5 Life, ecology and nature

Contents

5.1 Natural History

Biodiversity

There are about 1.7 million known species and new species are being discovered every day. It is estimated that one successful new form is created each year, while, under the present conditions, approx. 500 species per year become extinct. Some biologists estimate the real number of existing species as being 10 million, others as many as 80 million, Zoest (1998) reports. Distinguishing species from subspecies (taxonomy) is a constant on-going task. For example, the authoritative Dutch work: *Heukels' Flora* edited by Meijden (1996) has recently been drastically amended to accommodate the new international insights into the organisation, differentiation and nomenclature of the plant kingdom. Viewed from this angle, we live on an unknown planet with a rapidly diminishing biodiversity. Nevertheless, the existing species represent an enormous genetic richness, of which we are hardly aware.

A risk cover for life

Within any one species there are as many variations as there are specimens, and just to make the problems of ecological generalisation even greater, all these specimens live in different contexts and micro environments. To question the meaning of this enormous diversity at the species, genetical and habitat level is typically human, but it is not an ecological question in the scientific sense. All we can do as Pianka (1994) does, is to observe that this biodiversity has arisen due to evolution and that, in the past, when sudden environmental changes took place, it was this that ensured the continuation of life up to the present time. Life has survived all manner of catastrophes because there was always a species, or a specimen of a species, that could survive in the new environment. The extinction of the dinosaurs about 65 million years ago in the darkness, of a kind of nuclear winter, following a meteoric collision with Earth, gave an advantage to night animals, and among them, mammals like ourselves. Biodiversity acts, therefore, as the the risk coverage of life itself suggests Londo (1998) .

Plants first

Plant life, which transforms carbon dioxide into food and oxygen for the animal kingdom, is the foundation of this diversity.This forms the basis of the local food chain, down to the smallest scale on the surface of the Earth. Thus, in urban ecology, if one does want to begin with the basement and not the ridge tiles, when reconstructing our *oikos*[a] although for many this is the most interesting (caressible) part of the housekeeping, attention should first be given to botanical diversity.

Dutch plants

Approximately 1,500 of the 250,000 known plant species, worldwide, 3,500 of the 100,000 toadstools and 500 of the 23,000 mosses are found in the Netherlands, in the wild. The science of dividing plants into classes, orders, families and species is known as taxonomy. Taxonomy is based on kinships that can be deduced from evolution. Against that background, plants can be given a name. *Heukels' Flora* provides the scientific access to approximately 1,500 Dutch plant species.

Meijden (1996)

Fig. 672 *Heukels' flora*

[a] *Oikos* is Greek for 'house'.

Insects are the largest group

To find one's way in this flora, some insight is needed into the genesis of life (see para. 5.2.12). Insects often cooperate closely in the reproduction of higher plants, and of the 1,100,000 known species of insect, approximately 20,000 can be found in the Netherlands. Compared to those, the other groups of creatures are almost negligible: approx. 500 of the 50,000 known vertebrates (30 reptiles, 300 species of birds, 100 mammals).

Counting species or genetic complexity?

The question that comes to the fore here is whether one can compare one-celled life forms with multiple-celled forms that undergo cell differentiation. Although they live independently, their diversity among themselves can be likened to the internal cell diversity of multiple-celled forms. Should we use the number of species as the criterion for biodiversity? The disappointing discovery that human beings do not have very many more genes than species that, so far, have been considered to be much simpler, leads to a similar question, even though it indicates exactly the opposite. As far as the criterion for choosing the number of species is concerned, for the time being, we adhere here to the present mid-way scientific position.

5.1.1 Long-term biotic changes

This history is excellently documented on the bottom floor of the Naturalis Museum.[a] This museum was designed by Fons Verheijen. The design process is described in ‘Ways to study and research’, Jong and Voordt (2002) and is thus worth a visit.

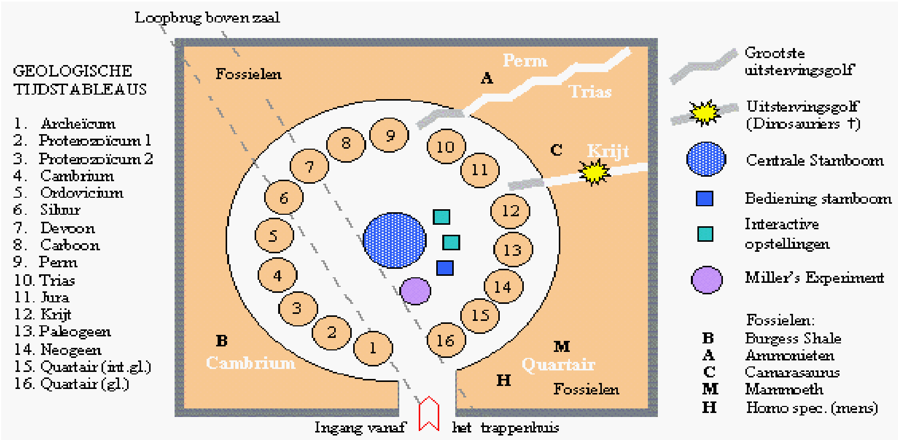


Fig. 673 *Eras at Naturalis*

The oldest forms of life

The oldest forms of life are single-celled marine organisms that later formed themselves into threads of algae. They have produced oxygen from carbon dioxide for more than a billion years. This form of life stagnated when carbon dioxide gases became depleted after the excessive growth that took place during the Carboniferous and Permian eras and carbon ceased to oxidate spontaneously. Fauna took over part of this oxidation process. Carbon dioxide fertilization is still a constant feature of horticulture to cause profuse growth.The increasing amount of CO_2 in the atmosphere, not only leads to a greenhouse-effect, but also to more profuse growth and increased agricultural production. Ecologically, from the point of view of biodiversity, this is not an advantage.

[a] See http://website.leidenuniv.nl/~siebersam/

Revolutions during the last billion years

During the last billion years there have been four important revolutions:

600 million years ago:	Fauna began to adopt chalky skeletons, so that suddenly their historical development can be read in the sediments.
400 million years ago:	Life established a foothold beyond the sea. Mosses and liverworts (*Bryophyta*) brought a green colour to the wet parts of the land (5.1.2).
230 million years ago:	Many animal and plant species suddenly became extinct, marking the end of the Palaeozoic. This made way for the Mesozoic, the Saurian Age. Seed-bearing plants started to develop, which had a completely diploid life cycle. These plants fertilised each other and dispersed diploid seeds (5.1.3).
65 million years ago:	The Cenozoic began with the extinction of the saurians and the advance of mammals (5.1.4).

