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THE ROLE OF ENVIRONMENT, HUMAN ACTIVITY AND EXOTIC ANIMALS IN THE SPREAD OF DISEASES.

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INTRODUCTION

Over the last 30 years the reversal in the declining death rate due to infectious diseases has alarmed international health experts. Dramatic successes in eradicating small pox, controlling polio and tuberculosis, and eliminating vector-borne diseases such as yellow fever, dengue and malaria from many regions convinced most experts the era of infectious diseases would soon be over. Unfortunately this optimistic prognosis was premature as a number of diseases have dramatically reemerged. Tuberculosis, cholera, dengue, plague, Avian influenza and malaria have increased in incidence or geographic range, as have new drug-resistant strains of bacteria. In addition newly recognized diseases, such as AIDS, SARS, Drug Resistant Tuberculosis, Cryptosporidiosis, e.t.c. have emerged**.** Dr. Mark Woolhouse and his colleagues at University of Edinburgh noted in the journal SCIENCE that "humanity is currently plagued by 1709 known pathogens (from viruses and bacteria to fungi, protozoa and worms)". They concluded that 49% of those are zoonotic and further it was noted that zoonoses are three times more likely to be emerging diseases than non-zoonotic diseases (Cook, 2003).

The present global emergence of infectious diseases is clearly associated with the social and demographic changes of the past 50 years, particularly urbanisation and globalisation, with the attendant spread of pathogens (agents causing disease) via infected humans, hosts, vectors or commodities. The change in the environment caused by human activities is also apparent in the transformation of much of our landscape and conversion of regional systems once dominated by natural ecosystems. Factors include expansion into urban or peri-urban habitat, deforestation, and the spread of intensive farming. The environment's role in the emergence of diseases is apparent in the connections between the direct consequences of human changes to urban and rural landscapes and ecosystems, and the secondary effects on disease emergence factors. Developing irrigated agriculture, for example, can create breeding grounds for mosquitoes, a vector for malaria. Likewise the inadequate storm drainage and sewerage systems often associated with rapid urbanisation not only increase the breeding habitat for disease vectors but facilitate the spread of waterborne pathogens causing cholera and leptospirosis.

Overwhelming evidence points to human demographic changes as the major direct and indirect factor contributing to the increase in infectious disease, with somewhat different dynamics and mechanisms at work in urban and rural environments. In the first case the increasing number of people crowded into dense settlements has dramatically increased opportunities for food, water, rodent and vector-borne pathogens to "colonise" and persist in human populations. Each pathogen has unique transmission and adaptive characteristics that determine a minimum population for survival (the threshold for measles is about 250,000 people). Whether the threshold is 100,000 or a million the number of large urban settlements and the average settlement size has been growing fast in recent decades. The number of cities of one million or larger was 76 in 1950, 522 in 1975, 1,122 in 2000, and is set to exceed 1,600 by 2015. This 20-fold increase translates to a roughly similar increase in global infectious disease vulnerability due to this one factor alone.

This type of growth has indirect social and environmental consequences that contribute to multiplying the actual increase in population. Poverty, poor living conditions, including lack of sanitation and infrastructure for waste-water and solid waste management, increases opportunities for vector- borne diseases and others passing from animals to humans. The geographic spread and expansion into peri-urban areas of the mosquito Aedes albopictus, exquisitely adapted for breeding in discarded plastic containers and used automobile tires, is a good example of how a potential vector of viral diseases has taken advantage of environmental change. Lack of sanitation and waste water treatment, and industrialscale intensification of animal production systems the world over, contribute to exotic species, and the proliferation and spread of water and food-borne pathogens. Increasingly frequent outbreaks of infections are caused by these and other organisms, many of which may eat alongside or prey on wild mammals and birds as natural parasites. The contamination of surface waters and spread of pathogens is further promoted by the alteration of catchments and watersheds accompanying urbanisation, and intensive farming around cities. Channelling streams, removing vegetation on the banks, and filling in wetland – all of which accompany unplanned urbanisation – eliminate the natural retention and nutrient recycling systems, as well as barriers to surface run-off contaminated with intestinal pathogens. Nutrient pollution leading to oxygen depletion in estuaries, lakes, streams and even stretches of ocean, such as the Gulf of Mexico, helps such pathogens survive too.

