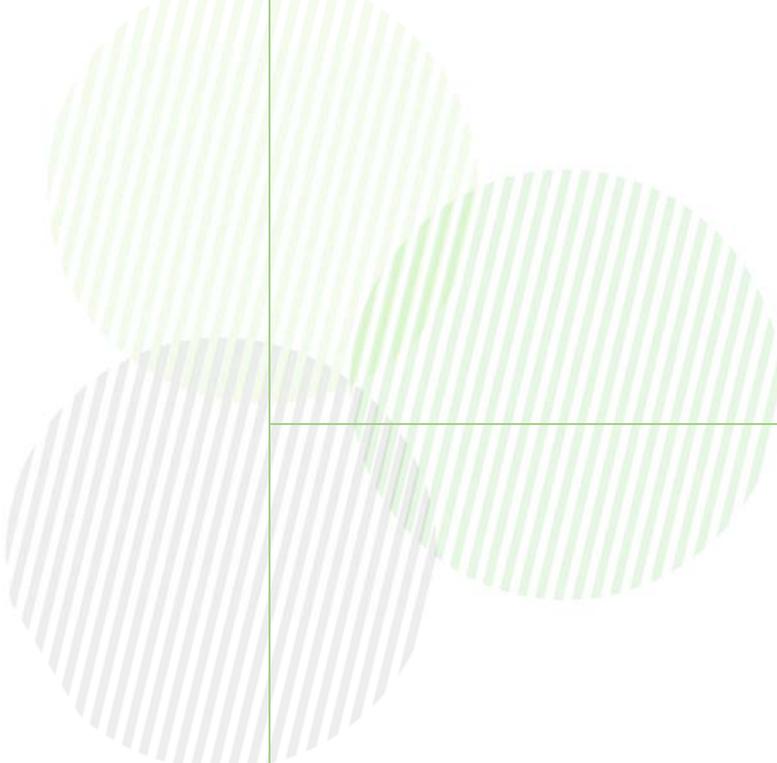
ARGUMENT 2.

Argument	Foreseen rebuttals of the other group	Answers to rebuttals
		

The project has been funded with the support of European Commission within ERASMUS+ program



ARGUMENT 3.

Argument	Foreseen rebuttals of the other group	Answers to rebuttals
		



Debate

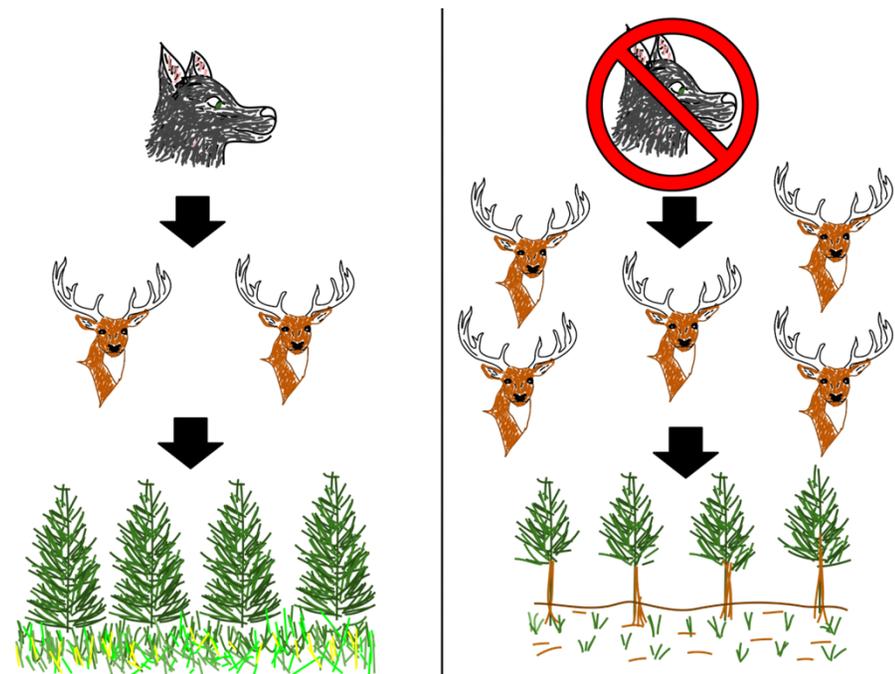
The best way to preserve an ecosystem is by rewilding

Topic: Environmental preservation



Basic terms

- **Trophic cascade** – Predators influence the abundance and behavior of prey. Prey abundance can be reduced if there are predators nearby, or prey can hide or move further. When the influence of a predator on its prey is so large that it reduces the trophic level at another level of the food chain (which affects the density of prey, in our case – vegetation), this is called a trophic cascade.
- **Megafauna** – Megafauna refers to large terrestrial mammals, larger than humans and not domesticated. The term refers especially to Pleistocene megafauna or extinct terrestrial animals, such as mammoths, most often larger than their modern relatives. As for the extant animals, megafauna includes elephants, giraffes, hippos, rhinos, cattle, etc. According to their diet, species of megafauna can be grouped into three categories: megaherbivores (e.g. elephants), megacarnivores (e.g. lions), megaomnivores (e.g. bears).



