Perception

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PARTICIPATORY EMERGENCY IN CIVIL PROTECTION PLANNING

TRAINING COURSE BOOKLET

UNIT 2

SOCIAL AND ENVIRONMENTAL IMPACTS

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Summary

UNIT 2 – SOCIAL AND ENVIRONMENTAL IMPACTS

ACTIVITY 2.1 – ENVIRONMENTAL AND SOCIAL CONNECTIONS

TOPIC 2.1.1 - INTRODUCTION TO THE CONCEPT OF ECOSYSTEM

Slide 4	The life of a society, of the human society, takes place in and because of ecosystems. We depend on ecosystems, and we modify ecosystems • **Human activities are capable of modifying, and to modify intensely, ecosystems**; the effects of these ecosystem changes are reflected in human activities themselves. The damage caused by human activities on ecosystems, comes back to human society. • The reason, or one of the reasons, is that **human society itself can be called an ecosystem, and human society is part of ecosystems**. We need to change the perception. • Ecosystems can play a key role in defending against natural hazards.They can help us with floods, droughts and wildefire, and so on. Knowing and respecting them help society to improve prevention strategies against natural hazards. And can make our society more resilient to future environmental challenges, like the climate crisis.
Slide 5	The **biosphere** (basically the entire planet earth) includes biomes. **Biomes** include many ecosystems. **Ecosystems** are composed of communities. **Communities** are composed of populations. **Populations** are composed of **individual organisms.** In an ecosystem it is possible to identify diverse **habitats**. A habitat is where a population lives. In each habitat, we can identify **ecological niches**. The ecological niche does not indicate a location in the space, but the **role** that individuals play in the space. So, the niche is the "set of activities" that an organism does in the ecosystem he lives in. Basically it's the way of living of those organisms, their surviving strategies, what they eat, which are the conditions that make their presence possible. For example bees and other insects are pollinators, and their ecological niche is one of the most important. An ecosystem is a geographic area where plants, animals, and other organisms **work together to form a bubble of life**. Ecosystems contain biotic or living factors, and abiotic factors or nonliving factors. • **Biotic factors** include plants, animals (humans are animals), and other organisms. • **Abiotic factors** include rocks, temperature, and humidity. • They can be physical or chemical. For example, solar energy, temperature are physical. Air composition, water composition and soil composition are chemical factors.
Slide 6	**The whole surface of Earth is a series of connected ecosystems.** Ecosystems are connected in a larger biome, and biomes are large sections of land, sea, or atmosphere. Type of biomes could be kind of forests or tundra for example. Basically the kind of biomes depends **on the climate**, basically temperature and precipitation of a geographical area. In the image you can see the terrestrial biomes.

	Sometimes biomes can have similar names, but they can be totally different. The biome of the Sahara Desert, for instance, is very different from the biome of the Gobi Desert in Mongolia and China. Even the cold desert ecosystems of the Gobi are distinct from the freezing desert ecosystems of Antarctica. Two regions with a similar climate may have the same biome; this does not mean that the same species are present in the two areas, but rather that organisms have developed the same adaptations. **The transition from one biome to another is gradual** and their boundaries are not as 'clear-cut' as seen on maps. Within the main biomes, local variations exist and each can be further subdivided into categories. Proceeding from the poles towards the equator we find 9 **terrestrial biome** types. **The largest part of the biosphere is made up of aquatic environments** and the communities that inhabit them. Waters, in fact, cover about three quarters of the surface of our planet. The vast majority of aquatic ecosystems consist of saltwater ecosystems, because almost all the water on Earth is collected in the oceans and seas. **In the oceans, it is possible to distinguish different zones** (each characterised by a particular community of organisms): the intertidal zone, the benthic zone and the pelagic zone. **Freshwater ecosystems**, such as rivers, lakes and ponds, represent a very limited portion of the water on the planet, but these environments are home to a wide variety of organisms: about **10 percent of all aquatic species**. In **rivers** and **streams** (seasonal streams), water flows through the riverbed with a variable velocity depending on its gradient; in lakes, on the other hand, turnover is slow, and in ponds, the waters are still. The abiotic and biotic factors that characterize rivers and streams undergo considerable variations as they pass from source to mouth. Near the source, the water is cold, low in nutrients, and rich in oxygen: **turbulence**, in fact, promotes scam bi between the water and the atmosphere. Further downstream, where the current velocity decreases, the water is warmer and richer in **phytoplankton**. The communities that populate the lowland stretch of a river comprehend: worms and insects, which burrow into the muddy bottom; fish such as carp, catfish, pike, and tench, which find food by smell and taste rather than sight; amphibians; and numerous species of waterfowl. In **lakes** and **ponds**, similarly to ocean ecosystems, it is light that most influences the life of organisms. Phytoplankton abounds in the photic zone and plants grow. **Temperature** is an important abiotic factor for freshwater communities.
Slide 7	Basically, ecosystems work with **flows or exchanges of energy** and with **exchanges of matter** (chemical recycling). In ecosystems, **energy enters in the form of electromagnetic radiation**: basically it's the light of the Sun. When we use the word "light" we are referring to just a very little part of the electromagnetic radiation: the part that we can see with our eyes. But there are other parts, like infrared light and ultraviolet light. **This energy comes from the Sun, enters in the biosphere, and goes from one organism to another one**. This passage between different organisms follows a particular structure of the ecosystems: the trophic structure. The flow of energy runs down the trophic structure, through different trophic levels. Basically, this structure is the food chain. • The first trophic level is occupied by the primary producers capable of producing food for themselves and others. They are usually plants. • From the producers, energy is transferred to herbivores, animals that eat plants. They are the primary consumers.

	• In the next trophic level we have animals that eat other animals, the secondary consumers. There are food chains that have a third and a fourth level of consumers, but generally do not exceed five levels. • Finally, in all ecosystems there is a final level, the **detritivore level**, formed by organisms that obtain energy from dead materials produced by all other levels. Basically decomposers, fungi and bacteria This can appear as a very linear structure, but it's not. Most animals are at the same time prey and predator: think of little snakes that eat mice and other little animals, but are eaten by eagles; so **food chains are often linked together to form a food web**. So it's very complex. • This complexity could be one reason why sometimes human activities cause damage to ecosystems, because we don't know so well how they work, or maybe we are not able to (or we don't want to) imagine long and non direct consequences. At each transition part of (90%) **chemical energy is 'lost' in the form of heat**, and released into the environment. Organisms are able to use only a small part of the energy they obtain. Therefore, if they were not continuously supplied with energy from the Sun, ecosystems could run out of energy, and die. This is the reason why a giant volcano eruptions or the impact of an asteroid can lead to the death of the ecosystem and mass extinction.
Slide 8	**Chemical elements** - such as **carbon**, **nitrogen** and **phosphorus** - are transferred and moved in **the biosphere. And this phenomenon involves both the abiotic component and the abiotic component**. An example: CO2, that is the main element of the cycle of carbon. You can see the cycle in the image.On a global scale, animals produce CO2 with respiration, that goes into the atmosphere and plants use this CO2 with photosynthesis, and they take thies CO2 from the atmosphere. **So the amount of CO2 in the atmosphere is balanced by the emission of CO2 with cellular respiration and CO2 removed by photosynthesis**. Also the oceans play a key role. **This is a very delicate balance,** and there are some human activities, such as burning fossil fuels, that add enormous amounts of CO2, and this will be the biggest problem of humanity in this century.
Slide 9	**Chemical recycling**, that involves the passage of matter through the different levels of an ecosystem. For example, water goes into a cycle that involves the entire biosphere. The **water cycle is driven by the heat of the sun** (you know, evaporation) **and basically it's continuous exchange between different 'reservoirs' or storage** (like oceans, lakes, rivers, aquifers but also atmosphere, glaciers and organisms too).
Slide 10	Basically, these are the main factors that lead the **interaction** between individuals. **Human interactions can be found in each of them**. Look at the factors of the population dynamic. They can explain how a population changes in an ecosystem, and they can explain how human society evolves, because society is an ecosystem. Populations are shaped by **interactions between individuals**, which can be of the same species or of different species, where there is interspecific competition, predation and symbiosis (symbiosis can be through parasitism, mutualism or commensalism). If competition involves members of the same population, it is called **intraspecific competition**. It is very common among vertebrates. Examples are the struggles among males of some mammal species to secure mating with females.

