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PURPOSIVE INTERVENTIONS INTO LIFE PROCESSES
An Attempt to Describe the Structural Dimensions of the Man-Animal-Relationship

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PURPOSIVE INTERVENTIONS INTO LIFE PROCESSES. AN ATTEMPT TO DESCRIBE THE STRUCTURAL DIMENSIONS OF THE MAN-ANIMAL-RELATIONSHIP.

Marina Fischer-Kowalski, Helmut Haberl[1]

(1) INTRODUCTION

We focus our attention to the question how the functioning of the socio-economic system determines the structural preconditions of the man-animal relationship. A description of these structural preconditions can be placed among "environmental concerns" and can and should be, according to our approach, part of national environmental information systems. During the last decade, backed by international support (UN, OECD, EC), environmental information systems have been established in most countries. Such information systems are a neccessary precondition for society's awareness of the relationship to its natural environment.

Environmental monitoring systems contain several typically fairly seperated parts. One part refers to the "states of the environment" (such as the contamination of air and water with noxious substances, soil erosion, the dying forest syndrome or the endangerment of species). Other parts express the activities and the costs of environmental protection and repairs. And still other parts - less popular than the aforementioned - seek to describe the stresses upon the environment exerted by the socio-economic system. This, to our mind, is usually done much too unsystematically, and furthermore, usually does not include the treatment of animals.

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[1] M.Fischer-Kowalski and H.Haberl are members of the IFF (Institute for Interdisciplinary Research and Continuing Education of the Universities of Innsbruck, Klagenfurt and Vienna) in Vienna. This article is based upon a two-years study on "causer-related environmental indicators" partly financed within a program for "New Paths Towards Measuring the National Product" ran by the Austrian Ministry for the Environment. It owes its basic ideas to the cooperation of the whole team, which contained besides the authors: Geli Brechelmacher, Harald Payer, Anton Steurer, Peter Wenzl and Helga Zangerl-Weisz.

Our propositions are guided by the idea that society's awareness of the "damages" it currently causes in its natural environment is crucial to possible changes of policies. To create an information system that meets this purpose requires a conception of the meaning of "damages" done to the natural environment, a conception wide enough to include the treatment of animals. For such a conception of "damages", or, in other words, for the distinction of what is "harmful" and what is "harmless" to the natural environment, we will review the following lines of reasoning.

(2) Four Paradigms for the Distinction of Socio-Economic Activities into "Harmful" or "Harmless" with Regard to the Natural Environment

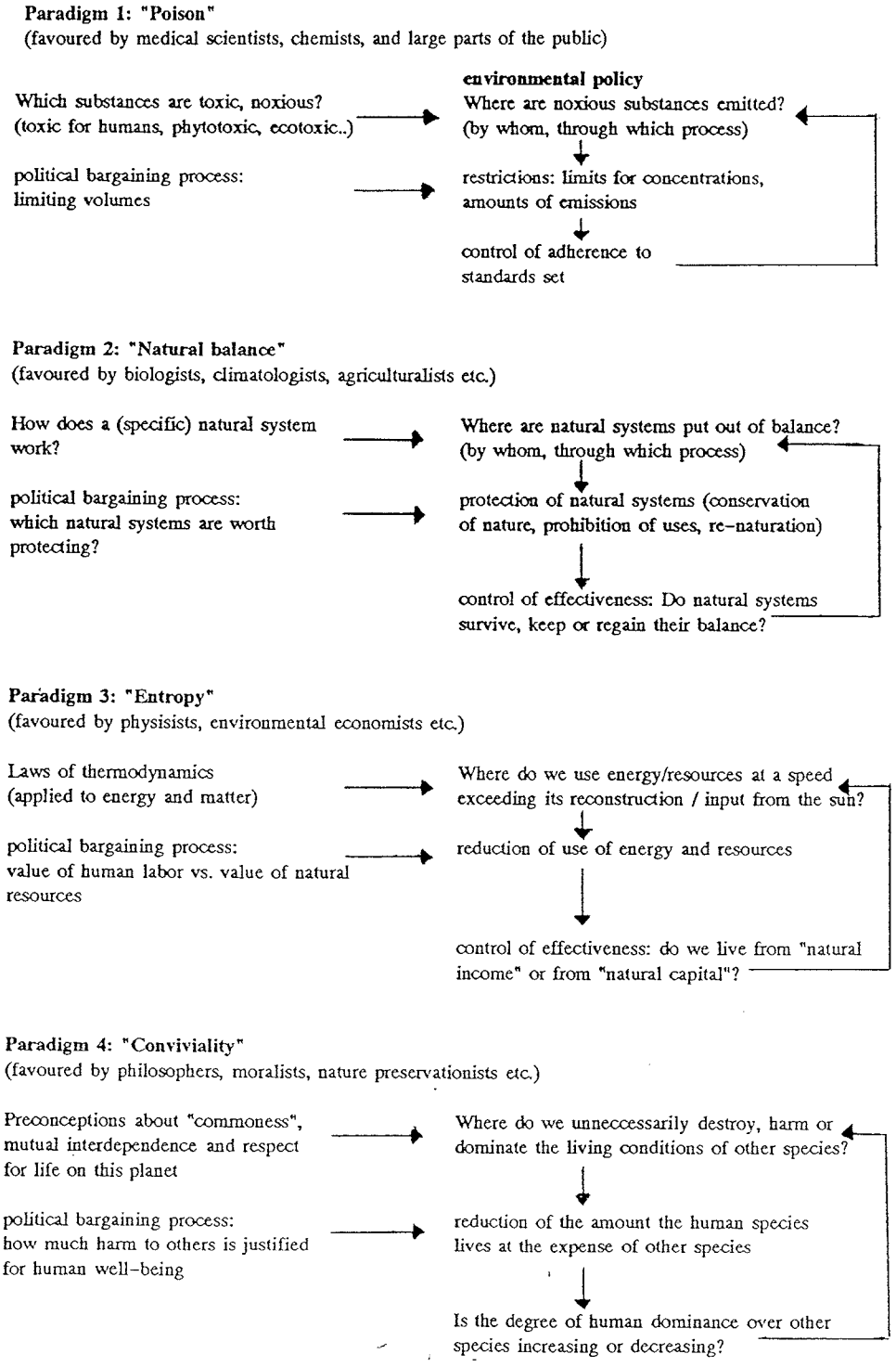
There exists a variety of conceptions to distinguish between what is "good" (or at least harmless) and what is "bad" (harmful) for the "environment". These conceptions vary according to scientific discipline and according to political and ethical understanding of the man - nature relationship. As these conceptions are basically underlying all value judgements (which environmental problem is most important?), they are very important in the environmental discourse. Nevertheless the question "which human action is environmentally detrimental" is seldom discussed explicitly. Often enough this results in serious misunderstandings.