5.1.2 400 000 000 years ago

Life gained a foothold beyond the sea. Where the land was wet, it became green with mosses and liverworts (*Bryophyta*).These plants can not establish themselves on drier areas because their structures are not sufficiently developed to take in water and store it to use during drought; they have no roots. In addition, they are dependent for reproduction on male gametes that swim.
Early in their development, mosses did not halve their genetic material by means of sex cells, but sometimes duplicated themselves on a part of the female plant. Only then was the duplicated (diploid) genetic material divided and dispersed as single spores that germinated as haploid organisms with a single set of genetic material. Mosses are predominantly haploid. They are not included in *Heukels' Flora.*

The earliest vascular plants

The next step was the appearance of the first staghorn and club-mosses, the horsetails and the ferns (*Pteridophyta*) (the first 15 families in *Heukels' Flora*). These were the earliest vascular plants, capable of transporting water internally. They can thus grow higher than the mosses. However, although fully grown ferns can withstand dry conditions because of their vascular system, they still need water to reproduce sexually. This is why the existing *Pteridophyta* are usually to be found in moist, shadowy places and/or why they often reproduce themselves vegetatively.

Flat-stemmed Club-moss

Giant Horsetail

Male-fern

Meijden (1999)

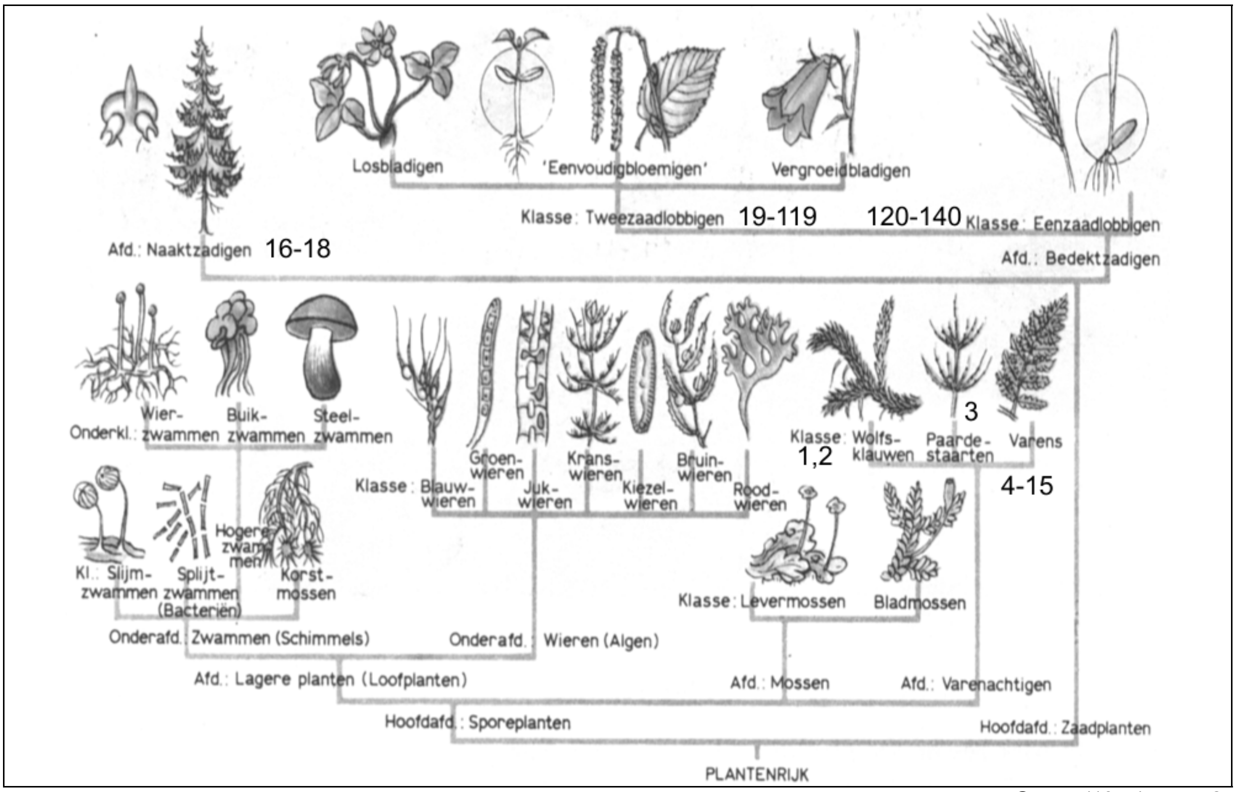
Fig. 674 *Pteridophyta*

Although small haploid forms do exist, the predominant forms on which all higher plants are modelled are diploid.

5.1.3 230 000 000 years ago

A family tree

Many plant and animal species suddenly became extinct, marking the end of the Palaeozoic. They gave way to the Saurian Age, the Mesozoic. Seed plants began to develop, with a completely diploid life cycle. They fertilised each other and dispersed diploid seeds.
The following appeared, successively:
gymnosperms (families 16-18, inclusive, in *Heukels' Flora*: the conifers),
angiosperms (families 19-119, inclusive)
monocotyledons (families 120 to 140, to which lilies and grasses belong)



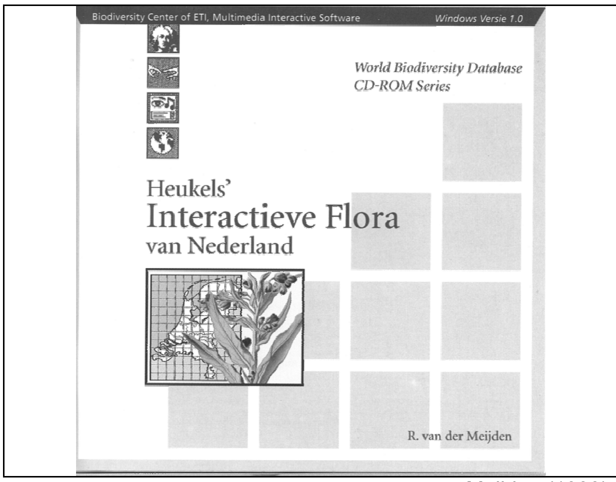
Garms (1977) page 2

Fig. 675 *Division of the Plant Kingdom*.