	The competition that takes place between individuals of two different species **exploiting the same resources**, which are available in limited quantities, is called **interspecific competition**. Depending on the species considered, food, water, space, and sunlight can be considered limited resources. Competition helps shape the structure of communities; in some cases, it may even result in the disappearance of a species, in others it may merely reduce the number of individuals present. The interaction between organisms in which one species feeds on another is called **predation.** Predation is not just about animals; the same term is also used in biology to describe the relationship between an herbivore (which in this case is the predator) and the plant on which it feeds (the prey). The close and permanent interaction that is established between organisms of different species within a community, when one species lives within or on the body of another, is called **symbiosis**. There are three main types of symbiosis. • **Parasitism** is a prey-predator relationship in which one organism feeds at the expense of the host. Parasites are generally smaller than their hosts. • In **mutualism** two populations of organisms mutually benefit from living together. • In **commensalism** one organism benefits from another without harming it. **The density of a population can fluctuate over time**. The change in the size of populations and the factors that regulate them represent what ecologists refer to as population dynamics. Variation in the density of a population is influenced by four principal factors: **birth rate, immigration, mortality and emigration**. Birth rate and immigration, tend to increase the value of density, the other two, mortality and emigration, tend to decrease it. In turn, these factors depend on phenomena called **limiting factors**. The limiting factors are of two types: **density-dependent** factors and **density-independent** factors. • Density-dependent factors affect a greater proportion of individuals as the number of individuals in a population grows. For example, when a population increases in size it may run out of food reserves; this produces increased competition among individuals that will lead to lower birth rates or higher mortality, with the ultimate effect of reduced density. • Density-independent factors are those that cause changes in birth rate or mortality in a population regardless of its size or density; these include abiotic factors such as climate, weather, fire, and habitat destruction. In the long run, populations are regulated by both types of factors.
Slide 11	• The MEA defines ecosystem services as **"the benefits that people obtain from ecosystems"**. • Another definition: Eco Services as "**the direct and indirect contributions of ecosystems to human well-being**". Basically we can say that Eco Services are "**the goods and services provided by ecosystems that directly and indirectly contribute to human well-being**". As you understand this is an anthropic point of view, or anthropocentric approach. **The Common International Classification of Ecosystem Services (CICES)** is the actual state of the art, so it's the best classification that we have at the moment, and it is broadly used in the EU. It includes three categories of ESS:

	• **Provisioning services.** These are the material, nutritional and energetic outputs from ecosystems from which we can obtain goods and products, like food and drinking water, but also medicinal plants, textile fibres. • **Regulation services.** These services can mediate or moderate the environment in which people live. And I also remember that we depend on the environment and benefit from it. Examples are pollination, water retention and flood storage, maintaining a liveable climate condition, cleaning polluted air or water. • **Cultural services.** These are all the non-material, non-consumption characteristics of ecosystems that contribute to people's mental well-being. Think about a good landscape, or the feeling of well-being when you are on a mountain or in valley, Some other classification systems include **supporting services**, such as soil formation or nutrient cycling. These support the provision of other services, but are excluded from CICES. Supporting services are only indirectly consumed or used and in CICES treated as part of the underlying structures, processes and functions that characterise ecosystems. For the analysis of changes in ESS, this report provides information on two aspects: the potential of the soil to provide ESS and the actual use, also called the flow, of ESS by humans.
Slide 12	Definition provided by European Environmental Agency. ***Ecological resilience*** *can be defined in two ways.* *The first is* ***how big can be the disturbance*** *that can be absorbed with no changing of the ecosystem.The second is how an ecosystem resists disturbance and how quickly it can return to the equilibrium state, before the disturbance.* Definition provided by Britannica. ***Ecological resilience****, also called* ***ecological robustness****, is the ability of an ecosystem to maintain its normal nutrient cycling and biomass production after a disturbance. The term resilience is also called robustness to describe the ability of a system to continue functioning during a disturbance and recover from it.*
Slide 13	Factors that reduce the resilience of an ecosystem are various. The following is a short and general classification of the main factors. - As Natural factors we can have • Natural climate change • Comets • Volcanoes • Drought • As human factors we can have • Anthropic climate crisis • Deforestation • Overfishing • Farming • Intensive agriculture and monocolture • Invasive species

	• Dumping of waste into the sea
Slide 14	Let's try now to better understand the concept of ecological resilience, focusing on strategies to increase it and considering 3 ecological levels: habitat, community, population **Connectivity** of terrestrial habitats. What is the connectivity? If the habitat where I live becomes critical for my living, I can move to another area and colonise it. I can do this if there is a level of connectivity. Upstream/downstream and river/floodplain connectivity in freshwater systems influence resilience in a number of ways. Connectivity supports population persistence: through the "rescue effect" or the ability to recolonize an area following a disturbance; allowing movement between habitats critical for different life stages (e.g., salmon access to spawning in headwaters streams as well as ocean waters for adult stages); allowing movement to new areas as current habitats become unsuitable with climate change (e.g., room for salt marshes to migrate inland as sea levels rise). **Spatial variation or spatial heterogeneity:** basically I have a greater variety of habitats and species, and I have a greater variety of processes and a complex and interconnected ecological system. The spatial variation also ensures the complexity and diversity of ecological processes and functions (which deliver ecosystem services) are maintained. Channelizing rivers and disconnecting floodplains with riverbanks it is useful to protect towns and cities from flooding, but reduces the complexity of river systems and eliminates some ecological processess: • flood storage like groundwater recharge, • water purification and filtration, • deposition of fertile soil *This is an important concept for managing natural hazards. Are Floods good or bad? Well there is no correct answer. I mean, for the ecosystem, floods are a good thing, they bring life. For a human city, a flood is bad, because it brings death (to be precise, brings death if not correctly managed or prevented). (Do you remember what is the first thing you study in school about ancient Egypt? / time for answering / The floods of the Nile that made agriculture possible every year on its banks. Now Egypt and Ethiopia are arguing hard about a dam built on the Nile and which is perhaps causing problems for the fertility of Egyptian soils.)* **Temporal variation**. For example, in the rivers, the timing and magnitude of seasonal flow patterns, are the basis for maintaining biodiversity and functional diversity. A dam or a dyke, if builded with no ecological perspective, can kill the ecosystem of the river, this is why there are some rules (e.g. minimal vital flow). **The size of ecosystems** is also important. Habitat areas must be large and unfragmented, so they can maintain larger population sizes, which contributes to a greater genetic diversity. Habitat fragmentation leads to small population sizes, reduces genetic diversity and reduces the capacity for adaptive evolution. **Functional redundancy** (redundancy is an important concept for ecosystems and for civil protection or emergency plans too). **Functional redundancy is when many different species may perform the same ecological functions.**

	For example, many different types of insects and birds are pollinators. This redundancy is sometimes called the **"insurance effect of biodiversity", because functions and ecosystem services can be maintained even if some species are lost**. Functional redundancy is generally increased by species diversity, genetic diversity, spatial heterogeneity. There is a difference betweens functional diversity and functional redundancy. Functional diversity: one species that do many functions Functional redundancy: one functions performed by many species. An important factor of species is the **sensitivity to environmental conditions or their ability to resist change**. For example, different species of trees have different capacities to tolerate drought conditions, which makes some more resistant to drought periods, in other words they have a low vulnerability to drought. **the greater is the response diversity across species, and wider and bigger is the set of environmental conditions that can be tolerated by the ecosystem**. So, the ecosystem is more resilient. Recovery from disturbances can be facilitated by **high growth rates**, in this ways populations return to pre disturbance levels more quickly. However, response traits and growth rates are frequently "bundled" in ways that intertwine resistance and recovery. For example, trees that are more resistant to drought may also be slower growing, meaning that their ability to recover from disturbance is limited, so a trait that may be resilient when droughts are intermittent, relatively infrequent, and not long duration, could mean reduced resilience when drought periods become more intense, frequent, and long-lasting. If growth rates are slow, recovery time will not be sufficient to balance resistance to short, more minor droughts. Last but not least: genetic diversity is key factor to biodiversity, and ecological resilience.