We have ordered these conceptions into four groups which we have called "paradigms", because of their unifying function in different "schools" of environmental sciences. Each of them is guided by a specific reference concept, and each of them is able to catch important aspects of the possible meaning of "damages" society causes to its environment. The paradigms are not mutually exclusive in the sense that one specific aspect of environmental damage might not occur in more than one paradigm. But they cannot be reduced upon one another, nor can they be merged into one single "grand" paradigm.[2] Each paradigm has its specific structure of reasoning, its own scientific and political tradition and au-

[2] The notion of "sustainability" used by environmental economists claims to be such a "grand" paradigm. But inspite of its generality we think it cannot embrace all aspects these 4 paradigms encompass. It excludes the "conviviality"-reasoning (paradigm 4) completely, and it would rule out some of the more short-term processes in the "poison"-paradigm. It seems a close relative to the "entropy"-paradigm, also sharing its unspecificity.

dience. But all four paradigms taken together permit a complete scanning of what can be meant if people talk about man's socio-economic system "causing environmental damage" (Fischer-Kowalski et al. 1992).

Figure 1: Four basic paradigms for the meaning of "environmental damage" caused by the socio-economic system (Fischer-Kowalski et al. 1991)



The first paradigm, referring to a "poisoning" of the natural environment, is most common in the public understanding of environmental damages. It is founded in medical and chemical reasoning, and the typical political answer within this paradigm is to issue limiting volumes for the emission of noxious substances. Human health serves as a core reference point: the emission of substances directly (such as CO) or indirectly (such as with substances destroying the ozone layer) detrimental to human health is considered environmentally harmful. Of course such substances often are also detrimental to animal life - but within this paradigm this usually is considered only as a side aspect, particularly if man's economic interests (e.g.fishing) are disturbed thereby.

Paradigm II, "natural balance", is more related to biological and ecological scientific traditions. It considers socio-economic activities as harmful that put natural systems, such as the climate, the soil or specific biotopes, out of their balance.[3] This may happen by the emission of noxious substances,[4] but it also may refer to quite different activities such as regulating rivers, chopping trees or importing alien species. Paradigm II requires a holistic view of the systems concerned. It bears close reference to the preconditions of animal life: The destruction of biotopes is commonly seen as the major reason for the extinction of species.

Paradigm III, "entropy", is founded in physic's theory of thermodynamics, but it also has made some career among environmental economists. Our planet is seen as a materially closed system where all processes that sustain life depend upon the input of energy by the sun. Whereas the amount of energy reflected into the universe is equal to the amount of input, this is not true for its entropy: The entropy of this energy is much higher and thus its usability much lower. The difference of entropy between input and output is the crucial resource all processes live on. Therefore socio-economic activities are considered harmful that use energy and materials in amounts and at a speed beyond their reconstruction by

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[3] On a logical level human "health" is a biological system just as well, and thus paradigm I might be considered a special case of paradigm II. But here we are not arguing on a logical, but on a typological level, trying to distinguish lines of reasoning that have a specific scientific tradition. Translated into biological terms one might argue paradigm I to use the human organism, paradigm II to use the ecosystem as a reference point.