This scheme gives a didactically simpler division into subclasses than the currently accepted scientific one shown in *Heukels' Flora*. The flowers of dicotyledons facilitiate a more purposeful fertilisation due to the intermediary activities of often species-specific insects.

CD-ROMs

This species specificy is thus focused on the recognisability of these reproductive organs. Species are thus identified in the basis of these organs. This process is currently simplified by using interactive CD-ROMs (Fig. 676 and Fig. 677).
This insight into the constitution of the soils, climatic conditions and growth possibilities gives urban architects a feeling of the *genius loci*.



Meijden (1999)

Fig. 676 *An interactive CD-ROM of Heukels' Flora.*

Marijnissen and Mol (1998)

Fig. 677 *CD-ROM Marijnissen*

These CD-ROMs give a good picture of the Leiden and Nijmegen approaches. The Nijmegen approach (Marijnissen) is less orthodox taxonomically and more accessible for lay people. Another electronic source is CBSs Biobase (see Fig. 796).

Taxonomy of plants

According to recent evolutionary insights, plant taxonomy is built up as follows:

Class -*da*	**Subclass -*dae***	Super order -*florae*	Order -*ales*	Family -*ceae*	Genus -*ida*, *ids*

Fig. 678 *The taxonomy of Dutch plant families (see the list on page 726)*

According to accepted interpretations of evolution, the lowest subclass, the *liliidae* (monocotyledons, such as lilies, grasses and orchids), were the most recent to come into existence. Taxonomy is not a static science; there is still no agreement on the sequence of evolution and subdivision. The families in *Heukels' Flora* of 1990 were still not classified according to the present international standard. In 1996 and 2005 drastic changes were made to the classification system and thereby to the nomenclature, much to the sadness of many.

5.1.4 65 000 000 years ago

The great extinction

The Cenozoic began with the extinction of the saurians and the advance of the mammals.[31] A meteoric impact in the region of the Caribbean caused so much dust to enter the atmosphere that, in the prolonged darkness that followed, plant growth stagnated and the large plant-eaters died out. It was mainly night animals, mammals, for example, that survived.

5.1.5 Pleistocene

The last 2 million years (the Quaternary or Pleistocene) has been occupied by ice ages (glacials) and warmer interglacials (see page 31). The two most recent glacial periods, the Saalian (Fig. 679) and the Weichselian (Fig. 680), were interrupted by the Eemian interglacial period.

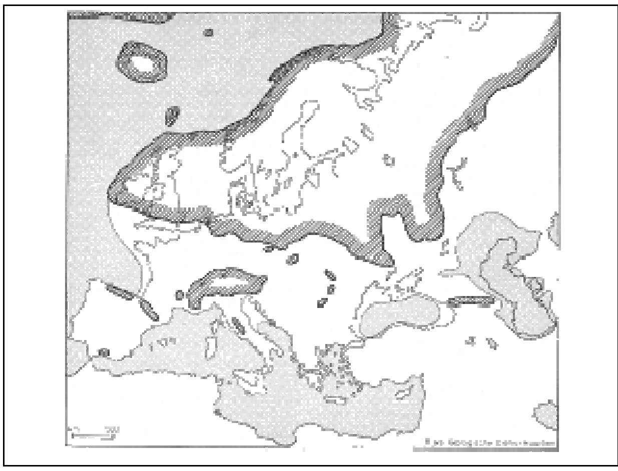


Fig. 679 *Saalian*

Fig. 680 *Weichselian*

Ice ages in The Netherlands

The higher parts of the Netherlands were formed in particular during the Saalian. The Weichselian did not reach the Dutch area.

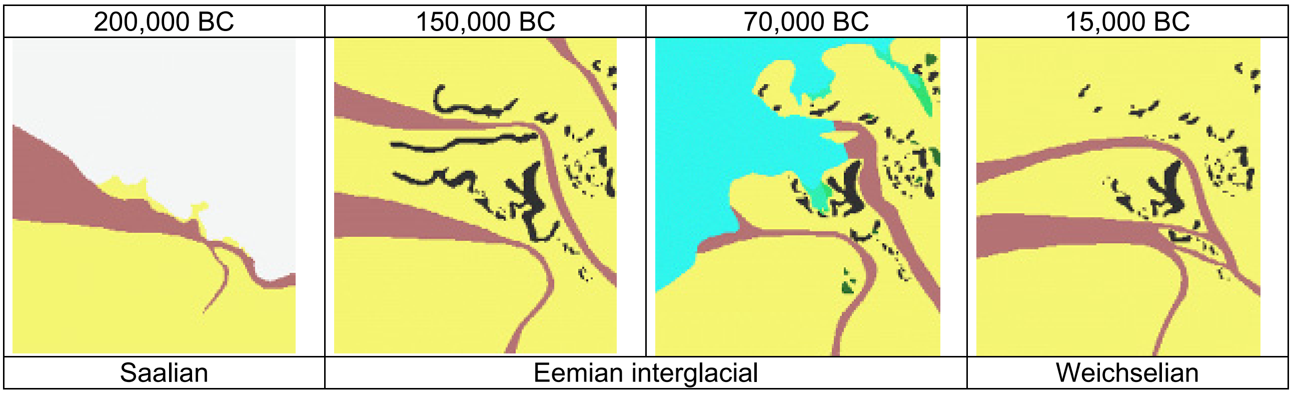
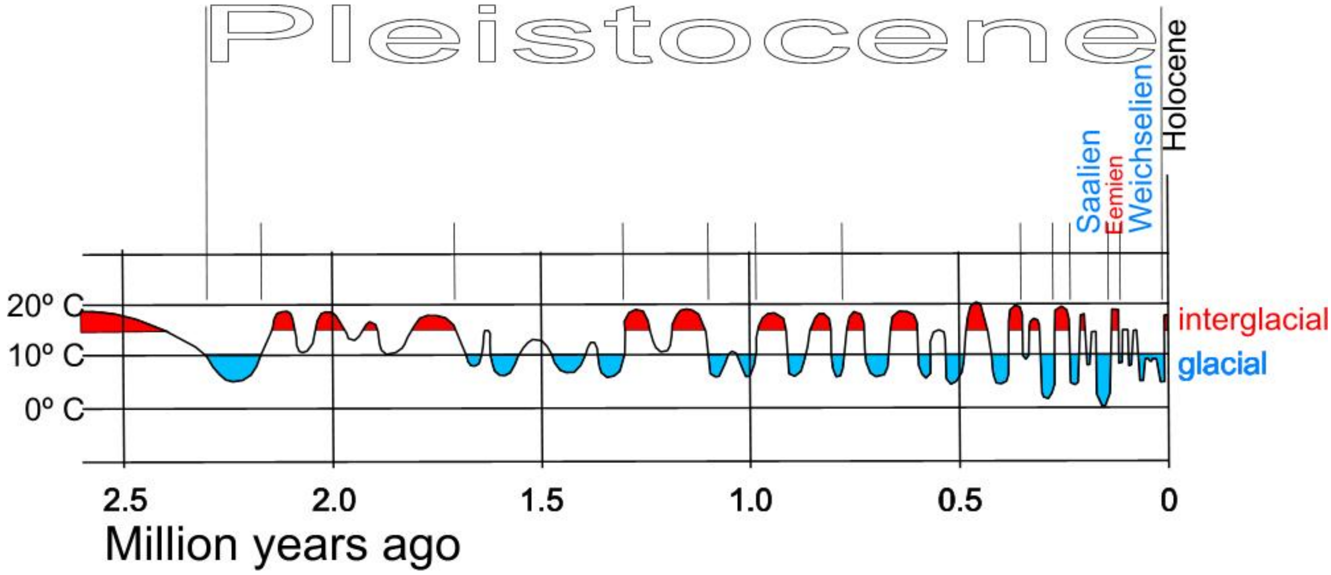