Source: Wikimedia Commons

- **The Pleistocene** – The Pleistocene epoch is part of the geological chronology. It started 1.81 million years ago and ended 11,550 years ago. The mass extinction of large mammals (megafauna), which included mammoths, mastodons, tiger sabers, gliptodonts and land sloths, started at the end of the Pleistocene and continued into the Holocene.
- **Rewilding** – It is a novel approach to ecological restoration, the aim of which is to restore natural processes in ecosystems. This most often involves the resettlement (reintroduction) of large wild species into endangered ecosystems, and in the case of species that were extinct in the past, the introduction of their closest phylogenetic relatives. Many environmentalists agree that most of the world's ecosystems last functioned independently of the influence of modern humans before the so-called Pleistocene extinction – around 50,000-7,000 years ago. This is why the Pleistocene ecosystems, and especially those of the late Pleistocene period, are considered to be the starting point for how ecosystems function without the influence of man, which is also the main measure of the ecological concept of rewilding, which should consolidate, revitalize and restore ecosystems to their initial state.



Source: Wikimedia Commons



Source: Openclipart

Introductory questions

- What would happen if agricultural land which had been cultivated regularly for years would be left to its own devices? From the point of view of preserving biodiversity, would this be positive? Would it be acceptable for the local community and decision makers?
- When should man intervene to prevent the extinction of species in the wilderness? What measures could be taken?
- Is rewilding a sensible and sustainable goal? How can we determine and test this?
- How would you feel if you knew that there are wolves in the area where you live?



RESOLUTION: The best way to preserve an ecosystem is by rewilding.



Source: Flickr

PRO

1. Today's species have evolved when the Earth was dominated by megafauna (large predators and herbivores) extinct mainly due to direct or indirect human influence. Therefore, it is necessary to introduce megafauna into the endangered ecosystems and renew the connections and functions that existed before the detrimental human action.
2. Rewilding is a collective name for several ecological approaches offering a wide range of solutions for environmental problems we are faced with today.
3. Every rewilding project can have a positive influence on local life habits and people's wellbeing.
4. Not only is it a novel and promising environmental concept, rewilding is somewhat of a narrative of hope.

CON

1. Rewilding as a project is destined to fail. From the Pleistocene until today, ecosystems have changed immensely, and species have had enough time to adapt to the conditions with no megafauna, which disables plans for reviving past ecosystems.
2. An insufficiently definite and imprecise definition brings confusion and contradicted views about the main goals and means of rewilding.
3. Rewilding can have many unwanted consequences for people; the relationship between humans and the wilderness has always been characterized by a series of paradoxes.
4. Rewilding is the new Pandora's box of environmental preservation and can harm biodiversity.

1. Today's species have evolved when the Earth was dominated by megafauna extinct mainly due to direct or indirect human influence, it is necessary to introduce megafauna into the endangered ecosystems and renew the connections and functions that existed before the detrimental human action. (PRO)



Source: Wikipedia

- Many environmentalists agree that most of the world's ecosystems functioned independently of the influence of modern man before the so-called Pleistocene extinction - which took place around 50,000-7,000 years ago.
- The extinction of megafauna was caused by humans, or more specifically uncontrolled overkill, as well as climate change - or, most likely, a combination of both.
- Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and it is adapted to them.
- This is why it is necessary to (re)introduce megafauna into endangered ecosystems and thus restore the natural relationships and functions that existed in them before the adverse influence of man.

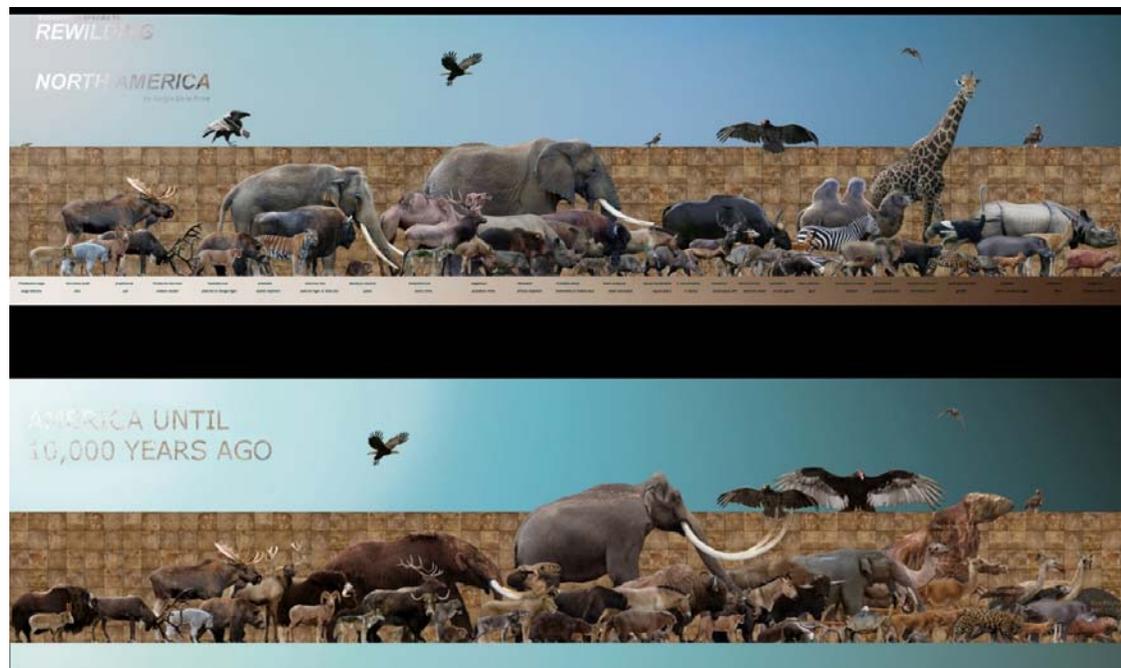
1. Rewilding as a project is destined to fail. From the Pleistocene until today, ecosystems have changed immensely, and species have had enough time to adapt to the conditions with no megafauna, which disables plans for reviving past ecosystems. (CON)