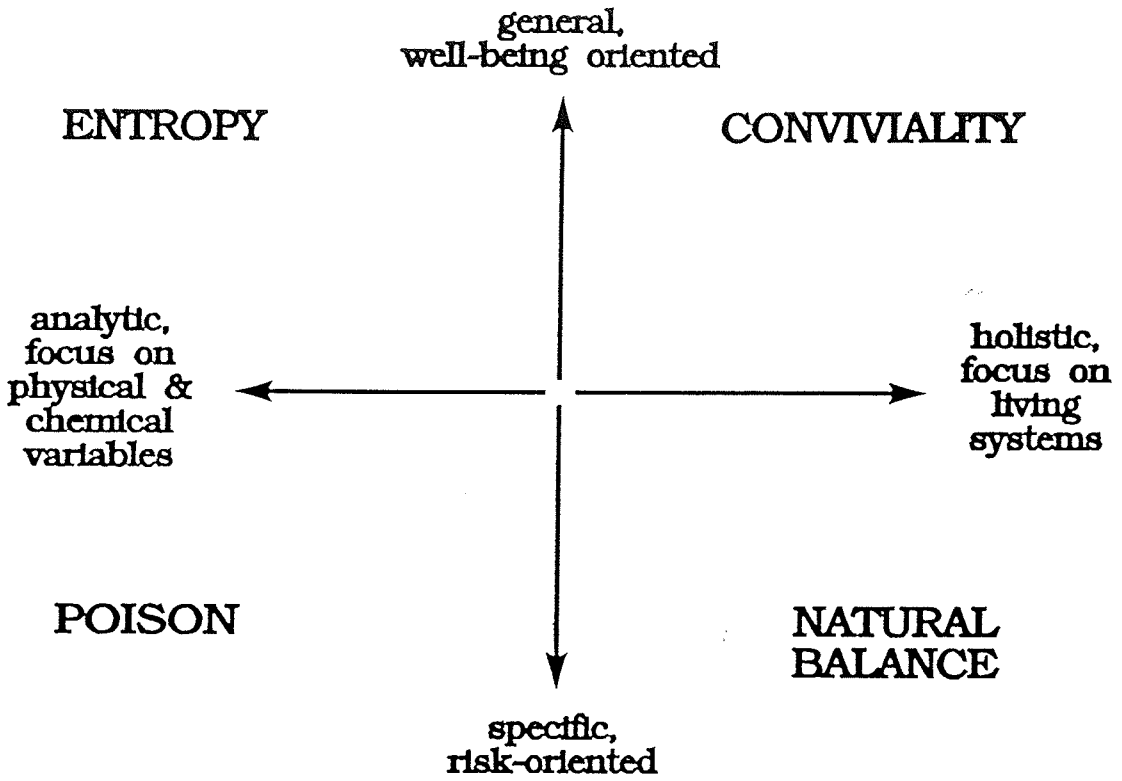
[4] But, in contrast to paradigm I, drawing attention not just to their amounts, but to specific circumstances such as location, season, steadiness etc.

sun-input, thereby overproportionally increasing entropy. In other words, it is considered harmful if the socio-economic system lives on this planet's capital instead on its income. This paradigm is very general, and it seems to bear little direct reference to animal life - it rather draws attention to the consumption of fossile fuels and the recycling of materials. Further down we will try to show though, that an interesting explicit connection between this paradigm and socio-economic influences upon animal life can be established.

Paradigm IV is the most uncommon of all. We have termed it "conviviality" with reference to Ivan Illich's (1973) famous book. He uses this term to describe tools and modes of production that imply as little mutual dominance and mutual instrumentalization between humans as possible. We think this term may just as well be used to describe the lack of dominance and instrumentalization mankind exerts upon other living species. At the core of this paradigm lies a preconception of "commonness", mutual interdependence and respect for the life on our planet. Reference point for distinguishing "harmful" from "harmless" socio-economic activities would be the degree in which they destroy, harm or dominate the living conditions of other species. This of course is a matter of degree: All species intervene into the living conditions of other species, both violently and pleasantly. But maybe human beings (especially those organized by industrial civilization) are particularly dominant and unpleasant neighbors.

We think that an information system on environmental impacts of the socio-economic system should bear reference to all four paradigms and should present evidence concerning the central set of variables in each of them. It has to be left to the political discourse and decision process to solve contradictions and to weigh arguments. The information system itself should not deprive any one line of reasoning of its possible empirical basis, nor priviledge one over the other.