Fig. 681 *The two most recent ice ages*

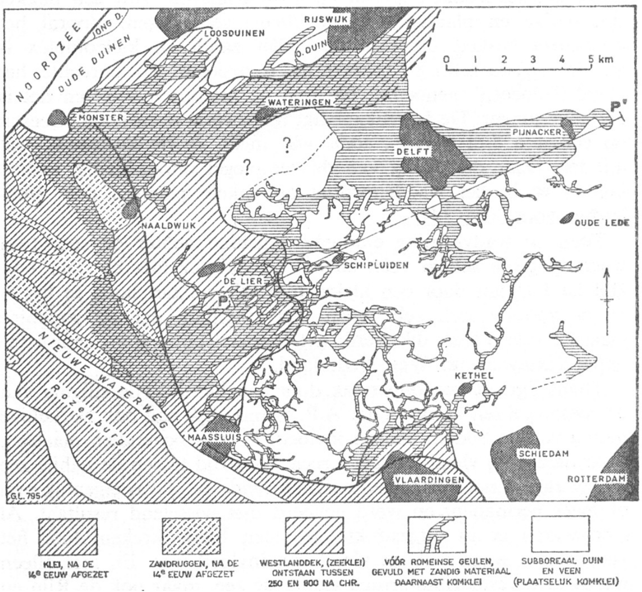
The forming of the Veluwe massif and the *Gelderse Poort* are clearly visible.

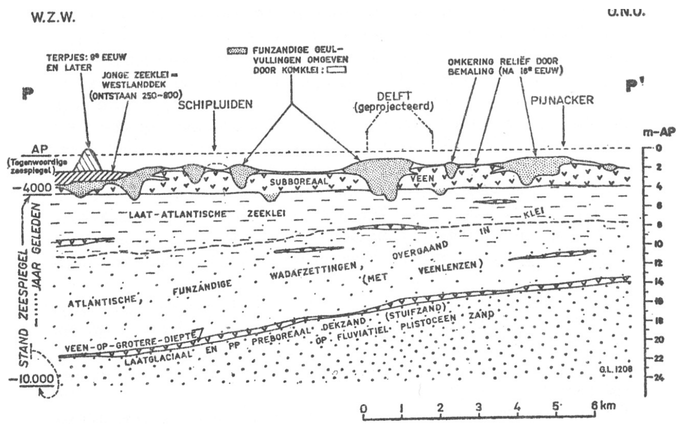
Holocene

The lower areas of the Netherlands were shaped from 10,000 BC onwards (Fig. 682).



See *Fig. 25* Sticht.Wetensch.Atlas_v.Nederland (1985) page 13





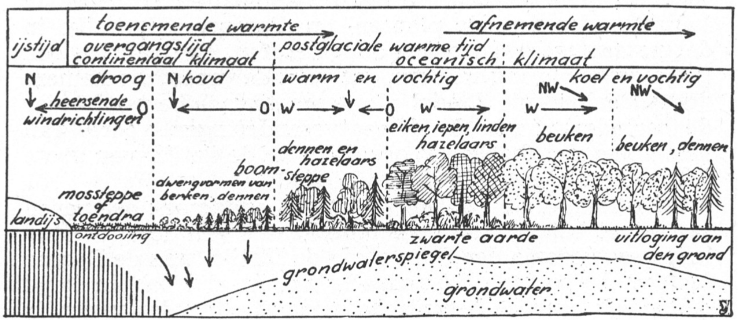
Faber (1966)

Fig. 682 *Temperature changes and deposits*

For instance, deposits under Delft to a depth of 18 metres beneath New Amsterdam Level (NAP) is Holocene; the Pleistocene extends to a depth of 400 metres[32]