Source: Needpix

- The global climate has changed and many species have survived, finding their ecological balance with other species, potentially stopping any plans to restore past ecosystems.
- Therefore, introduced species cannot respond properly to today's environment since they are not adapted to it.
- It is possible that the introduced species are so successful that they can disrupt existing food chains and start pushing out native species by taking over their resources and territories, which would ultimately lead to a decrease in biodiversity.
- Newcomers can also bring along exotic parasites and diseases, which would have unforeseeable negative effects on existing species.

2. Rewilding is a collective name for a number of environmental approaches that offer a range of solutions to the environmental problems we are faced with today. (PRO)



Source: Wikipedia

- The term rewilding came out of the collaboration between conservation biologist Michael Soule and environmental activist David Foreman in the late 1980s, which led to the creation of *The Wildlands Project* in North America.
- In this version of rewilding, the focus was on connecting the area and releasing keystone species into the wild - most important of which were wolves.
- The reintroduction of wolves into Yellowstone is cited as the most prominent practical example of this approach - wolves have influenced the behavior and density of elk populations (decreased the population) and indirectly stimulated the growth and development of favorite elk prey, young aspen shoots, thus dramatically affecting the plant community structure in this vast area.
- The European approach to rewilding is mainly focused on re-establishing large herbivores communities (or their closest taxonomic relatives) - cattle, horses, feral pigs, beaver and bison - who graze and brush plant vegetation, this way restoring or creating ecosystems.

2. An insufficiently definite and imprecise definition brings confusion and contradicted views about the main goals and means of rewilding. (CON)



Source: Flickr

- There is no consensus on what rewilding is and what it is not, which puts us at risk because we cannot clearly understand the goals of rewilding, nor can we clearly see the benefits it brings or foresee its potentially adverse consequences.
- Ecological systems and relationships within them are dynamic, and species in ecosystems are in an ongoing process of evolution, which makes it difficult to predict with certainty the consequences of introducing new species.
- There are failed examples of introductions or reintroductions and examples of when introductions or reintroductions caused unexpected negative consequence.
- We do not know to what extent an ecosystem should to be restored and this issue is crucial for determining the goals of individual rewilding projects.

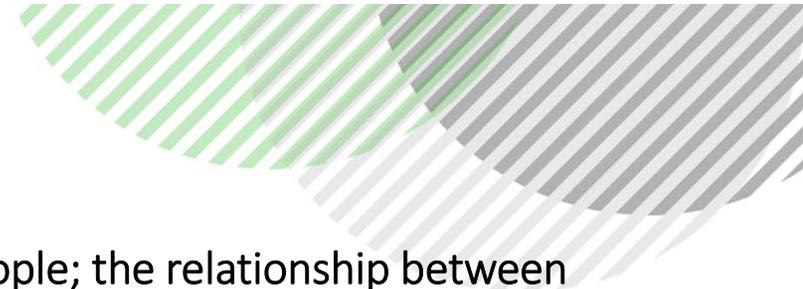


3. Every rewilding project can have a positive influence on local life habits and people's wellbeing. (PRO)



*Source:
Wikimedia
Commons*

- An increasing number of scientific studies shows that exposure to green and natural environments and spaces can reduce stress levels, promote positive emotions and cognitive functions, stimulate physical activity and promote social cohesion in humans.
- Rewilding can encourage and motivate activities which are inextricably linked to nature such as, for example, bird watching.
- The economic benefit is that it opens up space for a nature-based economy and alternative sources of income based on intangible contributions to nature.
- Rewilding encourages thinking about different regulatory measures and solutions based on nature, which concern climate, air quality, etc.



3. Rewilding can have many undesired consequences for people; the relationship between humans and the wilderness has always been characterized by a series of paradoxes. (CON)



*Source: National
Park Service*

- Conflicts between people and wild animals - for example, because herbivores destroyed crops or because large predators killed cattle - are becoming more frequent and more serious in those areas where animals have been reintroduced.
- Rewilding can cause controversy and resistance in humans if it leads to significant changes in areas rich in tradition and cultural and natural heritage.
- It is very difficult to convince people that there is nothing problematic about living near elephants or lions, which can harm their crops, pets, and even humans themselves.
- Since the Pleistocene rewilding would be too expensive, many suggest it is better to invest money in the preservation of the megafauna in its natural area of distribution.