Figure 2: Epistemological qualities of the four paradigms (Fischer-Kowalski et al. 1991)



This conclusion can also be supported by considering the empistemological qualities of the four paradigms as shown in figure 2. Obviously the "poison paradigm" and the "entropy paradigm" are more closely related to established ways of analytical thinking in chemical and physical dimensions, whereas both the "natural balance paradigm" and the "conviviality paradigm" present holistic views referring to living systems. Thus they are more recalcitrant to relate to analytical systems such as (economic) national accounting - but nevertheless holistic systemic approaches may be the ones to come. The vertical dimension, specific vs. general, and at the same time risk-oriented vs. well-being oriented, also has implications for the possible acceptability of the paradigms. For the time being it is much easier to argue for political measures in defense against specific risks than in favour of long term well-being. But this (hopefully) may change within the next decades, and an information system now created should be open for such changes.

We have proposed an environmental information system to the Austrian government that fulfils these requirements (Fischer-Kowalski et al. 1991a) and it has some chance of realization within the next future. It consists of three modules that are organized with reference to the above paradigms (see figure 3). Module 1 (EMIs) contains informations on emissions (gaseous, liquid and solid) and clearly relates to the "poison-paradigm". Module 2 (ESIs) contains ecological efficiency indicators for the economy (such as energy intensity, material and transport intensity) and thereby mainly relates to the "entropy paradigm", describing the physical "wastefulness" of the economy. Module 3 (PILs) contains indicators on purposive interventions into life processes and relates both to the "natural balance" and the "conviviality paradigm". Its content is outlined below.

(3) Purposive Interventions Into Life Processes (PILs)

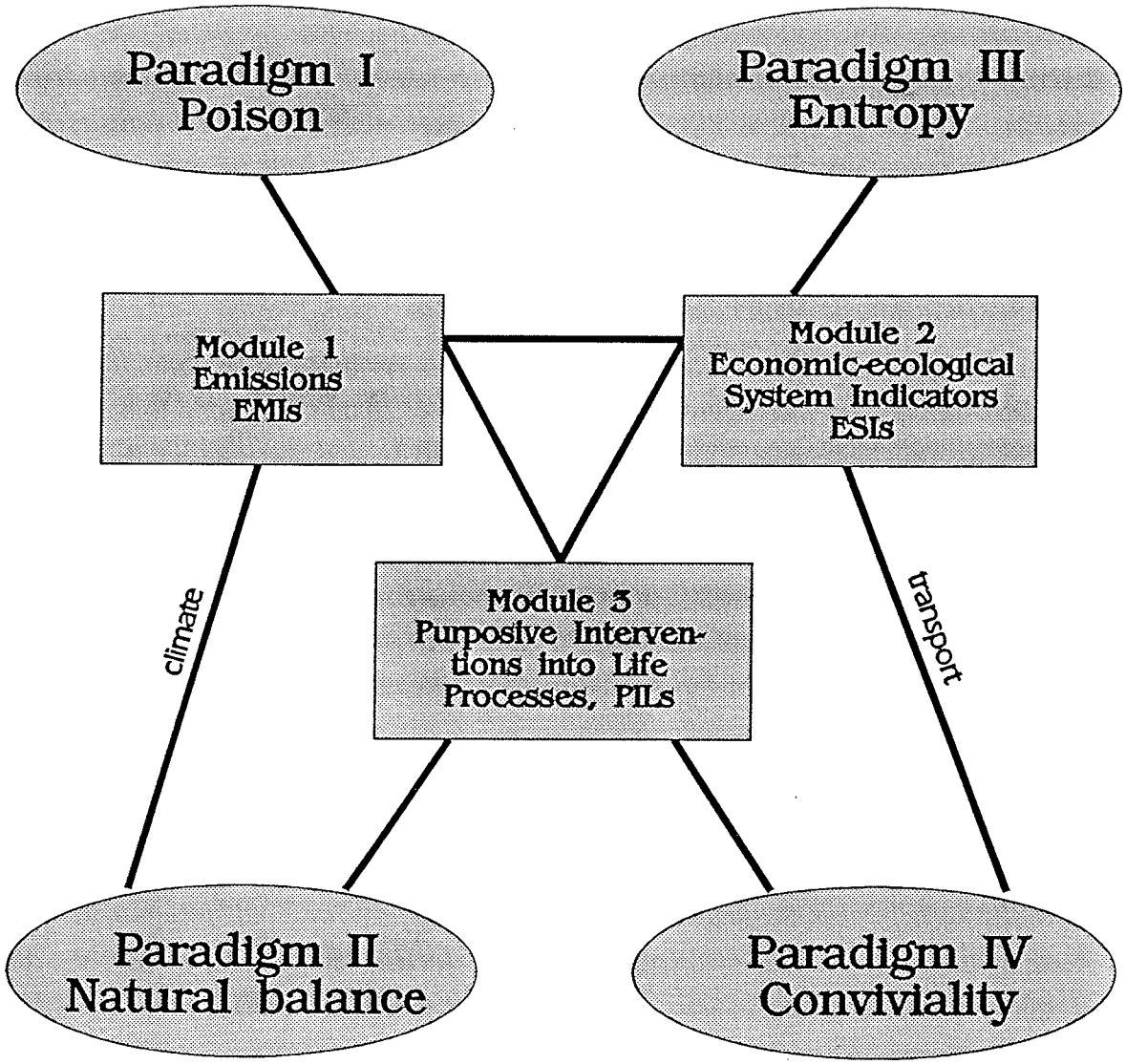
PILs do not refer to the unintentional emergence of annoying by-products of socio-economic processes such as emissions. A dam is built in order to use the energy of the river to drive turbines instead of eroding the riverbank and inundating floodplains. A water power plant normally does not produce emissions, but it strongly affects the ecology of rivers, floodplains and wetlands (Goldsmith & Hildyard 1984). For the purpose of a water power plant the socio-economic system has to intervene in the structure of a natural living system, change its functioning, or, in other words, colonize it.