Vegetation changes by temperature

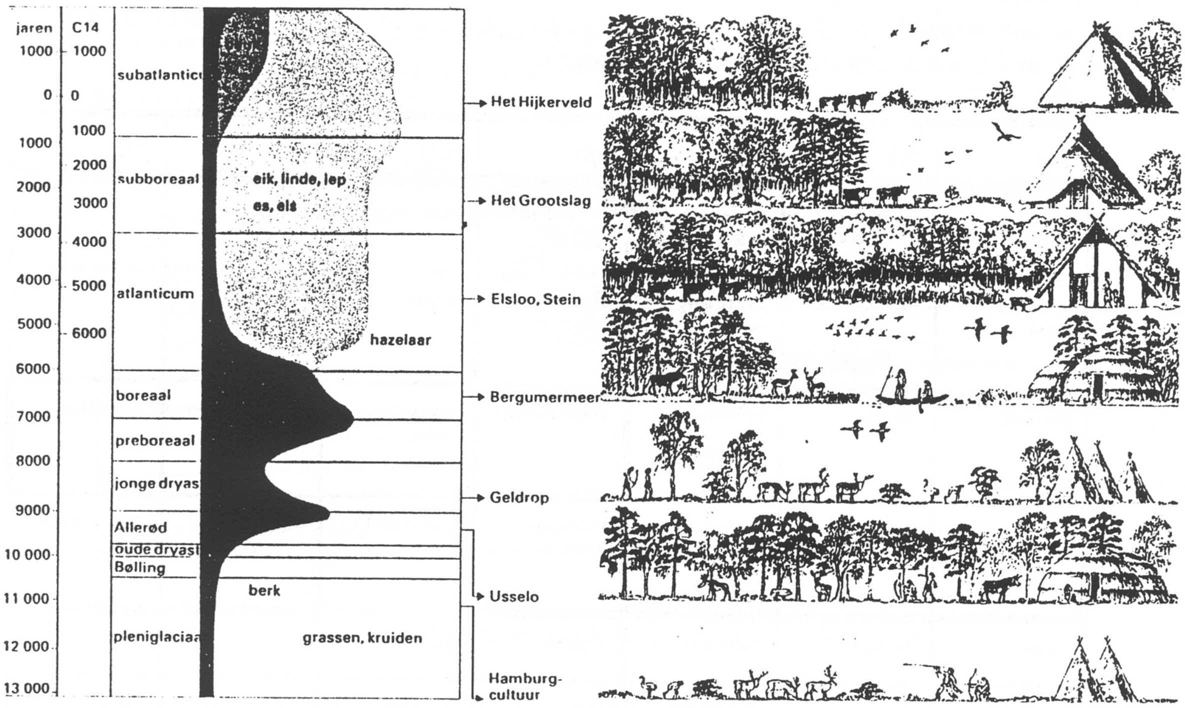
Fig. 683 shows how climatic changes greatly influence the vegetation.



Visscher (1949)

Fig. 683 *The influence of climatic changes on vegetation*

The picture that emerges from pollen dating is one of changing landscapes and habitation (Fig. 684).



Bloemers, Kooijmans et al. (1981) page 32

Fig. 684 *Landscape changes since the last ice age*

Paragraph 1.2.1 from page 31 on gives a closer picture of this.

5.1.6 References to natural history

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5.2 Diversity, scale and dispersion

Biodiversity

There are many estimates on biodiversity described much better than I can do by Zoest (1998). We know some 1.7 million well-described species but much more are unknown while some 100 000 species are lost since Linnaeus. The extinction rate is estimated 1000 per year now; the growth in evolution as 1 successful species per year. Though we now know the genome of some, we do not know yet how they work let alone we know their mutual relations. Even how our own species works is nearly completely unknown to us, though we already studied 3000 years on this topic. Having some success in medicine, we seldom understand exactly why. Compared with the combinatory explosion of unanswered questions we understand almost nothing, otherwise we could invent species. Possible principals punish researchers admitting that honestly and modestly. Mythmakers win the competition. However, myths may be useful for survival.

Responsability

Every state bears its own responsibility in this multitude of species like a modern Noah. Though The Netherlands occupies less than 0.01% of the earth's surface it entails approximately 35 000 (2%) of the earth's number of known species. Our responsibility is proportional to their global, continental (blue list), national (red list) or local rarity.
The concept of rarity and thus responsibility is scale-sensitive.

Health

Depending on the definition of health[a] I estimate that roughly 80% of the human population is unhealthy. There are positive and negative relations between human health and biodiversity. The impact of biodiversity on human health is unknown. Perhaps a small organism in some square kilometres of the remaining rainforests is on the long term a necessary condition for our life by producing tiny quantities of chemical compounds conditioning processes in our body and mind as catalysts, but we do not know. How to calculate the risk of loosing them?
The reverse impact of human health and growth on biodiversity is better known but not certain.

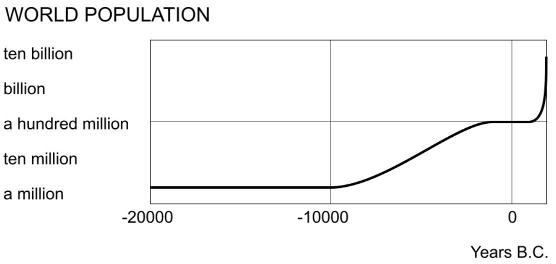


Fig. 685 *Estimated growth of world population*

Health is a scale dependent concept in time. Though world population is not healthy on an individual level, in the long term we are a healthy species growing in numbers exponentially ousting other species, living twice as long than some centuries ago.
And we are not only expanding in number. Per person we need more and more living space in our homes and neighbourhoods. In a wider context we reduced the space we need for agriculture reducing biodiversity in rural areas at the same time.

Intensity of use

However, some 20 years ago Jong (1985) found the *intensity* of urban use in The Netherlands was highest in shops (135 hours/m^{2}year). After shops came offices, social-cultural facilities, schools, home and garden (48 hours/m^{2}year). The other hours of the year (counting 8760 hours) in the urban surface may be available for other species depending on the conditions we leave them by design and use (distinguished by time scale). Some species accept or even welcome our presence like that in step vegetation (for example greater plantain, rats, mosquito's, sparrows). Could we welcome more rare species in our towns by creating ecotope cities or as Tjallingii (1996) stresses ecological conditions? How does it interfere with our health?

[a] Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. The Definition has not been amended since 1948. See http://www.who.int/about/definition/en/

5.2.1 The importance of diversity for life

Risk-cover for life

Londo (1997) considered diversity as a *risk-cover for life*. In the diversity of life there was always a species to survive or within a species a specimen that survived. Survival of the fittest presupposes diversity from which can be 'chosen' in changed circumstances. Diminishing biodiversity means undermining the resistance against catastrophes. From the 1.7 million species we know, we probably lost some 100 000. So, we not only introduce ecological disasters, but we also undermine the resistance of life against these disasters.