Exercises	
1	Identify ecosystem services in your area OR identify ecosystem services in a given area - What types of ecosystems or biomes are characteristic of your area (or chosen area)? - What ecosystem services do they provide? You can use the CICES classification for support. https://cices.eu/resources/ - How does the local community interact with these ecosystem services? Are they sufficiently protected in your opinion? - If you were an EFEP, which stakeholders would you contact in order to have participants interested in the use and defence of ecosystem services? The activity should be carried out in groups, so as to train participants to participate. The number of people per group can be chosen according to the total number of participants. After the activity there can be a sharing of the ideas and information the groups have worked on.

TOPIC 2.1.2 – ECOSYSTEMS AND NATURAL HAZARDS

Slide 4	This chapter want to analyse the **connections between ecosystems and natural hazards, and anthropic hazards too** by the way**.** **Ecosystem services can be affected by natural hazards**. In particular, provisioning and cultural services are most vulnerable. A natural disaster can compromise harvest and food from fields.Think about flood, landslides, drought, storms, wildfire and their effect on agriculture. But Ecosystem services can also do something to prevent impact and damage. Flows and exchange of energy, and flows and exchange of matter are linked with the third type of ecological service (but not only): **the regulating services.** These services, basically, act on flows of energy and matter. Think for example of the cycle of water and look at this regulating service: it can prevent floods. But there are also other services that can protect the ecosystems and the human society from extreme events, fires, coastal flooding. So, basically, protect ecosystems, so they can protect us and the society. It's a circle, a positive circle. Another important key message: the impact of disasters on ecosystem services is dependent on the **state of ecosystem degradation**. There is a complex and geographically specific relation between vulnerability to disasters and ecosystem services degradation. During the 2004 Tzunami, in Thailand, we had an example of how ecosystem degradation works: well-preserved coastal ecosystems were like barriers and shields that absorbed the energy of the wave. in other areas where ecosystems were degraded the damage was much higher. **Another important aspect is the cascading effect**: ecosystem services are interconnected, so the degradation on one could trigger and cause the degradation of another one. **At the moment we don't know yet the real cost of the impact of disaster to ecosystem services, probably underestimated.** Scientists and researchers are trying to create a full overview of the economic value of ecosystem services and they're trying to understand the economic costs of hazards to ecosystem services. The biggest problem is that some ecosystem services do not have market-prices. They are not in the economic system, so it's very difficult to estimate their value. The evaluation of economic impacts are limited to agriculture and forestry, so to those market-based services. Human activities such as **urbanisation**, **intensive cropping** and **grazing animals**, **deforestation** or **intensive forest management** accelerate **land degradation** and reduce the capacity of ecosystems to deliver precious services.
Slide 5	World climate warming will lead to **unexpected changes in ecosystem functions** (like carbon storage in soils, nutrient cycling, water purification, pollination, etc.), and these will increase disaster risks, especially, but not only, river floods, coastal floods, heatwaves, extreme weather events and wildfires. **We need to understand the ecosystems**, and their future changes in climate change scenarios, in order to **anticipate the ris**k and **to protect the ecosystem services**. And by protecting them, we will protect ourselves. To face climate change we have two ways: **Engineering adaptation and ecological adaptation.** Both are important, but where it is possible, ecological adaptation is better.

	Ecological adaptation can act on all the three elements of the Risk Equation. If I use, for example, draining soil to prevent from floods, I obtain 3 things: • **hazard reduction**, because urbanisation increase the intensity of floods, so de-urbanisation decrease the hazard; • I obtain **exposure reduction too**, because I cannot build houses or other things if I'm using that land for a defence system. So there are less goods at risks. • Finally, I obtain **vulnerability reduction**, because the damage is minor, and because that portion of land that I use as nature-based-solution can recover quickly. Ecological adaptation, basically, includes all the "**nature-based-solution**s"or "**green-solutions**" Measures can be very different in their impacts on society and on the landscape. For example, by creating a reservoir to reduce the risk of drought impact, farmers can continue to produce the crops they are used to. If the area converts to agroforestry, then the economy of the area will change. The advantage of this agroforestry option is, however, that it reduces the risk of suffering from a drought so great that no harvest at all can be collected. The reservoir option will fail if the reservoir is emptied, leading potentially to complete loss of the harvest. With floods, a similar sequence of events can be expected. If the dyke breaks during an exceptionally high flood, all is lost, whereas the ecological solution might lead to flooding when waters are high but the system as a whole will not generate a destructive flood, since the flow velocity of the water is reduced and the watershed as a whole can cater for more water storage. The eminent advantage of the ecological adaptation is that the positive ecosystem impact of an extreme event is preserved, whereas this is not the case with engineering solutions. The **challenge for the engineers and the ecologists** is to choose the best option, considering different parameters. Not always ecological is the best, it depends on the local situation. Challange: quantify, for both options, ecological and engineering adaptation, the cost of the solution (in monetary terms and in land consumption) and the risk if the adaptation fails, in the case of an extreme event. If both options are equally competitive, the tendency should be to choose the ecological solution.
Slide 6	In the tables **are shown the impacts of natural hazard on ecosystems and the ideas of adaptation**. Let's see just some examples: a volcano eruption, that can kill thousands of people at once, is a fertiliser bomb. The deposition of the ashes creates fertile soil. By the way, **volcanoes, earthquakes, and tsunamis are geophysical hazards** in which humans have no control, and are not dependent on climate change. So, there is no possibility to reduce the hazard, because we cannot control an earthquake like we control a flood.
Slide 7	Sometimes **strategies for adaptation could be the same for different risks**, take flood and drought For example, if we create **basins for storage water** to reduce the intensity of flood, by reducing the volume of water that flows, we can preserve this water and use it when there is a drought. Water, during floods, has to be seen like a **resource**, not like an enemy.

Slide 8	Wildfire: natural or anthropic? The two graphic are taken from the 2010 EFFIS report. On the left germany, on the right Portugal.
Slide 9	The last one is basically the Covid Pandemic.
Slide 10	Let's now some examples of how ecosystems services are affected by or can reduce risk of natural hazards. Ecosystem services are very fragile and subjected to a lot of natural hazards. Look how many provisioning services are affected by floods, Or by drought, or by forest fire. But the same ecological services can mitigate some of these hazards. Runoff, flow speed are elements of the floods.
Slide 11	Here is the same table but with regulation and cultural services.
Slide 12	Here are the shown the differences between engineering and ecological approach. The column of the ecological approach contains a lot of solutions, and we are only at the beginning, because it's just a few years since society has started studying these topics. So in the next year the solutions could increase in number and variety.
Slide 13	To summarise key concept: There is an increasing interest in the opportunities presented by the **ecosystem-based approach**, because it could help us against extreme events. Society is starting to understand that considering nature, in our choices, is a good thing not only for nature, but for society too. **Restoration actions**, as well as **ecosystem-based solutions,** can **help protect biodiversity**, **enhance resilience** and **improve the quality and quantity of ecosystem services**. Protect ecosystems and try to restore the ones that are degraded and compromised are key strategies. We have to put the ecosystem approach and ecological services in the centre of **decision-making.** And this idea leads us to the final step of this chapter: the Role of the society.
Slide 14	Let's talk about the role of society. Here there are some ideas to go in the direction suggested in the previous slide. • States and governments need to keep working on **sharing data** and exchange successful experiments and experiences based on ecological approaches. In fact, these solutions must be cost-effective, and collaboration is the only way to obtain this. • **So, we need money. Reputation** is probably the main driver for **economic actors** to make sure that ecosystem services work and function well, and convince them to invest in ecological approaches. • In Disaster Risk Reduction, **families** and householdes play a marginal role, if we focus on their impact, because it's limited. However, in families, new ideas are tried