Purposive interventions into natural ecosystems are historically the oldest form of modification of the environment in order to sustain socio-economic reproduction. It characterizes the beginnings of agriculture and animal breeding ("neolithic revolution").[5] This exchange with the environment is quite different to simple "input", e.g. intake of plants or meat as nutrition. And it is specifically human, at least as specifically as making use of tools.

There are many indications that PILs will gain even more importance in the future. As Moscovici (1990) and Oechsle (1988) stated, emissions are a typical

[5] Some authors even argue the success in this primary colonization of plants and animals to be the major explanatory variable for the longterm dominance of European civilization over all other civilizations (e.g. Crosby 1986)

Figure 3: The relationship between the proposed sets of indicators and reference paradigms of environmental damage caused by the socio-economic system (Fischer-Kowalski et al. 1991)



problem caused by a "mechanical" mode of economic reproduction (and a corresponding mechanical paradigm of nature). The necessity to reduce emissions is broadly accepted by now, and in the long run their importance will diminish in relative terms. On the other hand, a new "cybernetic" mode of economic reproduction (and paradigm of nature) is arising, which is characterized by qualitatively new and enhanced possibilities of human control over nature. This new paradigm can be seen in many examples. The application of analytical-chemical methods in ecology yielded new possibilities of directing and utilizing natural processes in order to meet human demands (Korab 1991). New biological technologies are developing rapidly and are politically strongly promoted - last but not least because it is hoped that they will be the urgently needed "clean technologies". These tendencies can be described as a strategy of replacing EMIs with PILs, for example using biological instead of chemical techniques (Fischer-Kowalski et al. 1991b).

We developed the following modules of indicators in order to mirror relevant processes with which the socio-economic system intervenes into life processes in favor of particular social uses (Fischer-Kowalski et al. 1991a, Haberl 1991, Wenzl & Zangerl-Weisz 1991):

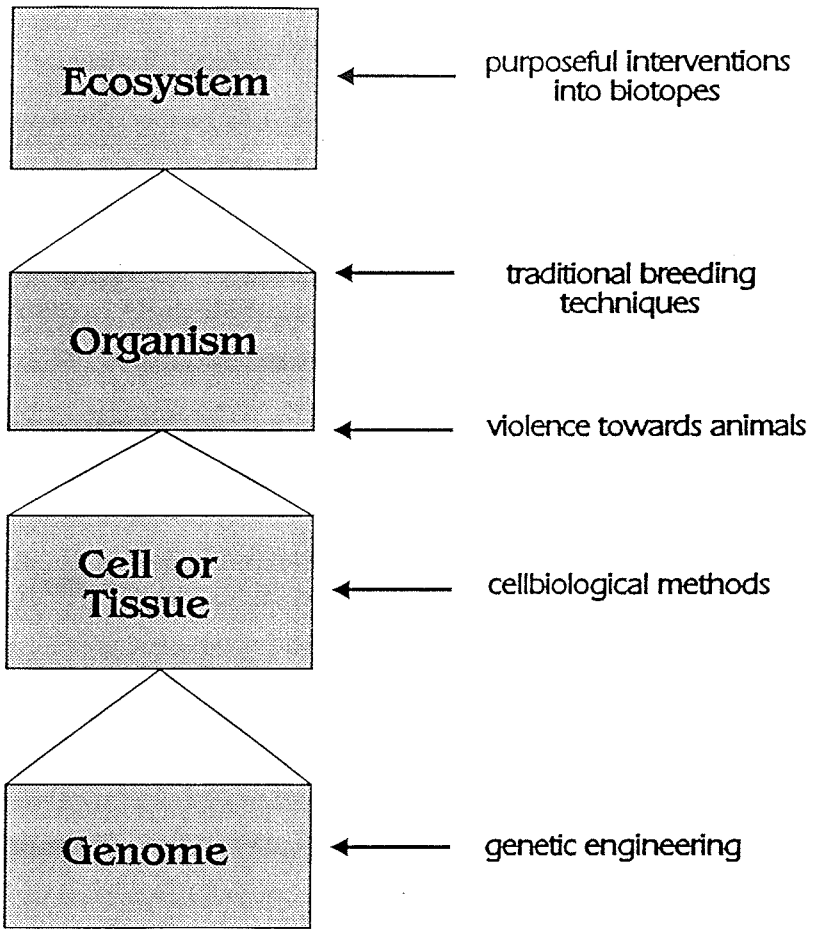
1/ Interventions into biotopes: Indicators for socio-economic efforts to change the structure of natural ecosystems. The most important general efforts of this kind are interventions into water systems, the appropriation of photosynthetically fixed energy (see below) and the input of technically produced substances (fertilizers, pesticides).