Ecological tolerance

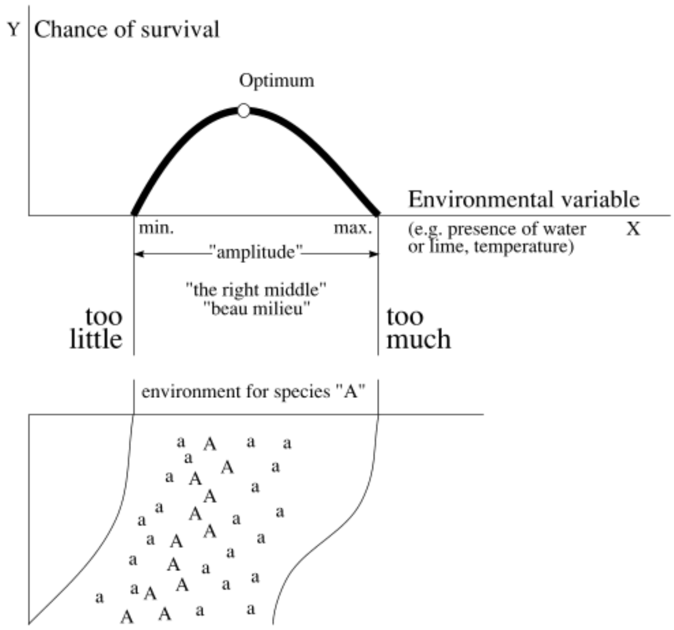


Fig. 686 *Ecological tolerance in theory and reality.*

The curve of *ecological tolerance* relates the chance of survival of a species or ecosystem to any environmental variable, for instance the presence of water. In that special case survival runs between drying out and drowning (Fig. 686).

Imagine the bottom picture as a slope from high and dry to low and wet. Species A will survive best in its optimum. Therefore we see flourishing specimens on the optimum line of moisture (A). Higher or lower there are marginally growing specimens (a). The marginal specimens however are important for survival of the species as a whole.

Suppose for instance long-lasting showers: the lower, too wet standing marginal specimens die, the flourishing specimens become marginal, but the high and dry standing specimens start to flourish! Long-lasting dry weather results in the same in a reversed sense. Levelling the surface and water-supply for agricultural purposes in favour of one useful species means loss of other species and increased risk for the remaining.

But there is a less friendly ecological lesson hidden within this scheme. Marginal specimens are important for survival of the species as a whole. A reservoir of unhealthy specimens favours species. Death regulates life. Health is also spatially scale-sensitive.

5.2.2 The importance of diversity for human living

A realm of exceptions

Biodiversity in mankind is a crucial value in our quality of life. As we are here we are all different and the very last comfort you can give a depressed person is 'But you are unique'. Reading Philp (2001) you should conclude that medicine hardly discovered that uniqueness in the evaluation of medicines. It hinders generalizing science using concepts as average and standard deviation. Dieckmann, Law et al. (2000), Riemsdijk and NOBO (1999) and Jong and Voordt (2002) are aware of that difficulty in ecology, organization theory and design study. Evolutionary ecology (see Pianka (1994)) is only comprehensible considering exceptions outside the limits of a normal test population (3·standard deviation) as Philp (2001) described.

Diversity is also a precondition for trade and communication. If production and consumption would be the same everywhere, there would be no economic life. If we would have all the same perceptions and ideas, there would be no communication. It is an important misconception to believe that communication only helps *bridging* differences. Communication also *produces* diversity by compensating each other and coordinating behaviour by specialization.

Possibilities of choice

The World commission environment and development (1990) of chairwoman Brundtland summarized the environmental challenge by stating sustainability as leaving next generations at least as much possibilities as we found ourselves. But what are possibilities? 'Possibilities' is not the same as economic supply. If our parents would have left us the same supplies as they found in their childhood, we would be far from satisfied. 'Possibilities' has to do with freedom of choice and thus variety. Our converging Schumpeter-economy as Krupp (1995) described and converging culture of Fukuyama (1992) leaves no choice. In our search for the alternative we find everywhere in the world the same hotels, the same dinners, the same language. This century, the last 'primitive' cultures are lost and with them an experience of life that no western language can express. After looking at their dancers in the afternoon on our rain forest holyday we find them back in disco in the evening.

A world without difference

The most extreme consequence of this levelling out would be a world without economy and even communication. That is the ultimate consequence of local autarky. If there were no longer any differences in production factors, exchanging goods and services would no longer be necessary. If total worldwide distribution of knowledge and consensus would be the result of our communication age, there would no longer be anything worthwhile to communicate. These thought experiments show clearly that 'difference' is also a hidden presupposition in communication and economy. The question remains on what level of scale self-sufficiency is desired: global, continental, national, local like Steekelenburg (2001) illustrates beautifully in his scenarios.

Quality

Quality can be measured in terms of possibilities of use, experience and expectation for future generations. The way design can sustain a sustainable development in the sense of Brundtland is to produce more ‘choices’ for man, animal and plant. If there were one best solution for all problems of architecture and urban planning, it would be the worst in the sense of choices for future generations! This paradox pleads more for diversity than for uniform solutions. Moreover, if there were a uniform solution, the designer would have no task. Quality is always a function of variation.

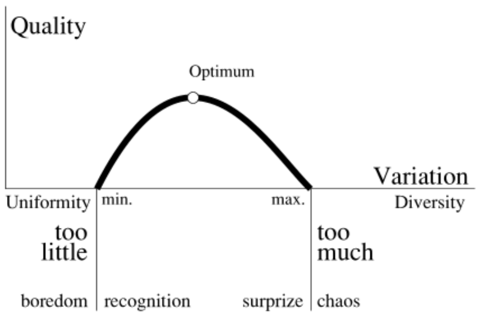


Fig. 687 *Quality = f(Variation)*

Quality of possible experience moves between diversity and uniformity, surprise and recognition. One step too far into both sides brings us in the area of boredom or confusion.

This is a simple conception, already recognized by Birkhoff (1933) and Bense (1954), but why did it not succeed, why is quality always posed as an unsolvable question? Because the concept of diversity is scale sensitive and so is our experience. When on one level of scale we experience chaos, in the same time on an other level of scale we could experience boredom.