	out and shared with family members and with neighbourhoods. So there is an involvement of the society, of the entire society. • **Civil protection agencies** can help. Right now the strategies of civil protection plans are based on how fast it is possible to move people, cars, materials, money before and during disasters. There is almost no consideration of natural services. • **Legal instruments** can be used to protect ecosystem services and to make easier to use nature-based-solution. • So, It is urgent to **work on prevention, not only on reaction**. **The role of EFEP tries to go in this direction.** And the first ecosystem that we have to discover and know better is the **social ecosystem,** in which there are many actors, connected, with many different needs.
Slide 15	Follow some ideas on specific groups of the society. Some concepts or key messages will be repeated, probably. Let's start from policy-makers. So **policy frameworks have to focus on prevention**, in order to avoid the loss of ecosystem services. Policy-makers should **implement nature-base-solutions at a big scale.** Green cities are an example of this: they can prevent flooding, droughts, and extreme weather events such as storms or heatwaves. We need **transboundary agreements between nearby countries**. Think for example about a river that flows into different states. Policymakers need to learn how to communicate **complex messages, based on scientific findings**. Governments should **support activities with low impact on biodiversity**, to avoid the degradation of ecosystem services. Basically, we need to **incorporate natural capital and the ecosystem services into** decision-making.
Slide 16	**Practitioners** and **specialized workers** are interested in studying successful examples of nature-based solutions. **Civil protection practitioners should receive education about ecosystem services**. One of the main limitations is that some impacts on ecosystem services, are difficult and hard to see. So, it is essential to build multi-disciplinary collaborations between scientists and civil protection practitioners. **Guidelines can be based on successful local cases of nature-based solutions.**
Slide 17	What can the scientific community do? We need **more research** to better understand the interaction between ecological services, nature based solutions and hazards, especially in long-term effects. We need to study climate change scenarios, and the effects on **local ecosystems.** In this way we can anticipate risk and protect the ecosystem services. The scientific community should promote **innovation, science communication** and sharing knowledge.

Slide 18	***Finally, what can we do?*** **In the past few years interest for climate change and for the environment has grown.** **Lot of people want to be informed** about prevention and mitigation from hazards. Lot of people, especially young people, **want to know the impacts of climate change** on their lives. Social media could help **collection of data about the impact of hazards,** and also help prevention, mitigation and rescue. **Citizens play a key role in implementing nature-based solutions**, and this role, if played collectively, can be powerful. Therefore, citizens should find a way to **participate in decision-making** process.

Exercises	
1	Consider the ecosystem services identified in the previous activity. - By what factors (human or natural) can they be put at risk? - How could these ecosystem services help defend from natural and anthropic hazards in your area? - If you were an EFEP, which stakeholders would you contact in order to have participants whose activities may in some way be a source of risk to ecosystem services? The activity should be carried out in groups, so as to train participants to participate. The number of people per group can be chosen according to the total number of participants. After the activity there can be a sharing of the ideas and information the groups have worked on.

ACTIVITY 2.2 – TYPES of EMERGENCIES and their IMPACT on the ENVIRONMENT and on the COMMUNITIES

TOPIC 2.2.1 – OVERVIEW ON POTENTIAL IMPACTS AND TARGETS

Slide 3	In the past sessions we talked about the hazards. Now we will see the impacts of those hazards on human society.
Slide 4	Let's start with a short introduction on what is an impact and how it's possible to assess it and estimate it.
Slide 5	What is the impact? 'Impact' derives **from the Latin word "impactus"**, that means 'hit', and literally it refers to a body breaking into a rigid surface. But this is a literally meaning: if **we talk about impact assessment, in the field of natural and human risks, we have another definition**. And we can many definitions, not just one, because this is a very recent field of study and research. Let's see a few examples. Impact can be all the **consequences** caused by an extreme event or climate change on natural systems (or ecosystems), economic, social and, in general, anthropic systems. If we want to go deeper, we can say that **Impact is the total effects of a disaster, both negative and positive effects**. For example, in the North of Europe and Asia, Climate Change can have positive effects, like climatic conditions to agriculture (make clear that climate change could not be positive, at all, but could have some local positive effects, it's just an example). The effects are **economic impacts, human impacts and environmental impacts,** and include dead people, injured people and **all the effects** on physical, mental and social well-being of the people. So, it's not just the house flooded. It's more and more complex, and this is why **we need a multiple spatial and temporal analysis, that consider many spatial scales and many temporal scales**. Not only in the place of disaster and on the day of the disaster, but also in other places, even far and in other moments, even long after the event. This is because in an interconnected world, the impact is almost never restricted and limited to the area hit and struck by the event. This kind of assessment, this kind of analysis, is essential to **understand the role of each risk factor**. So, to understand the roles played hazard, exposure and vulnerability.
Slide 6	When we talk about **damage and losses** we can make a first distinction: **Damage**, generally, means all the negative consequences, from physical consequences to social, economic, health and psychological effects. **Losses** mean generally economic consequences, measurable in money. But this is not a rigid distinction, we can use both terms. There is still a debate. A more important **distinction** is the one between **tangible and intangible damages**. **Tangible damages can be expressed in monetary terms, but for intangible this could be difficult or controversial**. How much money can we assign to human life? Or to a permanent injury? What value can I assign to the cultural heritage of a population? Or to an ecological service. And if I wanted to do this last one, how can I do that? Because some ecological services have not market price.

Slide 7	Let's see another way to classify the impacts. **There are direct consequences, and indirect consequences**. **Direct damage** can be physical harm or destruction. **Indirect damages are called now "second and higher-order" consequences**. In fact, with "**second" damages we are referring to consequences that become real in second time, short or long time, so we are considering a temporal scale**. Numbers that you see can be hours, days, weeks, years and even centuries: if we think about the climate change, the CO2 emissions of the 19th century are still having an effect today. In this graphic you can see how, some part of greenhouses gasses, could remain in the atmosphere for half a millennium. **We can also consider a functional scale**, because if a key element of a system is compromised, we can have consequences in other sectors of the system, and in other systems too, because our society and our world are interconnected. Basically, **these are the cascading effects**, a chain of effects. We can talk, in this case, of **systemic vulnerability.** Sometimes, **damage could be** not only provoked by the hazard, or by the phenomenon, but can **also be a consequences of decisions** made to mitigate some other damages. There are some example on this in Earthquakes in Italy, caused by wrong reconstruction strategies that didn't consider all the social and economic aspects.
Slide 8	**Give me data.** This must the most important slogan in risk management. Without data we are blind. Data collection is usually **carried out by administrations and insurance companies.** The **initial damage** data are important for two reasons: • to estimate monetary losses, in order to find out what monetary resources I need to recover. • And for the assessment of usability of infrastructures or buildings, in order to understand which are my priorities, understand where I can evacuate people, where is it safe or not safe to go? Can I go over that bridge? Can I stay in that house? Can I use that hospital? Damage assessment and usability assessment are different. Damage assessment: what is the damage? How much do I have to pay? Usability assessment: can I use that building or that infrastructure to evacuate or to manage in some way the post-emergency phase?
Slide 9	So, **data are important, but it's very difficult to have them, at the moment**. Because there are not so many tools to do it, and there is a no a standard way. So, maybe we have data, but they cannot "speak together" and we cannot make comparisons or analysis. There are two important models at the moment. **PDNA**: Post Disaster Needs Assessment, is used for natural disasters, to assess damage, losses and needs. **FEAT**: Flash Environmental Assessment Tool, to identify the potential consequences of chemical releases oh human health, livelihoods and ecosystems.

	POPULATION
Slide 10	In this section we will talk about the population at three different levels: people, habitat (so homes and neighbourhood), and the society. These are not separated levels, but it's a continuum, so they are very interconnected and the same concept can be valid for all the three levels. **People are the most important element to protect** from risk and disaster. Human exposure to hazards has been increasing in magnitude and complexity as a result of **population growth** and **expansion to hazardous areas**. Exposure will probably be main factor influencing the risk, in the near future.
Slide 11	We are not isolated people, we have relationship and interactions: from a **social point of view**, disasters **affect not only people directly exposed to events**, but could affect their families, their relatives, and friends. So, from a **spatial point of view**, **even people living far from the location of the event can be affected**, because of their relationship with community directly affected. From a **temporal point of view**, we have, as said before, **direct and instantaneous impacts, but also long-terms effects, that we can call gradual chronic effects**. Gradual effects can remain hidden for long time or can be underestimated at first, and this can make harder to face them and solve them. In the worst case, long term effects can be permanent effects. **We have many data about the first type of impacts, but not so much for long-term impacts**, this is of the reasons why they are difficult to assess. Usually, **temporal scale has a correlation with direct/indirect scale**. **Direct impacts** are basically deaths and injuries. **Indirect impacts** space from loss of home and jobs, or families, to physical and mental health. Stress it's an important element. During the terrible Earthquake in Japan in 2011, that one with the Fukushima accident, many aged people died not because of the Earthquake or the Tsunami but because of the stress, and the fear.
Slide 12	The difference between direct and indirect impacts lead us to the **concept of direct physical vulnerability (or individual) and indirect social vulnerability**. The first one is the the capacity of run or to resist to heatwave. The second one depends on the socioeconomic status. There is a correlation between socioeconomic status and exposure, because in areas with hazards maybe homes are cheaper, with less economic value. These are some parameters that influence the vulnerability of the population, at a physical level and a social level.
Slide 13	**So, we can say that the first key element is the time. Not only considering the time of effects, but also the time in which the event develops** The speediness, or rapidity, or velocity of the event gives me the chance to forecast the event and evacuate people. Also, short events can affect short and large number of people, think for example about a flash flood or an earthquake. Long events typically affect a large number of people, think for example about a drought. The duration of the has an influence on the number of people affects, so basically, the exposure. Different types of hazard can have very different temporal and spatial scales.