2/ Violence towards animals: Indicators with reference to causing suffering and pain with animals. This subset contains two indicators, one for the circumstances of animal husbandry (long-term aspect) and one for short-term aspects, killing animals and animal experiments.

3/ Interventions into evolution: Indicators for direct (genetic engineering) and indirect (breeding techniques) influences on the gene pool (for reference see Wenzl & Zangerl-Weisz 1991).

This systematisation is based upon the different biological hierarchical levels on which these interventions take place (figure 4).

Figure 4: Systematics of purposive interventions into life processes (PILs) referring to the level of intervention



Within each type of intervention we seek to operationalize the intensity with which the socio-economic system intervenes into natural living systems. "Intensity of intervention" is a very general notion, and it does not automatically imply a value-judgement concerning the consequences. The background assumption to this might be spelled as follows: The higher the intensity of intervention, the more the living conditions of other species and their evolution are determined by man. This may be interpreted in terms of responsability, in terms of sustainability of man's economy, or in terms of control resp. imperialism. This should be open to political debate: In all cases it seems reasonable to generate periodical informations that provide society with an awareness of its own interventions.

In the following paragraphs we will present some empirical evidence as to the relevance of the proposed indicators.

(4) Socio-economic Appropriation of Photosynthetically Fixed Energy

As outlined above, we consider the degree to which society appropriates photosynthetically fixed energy as an important indicator for the intensity of intervention into natural living systems, particularly into the living conditions of non-domesticated animals.

As all other heterotrophic organisms (including man), animals depend upon consuming energy-rich substances in order to sustain their metabolism. Directly (herbivorous animals) or indirectly (carnivorous animals) their energetic basis is produced by the green plants, which convert radiant energy of the sun into chemical energy in the process of photosynthesis.

The net primary production (NPP) is the photosynthetically fixed energy, accumulated by green plants in a certain period of time (usually one year).[6] It is the energetic basis for all other heterotrophic organisms (animals, bacteria, fungi). Consequently, "photosynthetically fixed energy ultimately supports the great diversity of species that inhabit the world's ecosystems." (Wright 1990, p.189). Thus, as we diminish the amount of NPP available to all other wild-living heterotrophic organisms,[7] we alter the structural conditions for wildlife on a global level.

An important fraction of the appropriated energy is used to feed domestic animals. This means that there is a connection between the human appropriation of energy flows and the use of animals for human benefits. In simplyfied terms: NPP is redirected from wildlife to livestock.

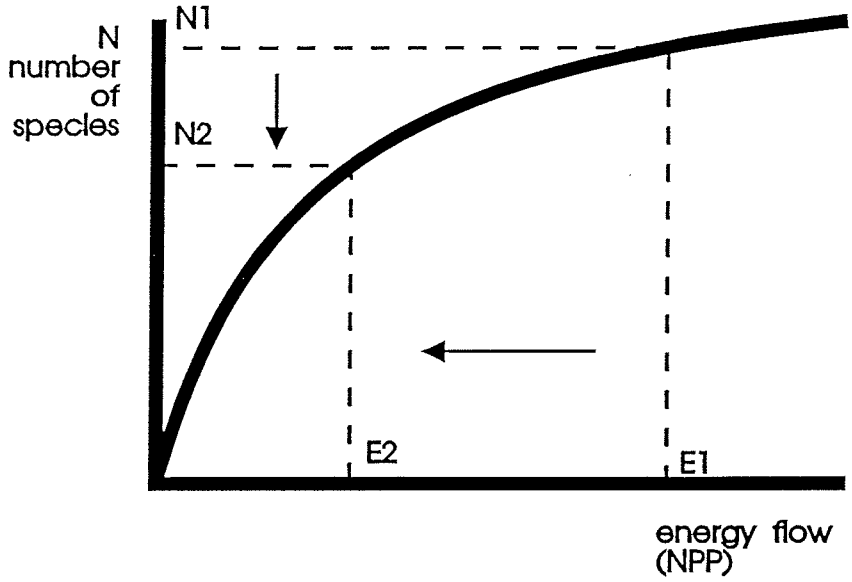
Ecologically NPP is an important parameter for several reasons. First, empirical studies show that "energy flow can be related to numbers of species with species-energy curves." (Wright 1990, p. 189) This means: If the amount of energy remaining in an ecosystem is reduced, the number of species living in this