In rural areas population and consumption play a less direct role in contributing to disease emergence, particularly as rural emigration is fuelling the demographic explosion in cities. It is more that urban areas are driving a sustained increase in the timber trade, agriculture, stock raising and mining, resulting in turn in deforestation and changes in land use that are transforming rural landscapes and natural areas in ways that often facilitate the emergence of disease. Deforestation or even "patchy" reforestation leads to ecological changes such as increased edge habitat and local extinction of predators that favour some disease vectors and reservoir species. Encroachment of individuals and settlements on natural ecosystems brings humans into contact with known and novel pathogens. The spread and intensification of farming results in the development of irrigation systems, ideal breeding sites for mosquitoes and a habitat for opportunistic insects and rodents that may be vectors or reservoirs for disease. Dams provide a favourable habitat for other vectors.

Climate change represents a potential environmental factor affecting disease emergence. Shifts in the geographic ranges of hosts and vector, the effect of increasing temperature on reproductive, development and mortality rates on hosts, vectors, and pathogens, and the effects of increased climate variability on flooding and droughts all have the potential to affect disease incidence and emergence positively or negatively. At present there is insufficient evidence to indicate what the net effect will be once climate changes begin to have a major affect on ecosystems. However, a dominant theme emerging from research on the ecology of infectious disease is that accelerated and abrupt environmental change, whether natural or caused by humans, may provide conditions conducive to pathogen emergence: pathogen adaptation, host switching, and active or passive or dispersal.

The resurgence of infectious diseases worldwide reflects our quick-fix mentality, with poor development planning, a lack of political determination and institutional inertia. It is not the inevitable result of development, environmental change, or even incremental population growth. On the contrary much can be done to reverse the current trend. As well as rebuilding the public health infrastructure for infectious diseases, there is substantial evidence and a growing number of examples of how regional planning and development, including urbanisation, agricultural expansion, and the management and conservation of forests and other ecosystems can minimise and even reduce outbreaks of infectious disease as well as environmental damage. Basically we need an integrated approach to pathogen control. This approach will involve meshing social and economic development programmes, environmental and natural resource management, with intervention based on the reinvigorated field of disease ecology and methods involving community participation (Bruce and Gubler, 2004).

HUMAN AND EXOTIC SPECIES IMPACTS

Adverse human impacts on biodiversity occur in very different ways, such as: habitat-destruction; overharvesting; climatic change; environmental pollution (air pollution, eutrophication, acid rain); commercial trade of (rare) plants and animals; introductions of species; and genetic engineering.

Habitat destruction

Destruction of habitats for al kind of purposes, construction of roads, canals, dams and houses is probably the most important threath to biodiversity.

Illustrative are the side effects of some well-intentioned international development projects. These are sometimes sponsored by international agencies concerned with such affairs and sometimes by the foreign-assistance departments of individual donor nations. Usually the projects are intended to benefit one segment of the economy of the recipient nation; but, because ecological advice generally is not sought and because of the broad effect of the proposed development on other resources or on the total environment, the side effects of some of these activities often far outweigh any benefits that are derived. An example is the Aswan High Dam of Egypt, where the need to increase the supply of water for irrigation and power was considered paramount. The environmental side effects, however, have been enormous and include the spread of the disease schistosomiasis by snails that live in the irrigation channels, loss of land in the delta of the Nile River from erosion once the former sediment load of the river was no longer available for land building, and a variety of other consequences. The responsibility of agencies concerned with international development to seek the best environmental advice is now generally accepted, but implementation of this responsibility has been slow.