Slide 14	Here we can see the hazard development in space and time for meteorological and climatological hazards.
Slide 15	Here we can see the hazard development in space and time for human-made hazards
Slide 16	**There are some indicators that can give us information on potential consequences on people.** For example…
Slide 17	For **meteorological** hazards, wind velocity and volume of rain are key element. But not for **climatological** hazards, when Duration of the event becomes the main factor, together with the temperature.
Slide 18	Here we can see indicators of potential damaging effects on people for human-made hazards
Slide 19	As said before, the **future projections show a rapid rise in numbers of deaths due to meteorological and climatological events**, because of c**limate change and population changes.** **How can we improve resilience at individual level? In other word, how can we reduce the vulnerability?** • The most effective strategies are based on the **education**, teaching people what to do in case of disaster. Self-protection and Self-prevention is the first step. • Secondly, it's impossible to reach all the population with just one strategy. We need **many strategies for each social group**, and especially for **most vulnerable people**.
	HOUSING AND HABITAT
Slide 20	**Natural hazards and human-made disasters can affect people's living environment**, from their houses to the surrounding environment.
Slide 21	**Population displacement is the primary measure of impact**. The displacement works on **many temporal and spatial scales**. Talking **about temporal scale** we can have, **from temporary to permanent relocation**, in the first case we have for e.g. short evacuations, and in the permanent case maybe there is no possibility to coming back at home. I**n cases of permanent relocation, there are two possibilities**: people can return to same area but in a difference home , or sometimes there are physical conditions or socioeconomic circumstances that lead people going somewhere else, with all the difficulties that you can imagine. In general, **relocation and rehousing can have very deep consequences on psychological and social aspects**. And relocation can increase social vulnerabilities that already exists.
Slide 22	Data on people displaced are often available after most disasters, because these data are collected during response actions. Displacement due to disasters affect about **24 million people each year, around the world**, **35 000 of them are in European Union**. Of course this is an average: as you can see in this graphic there are variations year by year. These numbers are expected to increase in a climate change scenario.

Slide 23	The following scheme it's just to give some ideas about the complexity of this topic. In general we an say that **number of people displaced and the degree of displacement** (temporary or permanent) depends on: • the typology and the intensity of the hazard; • the number of people and buildings exposed; • physical and socio-economic vulnerability; • capacity of coping, so responding and react to the event. In particular, building vulnerability have a direct effect on the degree of displacement. Can I repair my house? Can I have re-build? Or do I have to leave forever? And the socio-economic vulnerability influences the building vulnerability and socio economic consequences of the displacement.
Slide 24	So, vulnerability, in this case in the main factor. **Vulnerability of housing and habitat affects directly the population**. As said before we can talk about physical vulnerability and socio-economic vulnerability. **Physical vulnerability** is the probability that a group of people (e.g. children, adults, elderly people, people with disabilities) will be affected at a certain level by the consequences of a given hazard on buildings, critical infrastructures and environment. The **resistance of structures** to natural and human-made disasters strongly affects the numbers of people killed or injured and the number of people homeless. Other important elements are the functionality of **transport infrastructures and communication networks**, that determines the capacity to coping and manage the emergency. We can talk about evacuation vulnerability. Think for example to migrations in the Mediterranean Sea, caused by climate changes and wars: the evacuation vulnerability in that case is extremely high. It's also important the **resistance of service infrastructures**, the determines the possibility to return in the area affected by the hazard. Maybe my house is safe, but I have no more water service, or electrical service. About **evacuation vulnerability**: There is a physical component, resistance of transport network, but also a management component (Do I have an evacuation plan? Is that good?). And there is also a behaviour component: what is the perception of hazard in the population? And the perception of preparedness? How the population will react? And this last element leads us to the socio-economic vulnerability.
Slide 25	An important element: the damages is higher in lor-income and marginalised communities. Social vulnerability is a key element in the recovery process, and that depends basically on the poverty, because poverty affect directly the capacity to cope with impacts of the disaster. In addition, people in poverty have limited access to political power and representation. And there is also a lack of access to resources, not only economic resources. And, disaster recovery polices, if not equally distributed, can increase these social vulnerabilities.

Slide 26	**SOCIETY**
Slide 27	Maybe we don't have to explain what society is, because for our purpose, the common idea of society is enough. But maybe the focus on some element could be helpful and interesting. Well, we can think about the society as a **bubble of relations and connections, institutions, organisations**, formed by a large number of people, that try to **address some needs**. **Society is a system**, in which we can identify many elements, e.g. procedures, authority, human behaviour, roles, status, rules, values, institutions. **When we use the word institution, we refer to that mechanism that ensure the continuity of the society.** Not only, political institutions, but also schools, hospitals. Talking by general words, we can say that an institution is, or it should be, a social unit dealing with social problems.
Slide 28	Society is very complex and understand the element of vulnerability in the society is even harder. Basically, we can say that the **vulnerability affects the ability of a group of people to deal with disasters**. And by "dealing with" I mean to cope with the disasters, to resist to the disaster and to recover from the disaster. There are some f**actors that increase the vulnerability**, like the urbanisation or the lack of infrastructures. And, as you can image, **some people, are more vulnerable**. Poor people, migrants, women, children. In other words, all the minorities or people with less privileges suffer the most pain and hard consequences. There are many studies and outcomes from research that shows interesting correlations. A few more elements: • **The human cost of disaster is higher of poor people:** lost crops and damaged agricultural land have the hardest impacts on poor people and there are long-term consequences. • **Also the strength of institutions is a key element, because mortality rate is lower in societies that have strong institutional structures,** because institutions play an important role in preparation for disaster, prevention of them and protection of society.
Slide 29	When we talk about social impact, well there are many kinds of social impacts, interconnected with other types of impact.The impact is the last and main consequence of the risk, understanding the impacts is a key element to understand the risk. We can have physical impacts, that are basically the ones we have seen before. There are economic impacts. And, from a monetary point of view the higher impact is where there is a bigger economy, because there is more economic value exposed. A disaster can change the local economy of a community and can increase the number of poor people and their poverty. We have political impacts: after disasters there are spaces for concentration of political power, because disaster can influence government support and trust. If we think about social impacts in the strict sense we can have • Impacts on the educational systems. Maybe for a long period of time there is no possibility to go to a school, or the educational system is different. Think about the covid19, online school, we know that there have been some impacts on children.