[6] The gross primary production (GPP) is the whole amount of photosynthetically fixed energy. From this the plants cover their own energy demand; the remaining energy, which has not been used by the plant itself, is stored as energy-rich chemical substances - this being the NPP.

[7] in this functional context domestic animals are viewed as part of the socio-economic system

ecosystem will diminish (see figure 5). Secondly, there are limits to the fraction of NPP which can be used in a sustainable manner. The human appropriation of the NPP currently is estimated to lie between 20 and 40% of the total terrestrial global NPP (Wright 1990, Max-Neef 1991). Even if it is not clear, at which percentage of human appropriation of NPP the limits of sustainability are reached, the current amount already is considerable, and obviously it cannot be increased indefinitely.

Figure 5: Correlation between number of species and energy flow in ecosystems. If energy flow is reduced from E1 to E2, number of species will diminish from N1 to N2 (Wright 1990: 190)



We therefore propose to use the appropriation of net primary production by the socio-ecoomic system as (one of three) indicators for purposeful interventions into biotopes (Haberl 1991). The indicator is formulated as the difference between the hypothetical NPP of the undisturbed ecosystem and the actual NPP.

What does this mean? The hypothetical NPP_h (per space unit and year) depends upon morphological and climatic circumstances in the region under consideration. Under Austrian conditions it may vary from about 5 TJ/km^2.a (alpine grasslands) to 50 TJ/km^2.a (floodplains).[8]

[8] 1 TJ = 10^{12} J; 1 PJ = 10^{15} J

The socio-economic system may appropriate NPP in various qualitatively different forms that can basically be boiled down to two strategies: It may generate structures (such as highways or buildings) that prevent or drastically reduce the NPP in a certain area; the very same road prevents a certain NPP_h each year by its very existence.[9] The second type of intervention is consumption: Certain amounts of NPP are harvested (or grazed off by cattle) and serve as inputs to the socio-economic system, thereby being no more available to the ecosystem. Domestic animals, in this context, are viewed as part of the socio-economic system, because they belong to the realm of the economy (at the same time physically being natural living systems). What is shown in table 1 as NPP_a appropriated by the socio-economic system is therefore the sum of "prevented" NPP and "consumed" NPP.

Table 1: Appropriation of net primary production in Austria 1988: first estimation (Source: own calculations; Data: Bundesamt für Eich- und Vermessungswesen 1989, BMLF 1989a, BMLF 1989b, ÖSTAT 1990)

socio-economic uses	area concerned	photosynthet. fixed energy[1]		distribution
		hypothetical	appropriated by man	of approp.
	km^2	NPP_h (PJ/a)	NPP_a (PJ/a)	NPP (%)
agriculture[2]	15.900	370	250	40,4
grassland, alpine pastures	21.000	280	180	29,0
forests (logging)	34.300	580	110	17,7
gardens	1.700	40	20	3,2
traffic zones	1.600	40	40	6,5
buildings	700	20	20	3,2
other[3]	8.000	40	0	0,0
total	83.200	1.370	620	100,0

[1] first estimates based on international literature
[2] including wine
[3] indcluding waters and wasteland

Sources: Bundesamt für Eich- und Vermessungswesen 1989; BMLF 1989a; BMLF 1989b; ÖSTAT 1990; own calculations

[9] There may also be cases in which the intervention causes an increase of NPP above the "natural" level, such as with growing maize instead of wood. But in practically all such cases this surplus NPP is then extracted from the ecosystem by harvesting.

The hypothetical NPP on Austrian territory is estimated to be around 1.370 PJ/a. Thus the socio-economic appropriation of the products of photosynthesis in Austria amounts to almost 40% - 50% of the total production.[10]

This means that the socio-economic system produces and reproduces environmental structures that permit little more than half of the photosynthetically fixed energy for all other heterotrophic species but mankind. This certainly is highly relevant both from the viewpoint of the "natural balances paradigm" as well as from the "conviviality paradigm".

(5) Violence Towards Animals

Today it is generally accepted that animals are able to suffer (for a literature review see Haberl 1991, pp. 79ff). Animal suffering is not only caused by disease or injury but as well by motoric, perceptive or social deprivation (Heizmann 1989, Bartussek 1990, Bittermann und Plank 1990).