Overharvesting

Overharvesting, overcultivation or over-exploitation of natural resources is also a big threat to biodiversity. This human activity refers to a rate of exploitation or utilization that exceeds the cycling capacity of the natural resource. Classifying natural resources it has been traditional to distinguish between those that are renewable and those that are nonrenewable. The former were considered to be the living resources--e.g., forests, wildlife, and the like--because of their ability to regenerate through reproduction. The latter were considered to be nonliving mineral or fuel resources, which, once used, does not replace themselves. Because all natural resources in fact form a continuum, from those that are most renewable in the short term to those that are least renewable, they do not readily lend themselves to a single system of classification. It is useful, therefore, to examine the various types of natural resources in relation to their cycling time; i.e., the length of time required to replace a given quantity of a resource that has been utilized with an equivalent quantity in a similarly useful form. From this point of view, renewable resources can be considered as those with short cycling times (grass, timber) and nonrenewable resources as those with very long cycling times (coal, oil). Any resource can be nonrenewable, however, if the demand and rate of utilization exceed its cycling capacity.

Illustrative is the international exploitation of living resources, particularly the tropical forests of the world. These forests, which contain many hundreds of species of trees growing in diverse mixtures, were spared from exploitation in earlier decades because of their inaccessibility, the relatively low value of most of the trees for timber purposes, and the limited world demand. Heavily exploited for special uses were a few species of high value, such as teak, ebony, sandalwood, mahogany, and other furniture woods. Most tropical forests were not greatly disturbed, however. This situation has changed, and a wide variety of woods previously considered worthless are used for pulp, chipboard, and fibreboard or as cellulose for plastics production. With new machines and better transportation, it has become profitable to remove trees from previously remote areas and to ship logs, bolts, wood chips, or other partially processed materials to foreign markets. Faced with a high demand for their forest products, most developing nations have been willing to sign over timber rights to foreign companies, hoping thereby to increase their national incomes and to advance the general material welfare of their people. Unfortunately, most of these timber contracts contain few or no provisions for conservation. Forest industries that have excellent management and conservation records in their home countries behave differently in other lands. Great areas of tropical forest have been laid waste, soils bared to erosion, and the wildlife within them destroyed. Because no laws are violated in either the exploited or the home country, there is no effective redress. General international agreements governing the conservation of such living resources would provide an answer to this problem, but they are unlikely to be implemented in time to prevent the devastation of large areas of the tropical world.

Global Climatic Change

Climate change is likely to have considerable impacts on most or all ecosystems. The distribution patterns of many species and communities are determined to a large part by climatic parameters, however, the responses to changes in these parameters are rarely simple.

At the simplest level, changing patterns of climate will change the natural distribution limits for species or communities. In the absence of barriers it may be possible for species or communities to migrate in response to changing conditions. Vegetation zones may move towards higher latitudes or higher altitudes following shifts in average temperatures. Movements will be more pronounced at higher latitudes where temperatures are expected to rise more than near the equator. In the mid-latitude regions (45 to 60º), for example, present temperature zones could shift by 150 550 km.

In most cases natural or man-made barriers will impact the natural movement of species or communities. Arctic tundra and alpine meadows may become squeezed by the natural configuration of the landscape, while these and many other natural systems may be further confined by human land-use patterns. Many national parks and protected areas are now surrounded by urban and agricultural landscapes which will prevent the simple migration of species beyond their boundaries.

Rainfall and drought will also be of critical importance. Extreme flooding will have implications for large areas, especially riverine and valley ecosystems. Increasing drought and desertification may occur in tropical and sub-tropical zones, and at least one model has predicted a drying out of large parts of the Amazon.

Rates of change will also be important, and these will vary at regional and even local levels. The maximum rates of spread for some sedentary species, including large tree-species may be slower than the predicted rates of change in climatic conditions. In many cases further complications will arise from the complexity of species interactions and differential sensitivities to changing conditions between species. Certain species may rapidly adapt to new conditions and may act in competition with others.

Changes in seasons are already being noticed in many temperate regions. Birdsong is being reported earlier and spring flowers are emerging when it was once winter. In agricultural landscapes changes in the length of growing seasons may improve productivity in mid-latitudes and increase the potential for arable crops at high latitudes.

Negative impacts may include increased ranges of insect pests and diseases, and failure of crops in some regions from drought or flooding. On the relatively narrow habitats of the coastal margins, especially where these are backed by areas of intense human use, rising sea levels may lead to the squeezing out of important coastal habitats.

Rising sea temperatures will further affect the distribution and survival of particular marine resources. Corals have already shown an extremely high sensitivity to minor increases in temperature, while other studies have shown dramatic changes in the distribution and survival of the Pacific salmon in the late 1990s.