4. Not only is it a novel and promising environmental concept, rewilding is somewhat of a narrative of hope. (PRO)



Source: Wikipedia

- According to the *Living Planet Index*, between 1970 and 2012, fish, mammal, and bird populations declined by 58%.
- In addition to being a new and promising environmental concept, rewilding is in itself somewhat of a narrative of hope, and is it expected to stop or at least slow down defaunation and prevent further disruption of biodiversity.
- The United Nations General Assembly recently made the next decade 2021-2030 "a decade of ecosystems restoration", and it is rewilding that can provide new approaches to ecosystems restoration.



4. Rewilding is "the new Pandora's box of environmental preservation" and can harm biodiversity. (CON)



Source: Wikimedia Commons

- Many species have taken on new and unpredictable ecological roles and niches after inhabiting new areas, which often jeopardized the existence of local native species.
- Around half of the introduced vertebrate species became pests!
- An age-old ecological process cannot be replicated onto today's state.
- We have little reason to believe that it makes sense to inhabit many large animals and to expect that this would start processes similar to those of the late Pleistocene.

STORY (1): Trafalgar Square

Below the Trafalgar Square in London, hippopotamus bones, and bones of ancestors of straight-tusked elephants, giant deer, giant aurochs and lions were.

These lions were larger than those now living in Africa and survived in Britain until 11,000 years ago.

The same place was inhabited by spotted hyenas, which still live in Africa.



Source: Flickr

STORY (2): The Pleistocene Park In Siberia

Pleistocene Park is a major initiative that includes an attempt to replicate the Pleistocene state and restore the mammoth ecosystem.

It consists of an enclosed area of 16,000 hectares that is home to five major herbivore species: bison, musk ox, moose, horses, and reindeer

There is an ultimate goal of acclimatizing Siberian tigers should the herbivores become sufficiently abundant.



Source: Needpix



Erasmus+

Video material:

Ivan Umeljić / ODYSSEY debate: The best way to preserve an ecosystem is by rewilding

<https://youtu.be/pSkUaLb8emY>

George Monbiot: For more wonder, rewild the world

https://www.ted.com/talks/george_monbiot_for_more_wonder_rewild_the_world?language=en

George Monbiot: An animated guide to rewilding made simple

<https://www.youtube.com/watch?v=X-qquAUA1TI>

George Monbiot: From the top of the food chain down: Rewilding our world

<https://www.youtube.com/watch?v=t3I9gDocYdk>

Why humans run the world | Yuval Noah Harari

<https://www.youtube.com/watch?v=nzj7Wg4DAbs>



The best way to preserve an ecosystem is by rewilding

Material for teachers

With methodological guidelines, a lesson plan and an answer key to worksheets

The educational package "The best way to preserve an ecosystem is by rewilding" was developed within "Oxford debates for the Youths in Science Education" project.

It is a key material, facilitating the achievement of primary project goals, including increasing reasoning skills and interest in STEM, which in the future may result in taking up a scientific career.

When preparing students for the debate, one should not neglect the development of such skills as: communication excellence, argumentation or public speaking. Students should improve their ability to persuade effectively, argue properly, reason accordingly and speak out correctly. Composition of texts, using rhetorical means in oral statements, speaking in accordance with the rules of language culture, text interpretation, public speaking and presentation of texts, discussions and negotiations are of equally high importance.

In order to achieve the abovementioned goals, the implementation of thematic educational packages should be preceded by classes dedicated to preparation for debating as such. This can be accomplished in consultation with teachers of other subjects and the class teacher. The development of basic communication skills can be included in the class teacher's work plan, and the prepared lesson plans can be used during regular classes. Auxiliary materials can be found in the following documents:

1. **Warm up practice** – Annex No 2 to [National frameworks for implementation of Oxford debates in STEM in school practice](#) ;

This document includes the following exercises: active listening, public speaking and debating skills.

2. **Lesson plans aimed at general development of debating skills** – Annex No 2 do [National frameworks for implementation of Oxford debates in STEM in school practice](#) ;

This material consists of 7 lesson plans prepared by Dr. Foteini Englezou, president of the Hellenic Institute for Rhetorical and Communication Research. Scenarios are a guide to work. It is not necessary to follow all the lessons. The teacher can decide which scenarios (or their selected fragments) are most useful for working with a specific group of students. The document offers the following lesson plans:

1. Communication skills
2. Express your scientific argument, not your opinion
3. Build a valid scientific argument
4. Searching for evidence
5. Enhancing students' linguistic skills
6. Rebuttal and refutation
7. Fallacies

3. [Methodological Guide for Teachers. ODYSSEY: Oxford Debates for Youths in Science Education](#)

The final stage of preparation for debates based on specific packages is to familiarize students with the principles of debating, described in detail in the abovementioned document.

The best way to preserve an ecosystem is by rewilding

"The best way to preserve an ecosystem is by rewilding" educational package consists of the following elements:

- Multimedia presentation;
- Video-recording based on the presentation: <https://youtu.be/pSkUaLb8emY>
- Educational package "The best way to preserve an ecosystem is by rewilding" - material for students;
- Worksheets (the same for all packages);
- "The best way to preserve an ecosystem is by rewilding" - material for the teacher (with answer key).