5.2.3 Scale-sensitive concepts

Confusion of scale

As I mentioned in the introduction, rarity, responsibility for rare species and even health are scale sensitive concepts. So is quality. But any discussion on variety and thus variables can fall prey to confusion of scale. That means that even logic and science as forms of communication are prey to a scale paradox. The paradox of *Achilles and the turtle* is a beautiful example of a scale-paradox in time. The turtle says: 'Achilles cannot outrun me when I get a head start, because when he is where I was at the moment he started I'm already further, when he reaches that point I am again further and so on!' This conclusion is only incorrect by changing the time-scale during the reasoning. Russell finds something similar on set theory. Russell (1919) bans sets containing themselves and reflexive judgements, as 'I lie'. This sentence is not only a object statement, but in the same time a meta-linguistic statement about itself producing a paradox. When I lie I speak the truth and the reverse.

Scale paradox

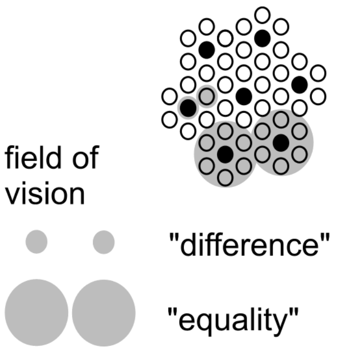


Fig. 688 *The scale paradox*

The *scale paradox* means an important scientific ban on applying conclusions drawn on one level of scale to another without any concern. The picture shows the possibility of changing conclusions on a change of scale by a factor 3. There are 7 decimals between a grain of sand and the earth. That gives approximately 15 possibilities of turning conclusions. Between a molecule and a grain of sand applies the same. This ban is violated so many times, that this should be an important criterion on the validity of scientific judgements.

The scale-paradox is not limited on concepts of diversity. An important example of turning conceptions into their opposite by scale is the duality of aim and means.
For the government subsidizing a municipality the subsidy is a means, for the municipality it is an aim. So the conception of means changes in a conception of aim by crossing levels of scale. The turning of '*Zweckbegriff*' into '*Systemrationalität*' discussed by Luhmann (1973) may be a turning conception of the same scale-sensitive character. In growing organizations *integration* on the level of the organization as a whole means often *disintegration* of the subsystems and perhaps a new form of integration in the sub-sub-systems. This process is called '*differentiation*'!

Avoiding confusion of scale

In Fig. 688 confusion of scale is already possible by a linear factor 3 difference in level of scale. That is why in spatial planning we articulate orders of size by a factor of approximately 3.

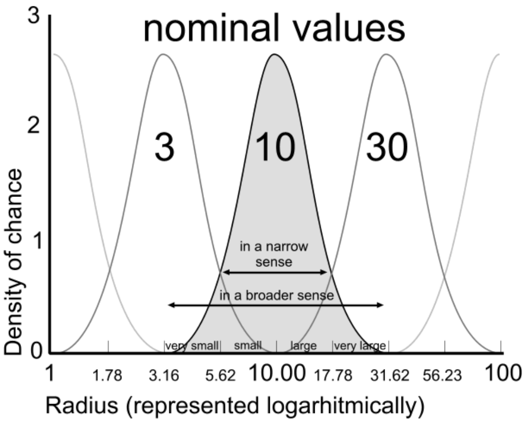


Fig. 689 *Names and boundaries of urban categories*

An element from the nearly logarithmical series {1, 3, 10, 30, 100 …} is the name (nominal value) of an 'elastic' urban category ranging until those of the nearest categories (scale range).
The name giving 'nominal' radius r=10 then is the median of a chance density distribution of the logarithm of radiuses between (rounded off) r=3 and r=30, with a standard deviation of 0.15. We chose a series of radiuses (and not diameters) because an area with a radius of {0.3, 1, 3, 10km} fits well with {neighbourhood, district, quarter, conurbation} or loose {hamlet, village, town, conurbation} in every day parlance.

Then also the system of dry and wet connections could be named in this semi logarithmical sequence according to average mesh widths.

5.2.4 Spatial state of dispersion as a condition of diversity

State of dispersion

Form as a primary object of design supposes state of dispersion.

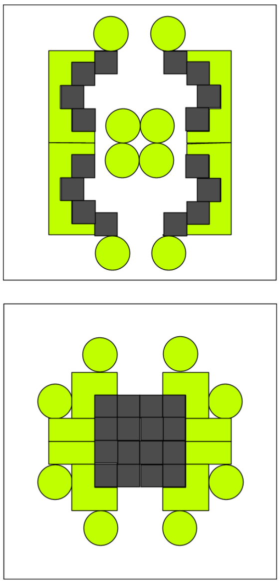
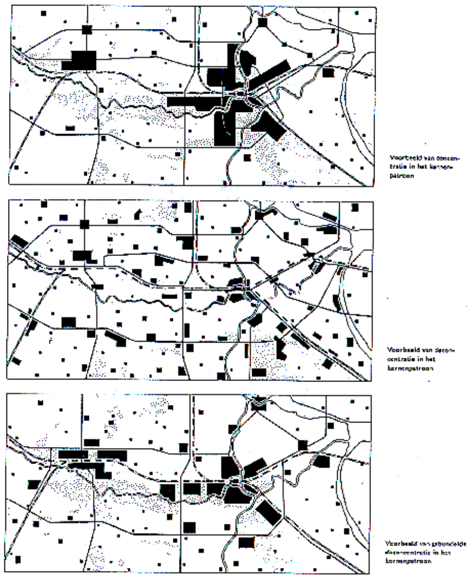


Fig. 690 *States of dispersion r=100m*



RPD (1966)

Fig. 691 *Accumulation, Sprawl, Bundled Deconcentration r=30km*

Scale articulation of dispersed states

Scale articulation is especially important distinguishing states of dispersion. State of dispersion is not the same as density. Considering the same density different states of dispersion are possible (Fig. 692) and that is the case on every level of scale again (Fig. 693).