In addition to causing a warming effect, increased concentrations of atmospheric carbon dioxide are known increase rates of photosynthesis in many plants, as well as improving water use efficiency. In this way the climate changes may increase growth rates in some natural and agricultural communities.

Desertification

About 3,6 billion of the world's 5.2 billion hectares of useful dryland for agriculture has suffered erosion and soil degradation. In more than 100 countries, 1 billion of the 6 billion world population is affected by desertification, forcing people to leave their farms for jobs in the cities.

Desertification takes place in dryland areas where the earth is especially fragile, where rainfall is nil and the climate harsh. The result is the destruction of topsoil followed by loss of the land's ability to sustain crops, livestock or human activity. The economic impact is horrendous, with a loss of more than $40 billion per year in agricultural goods and an increase in agricultural prices.

Climatic changes can trigger the desertification process, but human activities frequently are the proximate cause. Overcultivation exhausts the soil. Deforestation removes trees that hold the soil to the land. Overgrazing of livestock strips the land of grasses. According to a UN study, about 30% of earth's land - including the 70% of dryland - is affected by drought. Every day, about 33,000 people starve to death.

Desertification create conditions that intensify wildfires and stirring winds, adding to the tremendous pressure to earth's most precious resource, water, and, of course, the animals dependant on it. According to the World Wide Fund for Nature, the world lost about 30% of its natural wealth between 1970 and 1995.

Dust from deserts and drylands are blown into cities around the world. Dust from Africa reaches Europe through the Pasat wind, and even reaches US cities. Dust particles, which are less than 2,5 millionths of a metre in size, are inhaled, causing health problems and have been shown to boost death rates.

Environmental pollution

Environmental pollution or pollution is the addition of any substance (nutrients) or form of energy (e.g., heat, sound, radioactivity) to the environment at a rate faster than the environment can accommodate it by dispersion, breakdown, recycling, or storage in some harmless form. A pollutant need not be harmful in itself. Carbon dioxide, for example, is a normal component of the atmosphere and a by-product of respiration that is found in all animal tissues; yet in a concentrated form it can kill animals. Human sewage can be a useful fertilizer, but when concentrated too highly it becomes a serious pollutant, menacing health and causing the depletion of oxygen in bodies of water. By contrast, radioactivity in any quantity is harmful to life, despite the fact that it occurs normally in the environment as so-called background radiation.

Pollution has accompanied mankind ever since groups of people first congregated and remained for a long time in any one place. Primitive human settlements can be recognized by their pollutants--shell mounds and rubble heaps. But pollution was not a serious problem as long as there was enough space available for each individual or group. With the establishment of permanent human settlements by great numbers of people, however, pollution became a problem and has remained one ever since. Cities of ancient times were often noxious places, fouled by human wastes and debris. In the Middle Ages, unsanitary urban conditions favoured the outbreak of population-decimating epidemics. During the 19th century, water and air pollution and the accumulation of solid wastes were largely the problems of only a few large cities. But, with the rise of advanced technology and with the rapid spread of industrialization and the concomitant increase in human populations to unprecedented levels, pollution has become a universal problem.

Of all the pollutants released into the environment every year by human activity, Persistent Organic Pollutants or POPs are among the most dangerous. They are highly toxic, causing an array of adverse effects, notably death, disease, and birth defects, among humans and animals. Specific effects can include cancer, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders, and disruption of the immune system. These highly stable compounds can last for years or decades before breaking down. POPs released in one part of the world can, through a repeated and often seasonal process of evaporation, deposit, evaporation, deposit, be transported through the atmosphere to regions far away from the original source. In addition, POPs concentrate in living organisms through another process called bioaccumulation. Though not soluble in water, POPs are readily absorbed in fatty tissue, where concentrations can become magnified by up to 70,000 times the background levels. Fish, predatory birds, mammals, and humans are high up the food chain and so absorb the greatest concentrations.