It is recommended to implement the package during a minimum of three lesson units.

Many environmentalists agree that most of the world's ecosystems last functioned independently of the influence of modern humans before the so-called Pleistocene extinction around 50,000-7,000 years ago. Globally, 97 genera of large animals (weighing over 44 kilograms), collectively referred to as megafauna, disappeared during this period. The cause of megafaunal extinction was man, or hunting by man, as well as climate change, or a combination of both. Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and is adapted to them. Rewilding, a novel approach to ecological restoration, has recently been proposed in order to restore these ecosystem functions. In the most general sense, the aim of rewilding is to restore natural processes in ecosystems. This most often involves the resettlement (reintroduction) of large wild species into endangered ecosystems, and in the case of species that were extinct in the past, the introduction of their closest phylogenetic relatives.

The presented educational package "The best way to preserve an ecosystem is by rewilding" includes an overview of theoretical underpinnings of this novel and increasingly present ecological concept. It also allows students to formulate arguments for and against rewilding - from the point of view of several scientific disciplines: evolutionary biology, conservation biology, agriculture and economics.

The debate on the resolution: "The best way to preserve an ecosystem is by rewilding" may take place both during extracurricular activities in the field of natural sciences, in particular related to environmental protection, and in biology lessons. The level of the materials is adjusted mainly to secondary schools

Lesson 1. What is rewilding, what are the biological assumptions this concept is based on, and how would it affect the environment?

Rewilding is a novel subject for high school students. Although this concept is recent in conservation biology, it has been very present in the past several years, and there is a large number of articles in world's leading science journals on the topic. However, although this is a novel ecological concept, the scientific hypotheses at its core are tackled in high school biology classes. Through pro and con arguments, students will be able to expand their knowledge about topics such as evolution of plant and animal species and the influence of man on the environment.

It is recommended that students receive the materials a few days prior to the lesson. This will allow them to get acquainted with the topic of the lesson initially and facilitate active participation in the classroom. A multimedia presentation or a video recorded by the author of the package can be used during the lesson.

Lesson 2. „The best way to preserve an ecosystem is by rewilding” – constructing arguments for and against the resolution

The aim of the second lesson is to formulate as many arguments as possible (both for and against the resolution) that will be used by students during the debate, summarizing the work with the package.

Lesson plan

1. Organizational issues, checking the attendance list, familiarizing with the topic and objectives of the lesson [5 minutes].
2. Preparation of arguments [25 minutes]
3. The teacher divides the class into teams of two. Each team receives 8 question cards available in the educational package (materials for the student) and 2 copies of worksheet No. 1 (one for each student individually). Based on the questions, students formulate arguments for the presented thesis, against the thesis and those that are debatable and can be used in the discussion by both parties. Students work together, but each student individually completes his/her worksheet. There are examples of selected arguments for worksheet 1 are in the answer key.
4. Teams: proposition and opposition are formed [10 minutes].

Team selection may be executed in 2 forms, each of them having both advantages and disadvantages.

Students declare which arguments are closer to their beliefs. The teacher divides the class into teams (each with a similar number of students) in the manner reflecting their convictions. The second method assumes a division similar to the one above, with the difference that ultimately the team consisting of the supporters of a given resolution becomes the "opposition" team, while the opponents of the thesis become "proposition" team. The supporters of such a division assume that it teaches the participants of the debate to a greater extent to use arguments supported by facts, and is less based on emotions. Alternatively, division into teams can also be done randomly.

Finally, team selection can also be made by the teacher in a subjective way, ensuring that each team has both leaders and students who require more help, so that both teams have similar "winning potential". In order to save time for division, the teacher can do it at the beginning of the lesson, for example by distributing worksheets number 1 to the students, printed on sheets of different colour or marked in some other manner.

5. The teacher distributes worksheets number 2 to the students (one for each student) and explains the homework. An example of a filled out worksheet is available in the answer key.
6. Students in each team read prepared arguments in accordance with the assignment to a given group. Each student receives 1 argument, which he/she will develop (as homework) according to the guidelines in worksheet No.2.
7. Each team also appoints 3 people who will present the arguments prepared by the entire group. Students decide the order of their speeches. During the debate, other team members who are not directly involved in the debate, fill out worksheet.
8. Summary of the lesson, evaluation of students' work [5 minutes].

Lesson 3. Debate

During the final lesson, the teams conduct a debate according to the guidelines contained in the "Methodological Guide ..." It takes 45 minutes in total to conduct a full debate. During the debate, the teacher does not comment on the arguments or indicate the fallacies made by the students on an ongoing basis.