	• Healthcare: if the healthcare systems is stressed the quality of it can reduce. Again, covid is an example. • Migrations, and this is a socio-economic-physical and political impact. • Families: disasters can influence the birth rate, divorces rate and the psychology of children if parents are stressed by the disaster.
Slide 30	**CRITICAL INFRASTRUCTURES**
Slide 31	The Critical Infrastructures (CIs) are defined by the UNDRR as "**The physical structures, facilities, networks and others which provide essential services to the functioning of a society**". This definition has changed over time, in relation to the national backgrounds and to the major historical events, such as terrorist attacks and natural disasters, but the strategic importance of elements like aqueducts and roads has been known since the Roman Empire. Which are the critical infrastructures? Could be communications systems, chemical industries, commercial facilities, dams, emergency services and structures, energy power plants, financial systems, governments facilities, water services, transportation services, healthcare and hospitals, and many others. **Our modern society is more vulnerable to the impact of potential disruptions', because our life depends on technology, long-range supply lines and interconnected networks**. Think for example to what could happen with a **global down of internet**. Think about just 24 hours with no internet in the world. And, this is what could happen with a very intense geomagnetic storm. This is very related to the "**functional redundancy**", in the ecological services chapter.
Slide 32	**One of the most important and dangerous element of the Cis are the cascading effects.** Cis do not operate isolated, all the Critical Infrastructures are interconnected and interdependent: a disruption in one CI can trigger cascading effects on other systems and other Cis. **Cascading effects can result in 'cascading disasters'**, which can quickly become the centre of a crisis and can challenge the coordination of the emergency and the recovery.
	EMERGENCIES
Slide 33	Emergency facilities and infrastructure are defined as "a critical set of specialised agencies with specific responsibilities in protecting people and property in emergency situations". They include first responders, such as fire service personnel, police, primary healthcare operatives, civil protection responders and local authority workers. EMFIs must be **very resilient and designed to resist all levels of pressure**. **I can understand if my emergency response system is strong** when is **under pressure**. They should have **emergency and operational continuity plans** to help them continue functioning during emergencies. Emergency facilities such as healthcare facilities are dependent on **physical resilience**, and **non-structural** and **organisational components** such as evacuation planning

	If I'm charge of rescue people, or protect people, well I have be to a in a situation where I don't need protection o rescue. Emergencies facilities cannot fail during emergency. **Planning** and **redundancy** are key element in this, but both are expensive, and EMFIs easily become a target for monetary cuts in times of austerity.
Slide 34	**Vulnerability of EMFIs: i**ncreased urbanisation, diffusion of vulnerability in the urban environment and climate change make it likely that EMIFIs are in areas that are at risk from primary threats such as flooding or heatwaves. **Cascading effects: the operational continuity can be challenged by cascading effects** that originate in other infrastructure sectors. For example, power failures can cut the energy and electricity for emergency infrastructures, or disruptions of transport systems can make impossible for some doctors and nurses to go to the Hospital and operate. In general, this kind of problem is underestimated. Because in some areas we are still in a historical phase in which we are trying to explain that a Hospital should be near a river, in an area where it could happen a flood. This is a historical moment in which the first threats are not take into decisions.
Slide 35	**Example of Turin.** What you see is a map of the hydraulic hazard in Turin. The different shades of blue indicate different probabilities of flooding. The red circle indicates the location of a hospital, built in the flood zone.
Slide 36	However, even if the hospital was not in the flood belt (or was not reached by the flood, because it is in a low probability belt) it would still be a problem, because the road (red hatching) is flooded and therefore makes it difficult or impossible to reach the hospital.
	NETWORK
Slide 37	Many critical infrastructures are commonly described as 'networked', basically because of their high level of interconnection. In particular there are two main sectors that are very important and critical, the **energy sector and the transportation sectors**. In Europe have been observed some cascading effects on power grids and transport systems. Think for example to the problem of natural gas (fossil fuel) coming from the Russia and war in Ukraine. In the energy sector one of the main risk is the blackout, because there are consequences on all the other sectors. In the image on the right you can see the flows of energy between European countries. It's a free web site called "electricity map".
Slide 38	Europe's energy sector is shifting from a centric model dominated by fossil fuel to a **system with many distributed resources**, so from a few giant power plants to many little power plants. This second kind of system is more resilient, because there are less people and infrastructures depending on a few energy resources, and if there is a problem somewhere else, this new king of network can be more efficient, because I can move the energy from other places to the place where is the energy problem. Flexibility and redundancy. We have the **transportation network**, where one of the main problem is the **safety** of roads, of other infrastructures. Think about accidents on the highway, in the tunnels, or on the railway lines. Safety can be reached with many strategies, but of course maintenance is the key element. The collapse of the Morandi bridge, in Genova, in Italy, is a perfect example.

	But **maintenance is also important in other kind of networks, for example water network**. With water distribution systems, if the system is very old I can have many kind of problem: health of consumers, continuity of the service, economical sustainability, resilience during drought.
Slide 39	On of the key element to reduce vulnerability is start thinking about **infrastructural climate resilience**. Building climate resilience can involve a package of **management measures** (such as changing maintenance schedules) and structural measures. **New Technologies** have the potential to improve the CI management. Think about the **monitoring** with **data from satellites and Earth** observation that can evaluate the **state of health of CIs**. There are drones that allow allowing damage inspection in **difficult-access areas**. R**adars and laser-based sensors** can check both structural health of the CI The development of some **apps for Smart Phone make possible:** • sharing of **information in real time** • **citizen awareness** and **engagement**. **Exercises and stress tests** can let us better understand dependencies between Cis and weakness.
	CORE INDUSTRIAL AND ENERGY FACILITIES
Slide 40	Industrial installations and energy facilities are exposed to many hazards, natural or technological hazards. Some of these facilities become themselves a secondary hazard if they **store or use hazardous materials**. If there is a natural hazard that trigger a technological accident we can refer to this kind of risk as **natural-hazard-triggered technological accident (Natech) risk**. Examples of industrial and energy facilities that are critical for the EU are chemical facilities, pharmaceutical industry, refineries, and offshore facilities. **Failure or disruption of these facilities can cause impacts on society, on the environment an on the economy at a local, national or global level**. In some cases, cascading effects across sectors can reach global dimensions, resulting in a shortage or absence of some materials and products.
Slide 41	**Risk governance** should be approached from a territorial **perspective,** so considering the surroundings, to understand and forecast the **potential interactions** of industries, infrastructures, and communities. But also a **systemic view,** or systems perspective, is required for the management of this kind of risks, that means incorporating **physical**, **organisational** and **socioeconomic factors** into the analysis. **It's important to mention The EU's Seveso Directive requires the preparation of internal and external emergency plans** and the establishment of procedures to ensure that these plans are tested and revised as necessary. There are patterns related to **failures emergency management**: • lack of clear emergency response procedures with well-defined roles and responsibilities, and deficiencies in the emergency plan, • lack of accident scenarios in the emergency plan due to their low frequency of occurrence,

	• inadequate training of emergency managers and lack of emergency exercises, • inadequate evacuation plans, • inadequate public warning systems, • inadequate communication and coordination between on- and off-site response services, • unavailability of emergency power supply for safety-critical parts of a facility.
	COMUNICATION SYSTEMS
Slide 42	**Communication Systems** As we become more and more **dependent on our communication systems**, we will become more vulnerable and when those services are no longer available. Same example of before: imagine if internet was down for an entire day. When disaster hits, and communication services fail we become basically blind. We can't see anything. The vast majority of incidents are due to system failures (hardware failures and software bugs), followed by human errors, equipment failures and extreme weather events. Incidents due to extreme weather are increasing: heavy storms, major floods or wildfires caused by extreme drought. Incidents caused by malicious intent (i.e. cybersecurity incidents and physical vandalism) represented less than a 10% of the total.
Slide 43	**Empower local groups/communities to respond independently.** We must prepare the public for disaster in case of lost digital communication connectivity. Local resilience should be increased teaching to the public how to communicate in times of crisis or communication failure. **Explore/innovate communication technologies that can function independently from the physical infrastructure.** Basically using of radio frequency can a be a solution. All around the world there is a high number of **amateur radio**, that develop and experiment new ideas to communicate over long distances and different situations. These skills can be used during emergency, and they have been used. During the **Flood of Florence in Italy**, in 1966, the communication systems completely failed. But, thanks to amateur radio it was possible to organize the rescue of citizens of Florence.

Exercises	
1	Choose a case study concerning a disaster or accident of the types seen and prepare a commentary on it. - You can choose one of the case studies available on Chapter 3 ""Assets at risk and potential impacts" of the 2020 report ""Science for disaster risk management" (EC DRMKC). - In particular it highlights what the weak elements were and how you can act to prevent future disasters of that type.

ACTIVITY 2.3 – "ZERO RISK"

TOPIC 2.3.1 - DOES "ZERO RISK" EXIST?