Depletion of the Ozone Layer

Scientists also fear that the ozonosphere (or ozone layer of the atmosphere) is being depleted by the chemical action of chlorofluorocarbons emitted from aerosol cans and refrigerators and by pollutants from rockets and supersonic aircraft. Depletion of the ozone layer, which absorbs ultraviolet radiation from the Sun, would have serious effects on living organisms on the Earth's surface, including increasing frequency of skin cancer among humans.

Acid Rain

Another climatic effect of pollution is acid rain. The phenomenon occurs when sulfur dioxide and nitrogen oxides from the burning of fossil fuels combine with water vapour in the atmosphere. The resulting precipitation is damaging to water, forest, and soil resources. It is blamed for the disappearance of fish from many lakes in the Adirondacks, for the widespread death of forests in European mountains, and for damaging tree growth in the United States and Canada. Reports also indicate that it can corrode buildings and be hazardous to human health. Because the contaminants are carried long distances, the sources of acid rain are difficult to pinpoint and hence difficult to control. Acid rain has been reported in areas as far apart as Sweden and Canada. The drifting of pollutants causing acid rain across international boundaries has created disagreements between Canada and the United States and among European countries over the causes and solutions of the precipitation. The international scope of the problem has led to the signing of international agreements on the limitation of sulfur and nitrogen oxide emissions.

Eutrophication and Oligotrophication

Freshwater ecosystems go through eutrophication or oligotrophication. Eutrophication is an aging process in the life cycle of a lake, pond or slow moving stream. When this occurs a lot of dead organic matter settles at the bottom of the water. It all decomposes and forms an evergrowing layer of silt. This can take many thousand years to complete. The other aging process is known as oligotropication. This is a the total opposite of eutrophication, it is nutrient poor.

Lakes face to basic kinds of environmental problems which are: threats to water quality and the deterioration of shoreland. Pollution by industries, shipping and poor agricultural practices have led to poisoning of the water. Also changes in temperature lead to accelerated eutrophication. Eutrophication is an overload of different nutrients in the water which put an excessive demand on the oxygen content of the water, resulting in the chemical-biological death of a lake. Some of the world's major lakes currently suffer from such problems.

The effects of pollution on land (and in water) are to favour small-bodied, rapidly reproducing organisms that do not depend on complex food webs. The process of simplification and impoverishment is now global and affects terrestrial and aquatic communities alike. It is the continuously expanding result of chronic intrusions on natural systems by human influences. The impoverishment threatens all life because it reduces systematically the capacity of the Earth to support plants.

The authors of Nutrients in European Ecosystems say natural lakes, artificial reservoirs, rivers, coastal marine waters and terrestrial ecosystems are all affected to varying degrees of severity by nutrient excesses. In most cases, the damage varies only by geographic region. Many reservoirs serving essential uses such as public water supplies and irrigation are among the most affected by eutrophication because they are, of necessity, located close to areas of intense human activity. The report says eutrophication is a major issue in still water environments but, even after decades of scientific research, there are very few monitoring programmes in existence.

In rivers, the most widespread pollutant in geographic terms is phosphorus, which results in the development of large quantities of seasonal plant growth, leading to other types of impact such as perturbed oxygen and pH cycles, organic pollution and massive growth of toxic algae. The report also confirms that excess ammonium is present in many rivers. Excessive levels of nitrates, observed in many previous studies, represent a widespread degradation of river water and, locally, nitrate concentrations may prevent human uses of water.

In coastal marine waters, the frequency and geographic extent of eutrophication phenomena are increasing, even in marine areas previously believed to be unaffected.

In terrestrial ecosystems, nutrient impacts appear to be serious because of the uncertainty of recovery of the land-based systems, leading to losses of species and ecosystems.

The application of nutrient reduction policies is patchy, says the report. But the authors found it difficult to assess the effectiveness of these policies because of the general scarcity of data concerning primary causes, emissions and the status of ecosystems. All the necessary datasets are not available at European or national level, and do not even exist at all in some countries. It was only possible to obtain a small fraction of the existing data, and this fraction was insufficient to produce a full assessment.