An exercise-based debate should be structured as follows:

1. Opening of the debate by the moderator/chairperson[3 minutes].
2. Initial vote by the audience[2 minutes].
3. 1 st Researcher-Debater of the A research-team: Constructive Speech [4 minutes].
4. 1 st Researcher-Debater of the B research-team: Constructive Speech [4 minutes].
5. Cross-fire between the researchers-debaters (1) of both research teams [3 minutes].
6. 2 nd Researcher-Debater of the A research-team: Rebuttal Speech[4 minutes].
7. 2 nd Researcher-Debater of the B research-team: Rebuttal Speech[4 minutes].
8. Cross-fire between the researchers-debaters (2) of both research teams [3 minutes].
9. Preparation time for the Summary and Final Rebuttal by both research teams[2 minutes].
10. 3 rd Researcher-Debater of the A research-team: Summary Rebuttal[2 minutes].
11. 3 rd Researcher-Debater of the B research-team: Summary Rebuttal[2 minutes].
12. Grand Cross-fire between the researchers-debaters (1 & 2) of both research-teams[3 minutes].
13. 3 rd Researcher-Debater of the A research-team: Final Focus Rebuttal [2 minutes].
14. 3 rd Researcher-Debater of the B research-team: Final Focus Rebuttal [2 minutes].
15. Final vote by the audience / Short written feedback [3 minutes].
16. Presentation of the results by the moderator [2 minutes].

If the debate takes place during extra-curricular activities, then it is recommended to devote, for example, 90 minutes for this part. This will allow you to prepare the room for the debate, recall the rules, conduct the debate and discuss its course and finally evaluate the work of students.

In terms of classroom conditions, it would be ideal to allocate two adjoining lesson units to the debate. Taking into account the school circumstances, organizational difficulties and the inability to devote too many lessons to content extending the core curriculum, the debate can be conducted in one lesson, while maintaining high discipline in time. In this case, it is recommended that during the next lesson with the class additional 10 minutes are spent discussing the debate, pointing to strengths and mistakes made by the participants of the debate.

In this format, 6 students (3 from each team) actively participate in the debate. The teacher may also appoint a moderator from among the students and a time keeper. The rest of the students will receive worksheet number 3. Their task will be to listen carefully to the debate and to note the opposing team's strengths and areas for improvement, and to justify their choice. Completed worksheet no. 3 may be the basis for issuing a grade for activity in the lesson for students who did not take part in the debate directly, but participated in its preparation and were active observers of its course.

Worksheet No 1 – answers

FOR	„GREY AREA“	AGAINST
<p><i>Is composition of species, or their "distribution of forces" in the Pleistocene really the goal we should be aiming for when it comes to ecosystem restoration?</i></p> <p>The concept of rewilding relies on what we know about the functioning of ecosystems in the past, their functioning in the absence of human influence, or at least under lesser influence of humans. Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and it is adapted to them. In the Pleistocene era, populations of megaherbivores and large predators were much larger than they are today. This is why it is necessary to (re)introduce megafauna into endangered ecosystems and thus restore the natural relationships and functions that existed in them before the adverse influence of man</p> <p><i>Do you think that the current state of ecosystems is satisfactory, and whether maintaining the current state is actually destined to failure?</i></p> <p>Rewilding is a collective name for a number of environmental approaches that offer a range of solutions to the environmental problems we are faced with today. Rewilding is an ambitious alternative to the existing approaches to</p>	<p><i>How can man, as the one most responsible for the disappearance of animals, restore ecosystems to their proper condition?</i></p> <p>The extinction of megafauna was caused by humans, or more specifically uncontrolled hunting, as well as climate change - or, most likely, a combination of both.</p> <p>Pleistocene ecosystems, and especially those of the late Pleistocene period, are the starting point for how ecosystems function without the influence of man, which is also the main historical measure of the ecological concept of rewilding, which should consolidate, revitalize and restore ecosystems to their initial state.</p> <p><i>How can we evaluate its value if it is often unclear what is meant by this environmental approach?</i></p> <p>Ecosystems management assessments cannot be made without taking into consideration the consequences to people. All areas that are candidates for rewilding are more or less under the influence of humans and have a history of use by humans. Accordingly, a rewilding project can affect local life habits and people's wellbeing. Social change can have a positive influence on ecosystems and vice versa, and characteristics of an ecosystem are often</p>	<p><i>Could the introduced species react adequately to today's environment?</i></p> <p>The global climate has changed and many species have survived, finding their ecological balance with other species, potentially stopping any plans to restore past ecosystems. Therefore, introduced species cannot respond properly to today's environment since they are not adapted to it. For example, elephants, whose introduction is proposed, do not possess the thick fur of their Pleistocene ancestors, and cannot cope with the cruel winters of the American plains. The second species also "nominated" as a candidate for rewilding, camels, had previously been colonized in North America, but it soon turned out that today's environment was not hospitable to them.</p> <p><i>What are the dangers of species introduction to an existing ecosystem?</i></p> <p>Another scenario, also unfavorable, is possible - the introduced species are so successful that they can disrupt existing food chains and start pushing out native species by taking over their resources and territories, which would ultimately lead to a decrease in biodiversity.</p>

environmental conservation, and this term covers a range of ecosystem management ideas and practices. This term has several meanings. It is usually understood as the long-term maintenance or increase of biodiversity while reducing the impact of past and present human interventions through the restoration of species and ecological processes.

Where does the idea of rewilding come from and what is it like in practice?