Public perception of violence towards animals is stirred by cases of startling cruelty and by conflicts between proponents and opponents of animal experiments. The discussion about the inherent cruelty of modern techniques of animal husbandry - which affect by far more animals - has gained less public awareness. In 1990 Austria used 477.491 animals (mostly rodents) in animal experiments, but 57,2 million domestic animals where slaughtered in order to produce meat (see Table 3). If only 1% of the slaughtered animals have to suffer severe pain during slaughtering, this would be more than the whole number of animal experiments. Moreover, it is known that some slaughtering techniques (especially for poultry) cause pain to a considerable percentage of the killed animals (Studiengruppe Ökologie 1989).

[10] It is interesting to note that the amount of appropriated photosynthetically fixed energy corresponds quantitatively to the end use of (technical) energy, which for Austria is around 750 PJ/a.

We suggest to distinguish between two different aspects of violence towards animals:

- The long term aspect: Circumstances of animal husbandry and

- the short term aspect: Singular cruel acts like killing animals and animal experiments.

In both cases it should be assessed how many animals are treated under conditions which are worse than some relevant threshold. There exist some approaches to specify such thresholds:

1/ For domesticated animals some authors have developed indexes to describe the possible quality of life of animals making use of the characteristics of their stables etc. Such an index, the "Tiergerechtheitsindex" (animal adequacy index, TGI) has been developed by Haiger, Storhas and Bartussek (1988) and has been worked out in detail for cattle and pigs. With the help of such indexes it would be possible to define thresholds.

2/ For animal experiments indicator systems for the intensity of the impact have already been developed (Holz und Siegemund 1988)

3/ Similar research does not exist for the valuation of slaughtering techniques. In this case, field research is necessary to develop adequate methods.

It is clear that the definition of such a threshold implies political valuations: the pharmaceutical industry will have another notion of "cruelty" than members of the animals' rights movement. Therefore a political bargaining process would have to be organized - maybe in analogy to an "environmental impact assessment".

Today, as the definition of such thresholds is lacking, the only empirical data which can be presented refer to the total number of concerned animals (see table 2 and 3).

Table 2: Animal husbandry in Austria (Sources: ÖSTAT 1991, Studiengruppe Ökologie 1989, own estimations)

	Number (1.000 animals)
Agricultural livestock	21.800
Fur-bearing animals	60*
Pets in households	4.000*
Animals for experiments	150*
Animals in zoos, circus, ...	?
TOTAL	26.010

* estimations

Table 3: Animals killed and animal experiments in Austria (Sources: ÖSTAT 1991, Studiengruppe Ökologie 1989, Amtsblatt Wiener Zeitung 29.6.1991)

	Number (1.000 animals)
Commercial slaughtering	57.200
Fur-bearing animals	50*
Animals in experiments	477
Hunting	280
TOTAL	58.007

* estimations

According to table 2 the Austrians keep about 26 million animals for socio-economic purposes. If one may estimate only one third of them to have living conditions below some (humble) threshold, this amounts to as many animals as human inhabitants. Above that about ten animals per person and year are killed for human nutrition and other purposes.

(6) CONCLUSIONS

Two different approaches towards the description of society-nature interactions can be taken. The first of them is related to the concept of "metabolism". The socio-economic system is described in analogy to the physiological functioning of an animal. Within this concept society is viewed as a huge system, which takes inputs from nature ("resources") and releases (more or less obtrusive) outputs ("emissions", "waste" etc.). But this approach neglects the innumerable ways in which society intervenes into natural systems in order to meet human demands (agriculture, animal husbandry, genetic engineering etc.). These interventions can be conceptualized in analogy to "colonization". At the time being, the former concept of metabolism is much more common within the environmental discourse, even if issues like the protection of biodiversity or the prevention of cruelty against animals are gaining weight in the political debate.

We believe that this gap is due to the fact that these issues have been treated from the part of the victims and not from the part of the actors so far. For example, until now spectacular single cases of cruelty against animals raise more public attention than systematically applied structural violence towards animals. One possibility to raise public awareness is the incorporation of these issues into prominent environmental information systems, especially into information systems linked to the system of national accounts (SNA), which seems to be the socially and politically most influental information system of all modern societies.

The influence of the socio-economic systems on the structural preconditions of animal-life have to be described within such information systems at least on two levels. First, society has changed the whole surface of the earth, thus strongly restricting the energetic basis for wildlife: Globally speaking, only 60 to 75% of the previosly available photosynthetically fixed energy is remaining in the natural cycle today (Vitousek et al. 1986, Wright 1990). This figure is even lower in densely populated and highly industrialized countries like Austria, as we have showed in Chapter 5. This has important consequences (among others) on species endangerment. Secondly, society directly uses animals for nourishment, production purposes and experiments. This dimension should also be included in environmental information systems.

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