Commercial trade of plant and animal species

Commercial trade of living animals and plants as well as in the products derived from them is also a severe threat to biodiversity. Demands by wealthy nations for certain animal and plant products create particularly severe problems in less affluent countries. The trade in **endangered species** of wildlife is illustrative. The demand for furs and skins of rare animal species is artificially created in the fashion centres of the world. Prices paid by wealthy people for these items in affluent countries exceed the lifetime income of most people in the countries from which the leopards, crocodiles, tigers, and other wild species come. Poachers go to great lengths to obtain these animals wherever they can be found, including inside national parks and reserves. Because effective policing is virtually impossible, legal and illegal trade in wildlife begin to overlap, and both become firmly established. Exporters of wild animals and their products are the end links of profitable business chains that include far greater numbers of hunters and trappers in remote areas. Furthermore, for each animal or skin that reaches a foreign market, many more are destroyed in hunting, trapping, and transporting.

Introductions of non-native (alien) species

A major contributor to depletion and extinction, second only to habitat loss, is the introduction of species into new environments. These transplanted forms are called exotics. Every introduction of exotic species that become established results in changes to the receiving ecosystem. Unfortunately, most of the observed effects have been detrimental and irreparable by displacing native species, and altering trophic level structure. Introduced species often prey on many parts of an already established food web or compete with indigenous species for resources such as food or space. Without any natural predators, invaders can threaten or even eliminate indigenous species. They also carry with them the threat of new diseases which can destroy vulnerable native inhabitants. In some areas, native species are on the brink of extinction due to the introduction of an exotic species. Species have sometimes invaded new habitats naturally (e.g. when land bridges have become established) but human exploration and colonization has dramatically increased the spread of exotic species. Whenever man has settled far away from home, he has tried to introduce his familiar animals and plants. Many other species (e.g. rats) have been accidentally transported around the world.

The first cases were from European explorers, who often released goats and pigs so that later colonizers had an abundant source of familiar animal protein, and colonizers then brought more of the same.

Some of our most abundant wild animals and plants, especially those that do well in urban or disturbed areas, are introduced species that have become established. For example, the starling, cabbage-white butterfly, eucalyptus tree, mustard, many grasses, etc. Most insect and plant pests are exotic species. It is estimated that at least 4,000 exotic plant and 2,300 exotic animal species are now established in the United States.

Many exotics have disastrous effects on native flora and fauna. They often leave behind the factors that have evolved with them and that control their population and spread. In their new habitat there may be fewer predators or diseases, so their populations grow out of control. Prey organisms may not have evolved defense mechanisms and native species may not compete successfully for space or food, so are often pushed to extinction. Since exotic species are self-perpetuating, they can have permanence unmatched by other threats to biodiversity including overexploitation and habitat loss. Exotics are a factor contributing to the endangered or threatened status of 42% of animals and plants on the U.S. endangered species list.

The spread of exotics replaces healthy, diverse ecosystems with biologically impoverished, homogeneous landscapes. For example, places with a Mediterranean climate in southern Australia, the U.S. west coast, Chile and South Africa previously had few plant species in common (although they did show many examples of convergent evolution, leading to similar landscapes). They now share hundreds of weedy exotic species, mainly from the Mediterranean region.

Genetic engineering

The term genetic engineering initially meant any of a wide range of techniques for the modification or manipulation of organisms through the processes of heredity and reproduction. As such, the term embraced both artificial selection and all the interventions of biomedical techniques, among them artificial insemination, in vitro fertilization (e.g., "test-tube" babies), sperm banks, cloning, and gene manipulation. But the term now denotes the narrower field of recombinant DNA technology, or gene cloning, in which DNA molecules from two or more sources are combined either within cells or in vitro and are then inserted into host organisms in which they are able to propagate.

Genetic engineering has advanced the understanding of many theoretical and practical aspects of gene function and organization. Through recombinant DNA techniques, bacteria have been created that are capable of synthesizing human insulin, human growth hormone, alpha interferon, a hepatitis B vaccine, and other medically useful substances. Plants may be genetically adjusted to enable them to fix nitrogen, and genetic diseases can possibly be corrected by replacing "bad" genes with "normal" ones. Nevertheless, special concern has been focused on such achievements for fear that they might result in the introduction of unfavourable and possibly dangerous traits into (micro)organisms that were previously free of them--e.g., resistance to antibiotics, production of toxins, or a tendency to cause disease(De Valk, 2005).

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