From the 1920s to the present day, the area under aspen trees (*Populus tremuloides*), a key plant species in mountain forests in the western United States, has declined significantly and the average age of trees has increased. The disappearance of the aspen tree was associated with the disappearance of gray wolves (*Canus lupus*) from Yellowstone National Park (USA) between 1880 and 1920. Namely, due to the disappearance of wolves, the population of elk (*Cervus elaphus*) whose herds ruthlessly grazed on the vegetative shoots of aspen trees increased enormously.

The reintroduction of wolves into Yellowstone is cited as the most prominent practical example of this approach - wolves have influenced the behavior and density of elk populations (decreased the population) and indirectly stimulated the growth and development of favorite elk prey, young aspen shoots, thus dramatically affecting the plant community structure in this vast area.

defined by human decisions focused on particular ecosystem resources and functions. Consideration of interactions between ecosystems and humans in decision making and communicating the benefits of wildlife to the wider community can encourage actions which benefit both ecosystems and human communities, increasing the acceptability and success of rewilding.

Isn't ecology, as a relatively young discipline, constantly developing and reconfiguring - why should we expect rewilding to have a unique definition?

Rewilding primarily concerned the restoration of self-regulated ecosystems, with a strong emphasis on the role of predators in top-down ecosystem control. Today, the focus is on introducing or reintroducing species as a way of restoring ecosystem functioning through the enhancement of natural processes that are presumed to have existed before ecosystems were altered and rearranged by man through various interventions.

Is rewilding a new Pandora's box?

Pandora opened the box and set evils free, but she also found Elpis, the spirit of hope. And we hope that our efforts will stem from precise and detailed ecological theories and that they will offer sustainable solutions for biodiversity conservation - not just an opportunity to enjoy the scenery roamed by large wild beasts.

In addition, newcomers can also bring along exotic parasites and diseases, which would have unforeseeable negative effects on existing species. Not only is it debatable how introduced organisms will interact with native species, it is also a question how they will interact with all other organisms. For example, Eurasian horses have never encountered an African cheetah before, since they lived in geographically very distant locations. Therefore, it is unknown how these two species will cope with each other, as interactions between them have never been the subject of research, and it could reasonably be expected that surprising and unexpected behaviors might occur under new circumstances.

Does rewilding have a clear aim?

We want to indicate that there is no consensus on what rewilding is and what it is not, which puts us at risk because we cannot clearly understand the goals of rewilding, nor can we clearly see the benefits it brings or foresee its potentially adverse consequences.

Should we embark on a financially expensive endeavor if we don't have clear outcomes?

There are numerous failed examples of introductions or reintroductions, examples of when introductions or reintroductions caused unexpected negative consequence. This is also a financially very expensive undertaking, which is not negligible. Therefore, we need to be cautious and to shed light on and better

How does rewilding positively influence the habits and well-being of humans?

Rewilding plays an important role due to its intangible contribution to nature and the values that biodiversity brings with it. An increasing number of scientific studies shows that exposure to green and natural environments and spaces can reduce stress levels, promote positive emotions and cognitive functions, stimulate physical activity and promote social cohesion in humans. Above all, the wilderness experience provides an opportunity for ecotherapy and the promotion of psychological relaxation in children and adolescents, as well as for transformation and self-fulfillment in adults.

The economic benefit is that it opens up space for a nature-based economy and alternative sources of income based on intangible contributions to nature (exercise and similar activities)

Based on the current ecological situation, which consequences can we predict?

Globally, according to the *Living Planet Index*, between 1970 and 2012, fish, mammal, and bird populations declined by 58% - between 36% and 38% in terrestrial and marine ecosystems and by 81% in freshwater ecosystems. The disappearance, degradation or overexploitation of the environment and habitat are the main causes of this plummet.

The United Nations General Assembly recently made the next decade 2021-2030 "a decade of ecosystems restoration". It is rewilding that provides one of the possible directions to a vision in which "in 2050

understand the many unknowns of wildlife, as well as all the possible outcomes, especially environmental ones.

Is rewilding a new Pandora's box?

The most controversial aspect of rewilding, as many critics of the concept point out, is that it is a "new Pandora's box in environmental conservation" which can harm biodiversity, and that particular danger lies in the spread of exotic species in ecosystems which they have never inhabited before. The biggest problem is not that lost interactions in an ecosystem may not be restored, but the biggest problem is the risk that some new, unwanted interactions will emerge.

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<p>biodiversity will be something that will be respected, preserved, restored and managed wisely, preserving ecosystem functions." Rewilding can provide new approaches to ecosystems restoration.</p>		
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Worksheet No 2 – examples of argument (pro)