Slide 3	Can you guess the major cause of death in Europe in 2017?
Slide 4	Over 4.6 million people died in EU countries in 2017 (Figure 3.7). The main causes of death in EU countries are circulatory diseases and various types of cancer, followed by respiratory diseases and external causes of death. Circulatory diseases continue to be the leading cause of death across the EU, accounting for about 1.7 million deaths in 2017 or 37% of all deaths. Ischaemic heart diseases (including heart attack and other diseases) and stroke are the most common causes of cardiovascular mortality (see indicator "Mortality from circulatory diseases"). Mortality rates from circulatory diseases are much higher among men than women (about 40% higher). Some 1.2 million people in EU countries died of cancer in 2017, accounting for 26% of all deaths (25% among women and 28% among men). Breast cancer and lung cancer are the leading causes of cancer death among women, whereas lung cancer and colorectal cancer are the two main causes of cancer death for men (see indicator "Cancer incidence and mortality"). After circulatory diseases and cancer, respiratory diseases are the third leading cause of death in EU countries, causing some 366 000 deaths in 2017 or 8% of all deaths. The vast majority of these deaths occur among people aged over 65. Respiratory diseases accounted for 7% of all deaths among women and 9% among men. Chronic obstructive pulmonary disease (COPD) is the most common cause of mortality among respiratory diseases, followed by pneumonia. External causes of death, including accidents, suicides, homicides and other violent causes of death, were responsible for 4% of all deaths among women and 5% of deaths among men across EU countries in 2017. The most important causes of violent deaths are suicides (48 000 deaths in 2017) and transport accidents (about 27 000 deaths). Transport accidents are a particularly important cause of death among young people (aged 18-25), whereas suicide rates generally increase with age (see indicator "Adult mental health"). Looking at other specific causes, Alzheimer's and other dementias accounted for 5% of all deaths in 2017, and were a cause of death more important among women. Diabetes represented 2% of all deaths across EU countries. The main causes of death differ between socio-economic groups, explaining the gap in life expectancy. Social disparities are generally larger for the most avoidable causes of death (Mackenbach et al., 2015). Overall mortality rates (age-standardised) ranged in 2017 from less than 900 deaths per 100 000 population in France, Spain and Italy (which is about 15% lower than the EU average) to over 1 400 deaths per 100 000 population in Bulgaria, Romania, Latvia, Hungary and Lithuania (over 40% higher than the EU average) (Figure 3.8). The main reason for the much higher mortality rates in this latter group of countries is higher mortality rates from circulatory diseases, the leading cause of death. In Hungary, higher mortality rates from cancer also explain a large part of the difference with the EU average (Eurostat, 2020).
Slide 5	Can you guess the most dangerous place?

Slide 6	Home: 4.500.000 injuries and 8.000 fatal injuries Working places / Factories: 633.149 injuries and 1.107 fatal injuries Car: 239.198 injuries and 3.192 fatal injuries
Slide 7	**Can you guess the most risky means of transport?**
Slide 8	For example, it is well known that an aircraft is statistically the safest way to travel, but basically people are more afraid of getting on a plane than in their own car, where the probability of dying is much higher.
Slide 9	**Can you guess the most dangerous animal?**
Slide 10	Another interesting fact related to the perception of risk is connected to the animal kingdom: the animals most likely to be killed by are not sharks or lions, but mosquitoes and humans themselves.
Slide 11	**Can you guess the most hazardous source of energy?**
Slide 12	Even in the energy sector, security is often subject to biases and perceptions that do not correspond to reality. Nuclear energy is often considered the most dangerous, but data show that fossil fuels are actually far riskier than other sources of energy; 8 million people died in 2018 from fossil fuel pollution, according to new research from Harvard University.
Slide 13	Risk perception is defined as **people's judgments and assessment of hazards that might pose immediate or long-term threats to their health and well-being**. From: Encyclopedia of Environmental Health, 2011. People can OVERSTATE UNDERSTATE the risk depending on whether they KNOW it or not Risk perception is extremely "SUBJECTIVE". Individuals base their risk assessments not so much on statistical predictions (e.g. the possible number of deaths), but on qualitative characteristics, i.e. the perceived properties of the source of the risk and the situation
Slide 14	**Familiar vs Unfamiliar** Familiarity with a given situation helps reduce the level of the perceived risk. The perceived risk increases when the situation is new, unfamiliar, or hard-to-comprehend. Perception about the level of risk can be significantly increased if there is an incomplete scientific understanding about potential health effects from a particular situation or technology. **Personal control vs Lack of control over a situation** If people do not have any say about a situation (e.g. power lines and mobile telephone base stations, especially near their homes, schools or play areas), they tend to perceive the risk from such situations as being high. **Voluntary vs Involuntary exposure** People feel much less at risk when the choice is theirs.

	Dreaded vs Not-dreaded outcomes Some diseases and health conditions, such as cancer, or severe and lingering pain and disability, are more feared than others. Thus, even a small possibility of cancer, especially in children, receives significant public attention. **Direct vs Indirect benefits** If people are exposed to RF fields from mobile telephone base stations, but do not have a mobile telephone, or if they are exposed to the electric and magnetic fields from a high voltage transmission line that does not provide power to their community, they may not perceive any direct benefit from the installation and are less likely to accept the associated risk. **Fair vs Unfair exposure.** Issues of social justice may be raised because of unfair exposure. For example, if facilities were installed in poor neighbourhoods for economic reasons (e.g. cheaper land), the local community would unfairly bear the potential risks.
Slide 15	Using several of these risk characteristics in the context of risk communication, Covello proposed four theoretical models that explain how people perceive risks, how they process risk information, and how they make decisions accordingly. First, *the risk perception model* identifies a wide variety of factors that influence people's risk perceptions. They include voluntariness, controllability, familiarity, equity, benefits, understanding, uncertainty, dread, trust in institutions, reversibility, personal stake, ethical/moral nature, human versus natural origin, and catastrophic potential. For example, if people perceive a risk to be voluntarily incurred, they are more likely to accept it because they understand their role in experiencing the implications of the risk. By contrast, if people have less intense and less fearful emotions toward a risk, they are more likely to accept it. These factors determine the public's level of concern and elevate or decrease worries, anger, fear, hostility and outrage;
Slide 16	Second, *the mental noise model* posits that events producing a higher level of mental noise (or stress) reduce people's ability to process risk-related information. Factors that cause a high level of mental noise include controllability, voluntariness, familiarity, cause of the disaster (human-made versus natural), dread, uncertainty, and the victim's vulnerability (e.g., child, pregnant woman). These factors closely resemble those identified in the risk perception model. Mental Noise Model provides a means for understanding how the public processes information in periods of high stress and anxiety (Covello, et al. , 2001, p. 7). As the perceived threat rises, an individual's consequent ability to process information decreases. The creation of mental noise effectively blocks the individual's ability to hear the message and affects his/her willingness and ability to process it.
Slide 17	Third, *the negative dominance model* predicts that situations producing risks and subsequent emotions such as fear, dread, and anxiety create an environment where people are more likely to focus on negative messages Negative Dominance Model addresses how the public processes negative and positive information in high concern situations (Covello, et al. , 2001, p. 7). The model suggests that the relationship between the two messages is asymmetrical; the negative messages receive substantially more weight than the positive ones. In other words, the public places more value on their losses than on their gains.