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
<p>Today's "power distribution" of species evolved in a period when ecosystems were rich in megafauna and it is adapted to them. In the Pleistocene era, populations of megaherbivores and large predators were much larger than they are today. This is why it is necessary to (re)introduce megafauna into endangered ecosystems and thus restore the natural relationships and functions that existed in them before the adverse influence of man.</p>	<p>From the Pleistocene until today, ecosystems have changed immensely, and species have had enough time to adapt to the conditions with no megafauna, which disables plans for reviving past ecosystems. There is no doubt that many ecosystems need protection. However, when it comes to the increasingly discussed new concept - rewilding, there is a danger that existing ecosystems, which still manage to persevere and survive, will get into even worse condition due to the incautious introduction of new species, and that the relationships developed in them will be disrupted.</p>	<p>Ecosystems management assessments cannot be made without taking into consideration the consequences to people. All areas that are candidates for rewilding are more or less under the influence of humans and have a history of use by humans. Accordingly, a rewilding project can affect local life habits and people's wellbeing. Social change can have a positive influence on ecosystems and vice versa, and characteristics of an ecosystem are often defined by human decisions focused on particular ecosystem resources and functions. Consideration of interactions between ecosystems and humans in decision making and communicating the benefits of wildlife to the wider community can encourage actions which benefit both ecosystems and human communities, increasing the acceptability and success of rewilding.</p> <p>Rewilding, in the most general sense, tends to restore natural processes in ecosystems, most often focusing on the reintroduction of large wild species, and if it is an extinct species, then on introducing their(taxonomically) closest relatives. In addition to being a new and promising environmental concept, rewilding is in itself somewhat of a narrative of hope, and is it expected to stop or at least slow down defaunation and prevent further disruption of biodiversity.</p>

	<p>We want to indicate that there is no consensus on what rewilding is and what it is not, which puts us at risk because we cannot clearly understand the goals of rewilding, nor can we clearly see the benefits it brings or foresee its potentially adverse consequences.</p>	<p>From the 1920s to the present day, the area under aspen trees (<i>Populus tremuloides</i>), a key plant species in mountain forests in the western United States, has declined significantly and the average age of trees has increased. The disappearance of the aspen tree was associated with the disappearance of gray wolves (<i>Canus lupus</i>) from Yellowstone National Park (USA) between 1880 and 1920. Namely, due to the disappearance of wolves, the population of elk (<i>Cervus elaphus</i>) whose herds ruthlessly grazed on the vegetative shoots of aspen trees increased enormously.</p> <p>The reintroduction of wolves into Yellowstone is cited as the most prominent practical example of this approach - wolves have influenced the behavior and density of elk populations (decreased the population) and indirectly stimulated the growth and development of favorite elk prey, young aspen shoots, thus dramatically affecting the plant community structure in this vast area.</p> <p>The European approach to rewilding is mainly focused on re-establishing large herbivores communities (or their closest taxonomic relatives) - cattle, horses, feral pigs, beaver and bison - who graze and brush plant vegetation, this way restoring or creating complex and numerous species-rich ecosystems in areas previously used for agriculture</p>

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		<p>or forestry. In this version, rewilding may include the release of captive animals into the wild, as well as the return (reintroduction) of endangered species.</p>
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Worksheet No 3 – examples of argument (con)

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
<p>The global climate has changed and many species have survived, finding their ecological balance with other species, potentially stopping any plans to restore past ecosystems. Therefore, introduced species cannot respond properly to today's environment since they are not adapted to it. For example, elephants, whose introduction is proposed, do not possess the thick fur of their Pleistocene ancestors, and cannot cope with the cruel winters of the American plains. The second species also "nominated" as a candidate for rewilding, camels, had previously been colonized in North America, but it soon turned out that today's environment was not hospitable to them.</p>	<p>Rewilding is an ambitious alternative to the existing approaches to environmental conservation, and this term covers a range of ecosystem management ideas and practices. This term has several meanings. It is usually understood as the long-term maintenance or increase of biodiversity while reducing the impact of past and present human interventions through the restoration of species and ecological processes.</p>	<p>We want to indicate that there is no consensus on what rewilding is and what it is not, which puts us at risk because we cannot clearly understand the goals of rewilding, nor can we clearly see the benefits it brings or foresee its potentially adverse consequences</p>
	<p>Rewilding, in the most general sense, tends to restore natural processes in ecosystems, most often focusing on the reintroduction of large wild species, and if it is an extinct species, then on introducing their(taxonomically) closest relatives. In addition to being a new and promising environmental concept, rewilding is in itself somewhat of a narrative of hope, and is it expected</p>	<p>There are numerous failed examples of introductions or reintroductions, examples of when introductions or reintroductions caused unexpected negative consequence. This is also a financially very expensive undertaking, which is not negligible. Therefore, we need to be cautious and to shed light on and better understand the many unknowns of wildlife, as well as all the possible outcomes, especially environmental ones.</p>
	<p>The biggest problem is not that lost interactions in an ecosystem may not be restored, but the biggest problem is the risk that some new, unwanted interactions will emerge. Experience tells us that there are numerous examples indicating the extent of this risk. Many species have taken on new and unpredictable ecological roles and niches after inhabiting new areas, which often led the existence</p>	

	<p>to stop or at least slow down defaunation and prevent further disruption of biodiversity.</p>	<p>of local native species to a tragic outcome. In fact, around half of the introduced vertebrate species became pests!</p>
		<p>At the moment, data on explicit attempts of rewilding are scarce, and scientific sources mainly consist of essays and articles that put forward the views and personal opinions of researchers. The most controversial aspect of rewilding, as many critics of the concept point out, is that it is a "new Pandora's box in environmental conservation" which can harm biodiversity.</p>