Slide 18	Trust Determination Model highlights the importance of establishing trust in all forms of risk and crisis communications (Covello, et al. , 2001). Trust comes first in all messages, regardless of purpose or content. Without it, success will be limited. Further, the trust required to fully engage the public in the message is a long-term process. It requires thoughtful processes and methods in addition to sound communication skills. *the trust determination model* highlights the importance of perceived trust of the communicator in people's perceptions of and reactions to given risks. It highlights several trust determination factors that help build the communicator's trust, such as caring and empathy, competence and expertise, honesty and openness. Of these four models, the risk perception model has been used most widely.
Slide 19	Covello's four models focus on how individuals' psychological characteristics affect risk perceptions. Other approaches have indicated a variety of cultural and social influences on people's perceptions and responses to risks. The social amplification of risk framework (SARF) attempts to show the relations among the technical analysis of risk and the cultural, social, and individual response structures that shape people's experience of risk (Kasperson et al., 1988). SARF presumes that risk events interact with psychological, social, and cultural processes in ways that can heighten or attenuate public perceptions of risk and related risk behaviors. An important feature of SARF is that it highlights the roles played by communication channels in risk amplification and attenuation. One channel is informal and interpersonal communication networks. Friends, family, and co-workers may amplify or attenuate risk perceptions by giving one another information or reinforcing habitual perceptions and cultural biases. The other channel is the news media, which can determine which risks receive public attention. The media tend to pay more attention to (and thereby amplify) unusual or dramatically striking risks, and they pay less attention to well-known or dramatically uninteresting risks, even though such risks may continue to be severe. Taken together, the psychometric paradigm, Covello's four theoretical models, and SARF highlight how people's risk perceptions are determined by various risk characteristics and factors of individual psychology, societal institutions, and communication channels
Slide 20	Why is it so difficult to talk about risks? Even if this topic touches everyone directly, because it deals with our safety Because we are in an unpredictable domain
Slide 21	One example of how difficult it is to predict something and thus plan a response is the BLACK SWAN phenomenon, which is defined as a phenomenon that occurs even though it had been thought to be impossible >> from the fact all swans were thought to be white until black swans were discovered in Australia
Slide 22	The preparedness paradox is the proposition that if a society or individual acts effectively to mitigate a potential disaster such as a pandemic, natural disaster or other catastrophe so that it causes less harm, the avoided danger will be perceived as having been much less serious because of the limited damage actually caused. The paradox is the incorrect perception that there had been no need for careful preparation as there was little harm, although in reality the limitation of the harm was due to preparation. Several cognitive biases can consequently hamper proper preparation for future risks.
Slide 23	Cognitive biases[edit] Cognitive biases play a large role in the lack of urgency in preparation, hampering efforts to prevent disasters. These include over-optimism, in which the degree of disaster is underestimated, and the fact that many disasters do not reach their breaking point until it is too late to take action. In over-optimism and normalcy bias, people believe that disasters

	will happen elsewhere, and even if they do happen locally only their neighbors will be affected. Another obstacle to preparedness is the interval between disasters. When there is a long time between disasters, there is less urgency to prepare. This is due to fewer people remembering the last disaster, which reduces its emotional impact on the group. This effect is heightened when some measure of action is taken to prevent the disaster, which further reduces the memory of the original danger and consequences. Financial concerns can also contribute to the preparedness paradox. There is a tendency to over-value known short-term costs, as well as to under-value unknown long-term rewards. The fact that preparing for disasters is expensive in the short term and its value in the long term cannot be determined could lead to catastrophic consequences if the choice is made to not prepare.
Slide 24	Examples A breach in a levee in Papendrecht, the Netherlands, during the North Sea flood of 1953, flooding houses that had been built behind it A specific application of the preparedness paradox is the "levee paradox." Levees are structures which run parallel to rivers and are meant to offer protection from flooding. Paradoxically, their construction leads to a reduced awareness of and preparation for floods or breaches. The perception of safety also leads to unsafe land development in the floodplain which is supposed to be protected by the levee. Consequently, when a flood does occur or the levee breaches, the effects of that disaster will be greater than if the levee had not been built. The 2011 Tōhoku earthquake and tsunami and the resulting Fukushima Daiichi nuclear disaster is another example of the preparedness paradox. Even though the Onagawa Nuclear Power Plant was closer to the epicenter of the earthquake, it withstood the cataclysm because of the preparations made by the facility's owners. On the other hand, the Fukushima Daiichi Nuclear Power Plant suffered heavy damage because of a lack of preparation due to the perception of less risk. The Chernobyl nuclear power plant disaster should have been a warning to the Fukushima operators on the necessity of preparedness. Preparing for a pandemic is a particularly evident example of the preparedness paradox. Because adequate preparation means that no mass deaths or visible consequences will occur, there is no evidence that the preparation for the pandemic was necessary. Historical perspective can also contribute to the preparedness paradox. From the point of view of historians after the Year 2000 problem, the preventative action taken has been described as an "overreaction", instead of a successful effort to prepare for an upcoming problem. For disaster management professionals, this is an example of a no-win situation.
Slide 25	Examples The 2011 Tōhoku earthquake and tsunami and the resulting Fukushima Daiichi nuclear disaster is another example of the preparedness paradox Even though the Onagawa Nuclear Power Plant was closer to the epicenter of the earthquake, it withstood the cataclysm because of the preparations made by the facility's owners. On the other hand, the Fukushima Daiichi Nuclear Power Plant suffered heavy damage because of a lack of preparation due to the perception of less risk. The Chernobyl nuclear power plant disaster should have been a warning to the Fukushima operators on the necessity of preparedness.

Slide 26	Preparing for a pandemic is a particularly evident example of the preparedness paradox. Because adequate preparation means that no mass deaths or visible consequences will occur, there is no evidence that the preparation for the pandemic was necessary. Historical perspective can also contribute to the preparedness paradox. From the point of view of historians after the Year 2000 problem, the preventative action taken has been described as an "overreaction", instead of a successful effort to prepare for an upcoming problem. For disaster management professionals, this is an example of a no-win situation.
Slide 27	So involving citizens is a means to build smarter and more resilient communities as, as we have seen, knowledge is one of he most powerful synchronizer between real probability of a risk and its perception Experience teaches: this is why the Municipal Plan is a constantly evolving tool, because the territory is constantly evolving The citizen is an active subject and as such contributes to consolidating a community capable of reacting to an emergency

Exercises	
1	Given a risk, plan a (simplified) communication campaign for a community In this document: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap9_FINAL-1.pdf you find a variety of case studies. I suggest using heat waves in Europe as an example. This text and the case study is quite complex, so I suggest using it for students with high/medium preparation. A simpler document to use is the following: https://www.epa.gov/natural-disasters/flooding#recover which is focused on a particular moment in disaster recovery after a flood. Organisation: in pairs. Each couple will present their campaign to the rest of the class and receive feedback. They must keep in mind for whom they are communicating, on what, with chich aim and tools/channels used. Duration: 1 hour

SOURCES AND INSIGHTS

Activity	Topic	
1	1.1	Ecosystems • National Geographic: https://education.nationalgeographic.org/resource/ecosystem • *Britannica:* https://www.britannica.com/science/mesopredator-release • *EEA, definition:* https://www.eea.europa.eu/help/glossary/chm-biodiversity/ecological-or-ecosystem-resilience • *EEA, ecosystem types in Europe:* https://www.eea.europa.eu/data-and-maps/data/ecosystem-types-of-europe-1 • *EEA, mapping Europe's ecosystems:* https://www.eea.europa.eu/publications/mapping-europes-ecosystems-1 Ecosystems Services • European Commission – Deltares http://www.worldsoilday2017.eu/pdfs/Soils4EU_D1.2_ecosystemservices_MAES.pdf • CICES: https://cices.eu/resources/ Ecosystem Resilience • ESA: https://esajournals.onlinelibrary.wiley.com/doi/10.1890/1540-9295%282003%29001%5B0488%3ARDECAR%5D2.0.CO%3B2#:~:text=Ecosystem%20resilience%20is%20defined%20as,to%20reorganize%20and%20renew%20itself. • Science Direct: https://www.sciencedirect.com/topics/earth-and-planetary-sciences/ecosystem-resilience Nature Based Solutions: • https://www.sciencedirect.com/science/article/pii/B9780128198711000178
	1.2	Sub-chapter 3.5 "Assets at risk and potential impacts – Environment and ecosystem services" of the 2020 Report "Science for disaster risk management" https://drmkc.jrc.ec.europa.eu/portals/0/Knowledge/ScienceforDRM2020/Files/ch03_subch0305.pdf IFFI European Wilde Fire Report 2010 https://effis-gwis-cms.s3-eu-west-1.amazonaws.com/effis/reports-and-publications/annual-fire-reports/forest-fires-in-europe-2010.pdf
2	2.1	
3	3.1	The Black Swan: The Impact of the Highly Improbable, Nassim Nicholas Taleb, 2008 Per un catastrofismo illuminato. Quando l'impossibile è certo, Jean-Pierre Dupuy, 2011 Improving resilience: https://www.epa.gov/sites/default/files/2015-08/documents/flood_resilience_guide.pdf