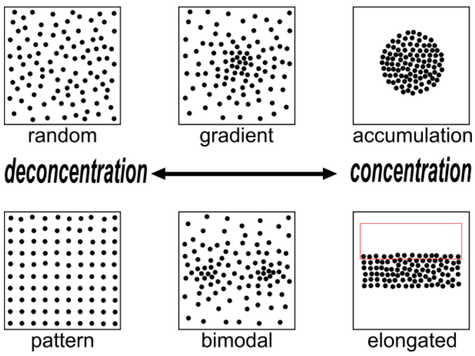


Fig. 692 *States of dispersion in the same density on one level of scale*

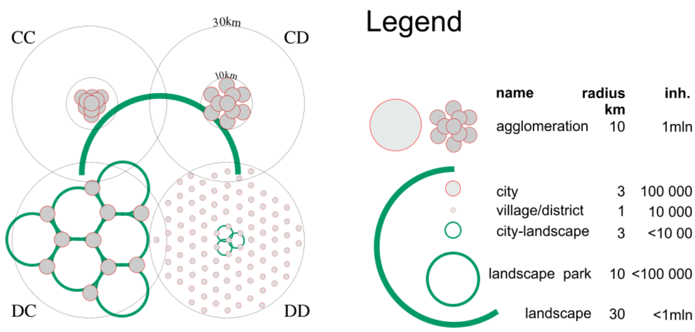


Fig. 693 *One million people in two states of distribution on two levels of scale (accords CC, CD, DC and DD).*

Fig. 692 shows the use of the words concentration (C) and deconcentration (D) for processes into states of more or less accumulation respectively. Applied on design strategies in different levels of scale we speak about 'accords' (Fig. 693).

In Fig. 693 the *regional density* is equal in all cases: approx. 300inh./km^2. However, in case CC the built-up area is concentrated on both levels ($C_{30km}C_{10km}$) in a high *conurbation density*: (approx. 6000inh./km^2).

In the case CD people are deconcentrated only within a radius of 10km ($C_{30km}D_{10km}$) into an average conurbation density of approx. 3000 inh./km^2.

In the case $D_{30km}C_{10km}$ the inhabitants are concentrated in towns (concentrations of 3km radius within a radius of 10km), but deconcentrated over the region. This was called ‘Bundeled deconcentration’ in NRO2. The *urban density* remains approx. 3000 inh./km^2.
In the case $D_{30km}D_{10km}$ they are dispersed on both levels.

Urban sprawl

Urban sprawl in a radius of 10km hardly influences the surrounding landscape when the inhabitants are concentrated in a radius of 30 (the two variants above in Fig. 693).
However, the urban sprawl in a radius of 30km breaks up the surrounding landscape in landscape parks. By that condition the sprawl within a radius of 10km is important again: the landscape parks are broken up further into town landscapes. In The Netherlands until 1983 DC was the national strategy (‘Bundled deconcentration’, ‘Gebundelde Deconcentratie’ from NRO2, RPD (1966)), after NRO3, RPD (1983) the policy changed into CC (Compact town’, ‘Compacte Stad’), but turned out in practice as CD and even DD. The result of both strategies was disappointing.

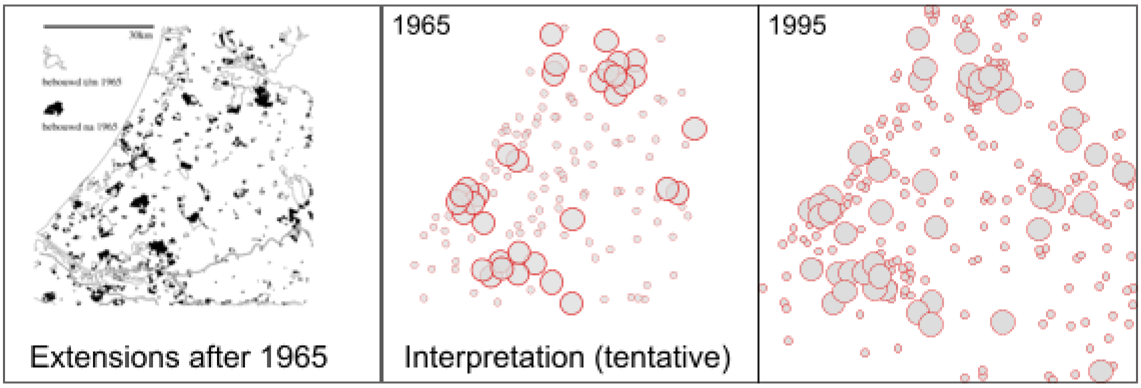


Fig. 694 *Urban sprawl in Randstad, The Netherlands*

Distribution and abundance of organisms

In prominent ecology textbooks there are several definitions of ecology emphasising dispersion or with an increasing awareness of scale (in that case we will speak about spatial distribution):

Andrewartha (1961), cited by Krebs (1994): Ecology is the scientific study of the *distribution and abundance* of organisms.
•Krebs (1994): Ecology is the scientific study of the *interactions* that determine the distribution and abundance of organisms.
•Pianka (1994): Ecology is the study of the *relationships between organisms* and the totality of the *physical and biological factors* affecting them or influenced by them.
•Begon, Harper et al. (1996): Ecology is the scientific study of the interactions that determine the distribution and abundance of *organisms, populations and communities.*

Kolasa and Pickett (1991) seem to be the only ecologist fully aware of scale articulation consequences.

Time-space scaling

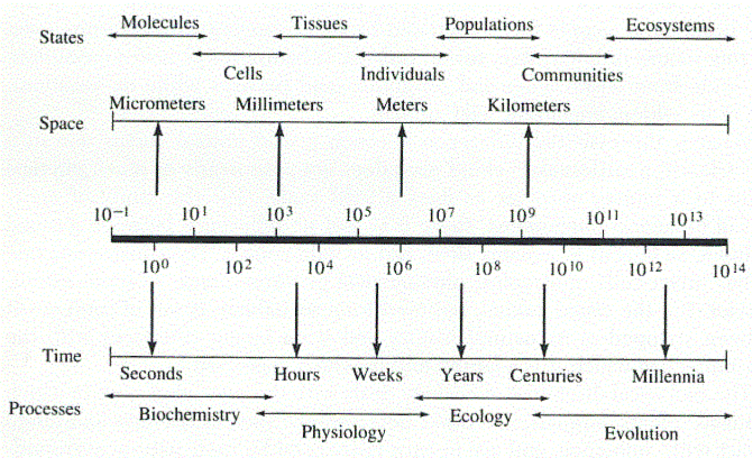


Fig. 695 *Diagrammatic representation of the time-space scaling of various biological phenomena.*

Pianka stresses relationships in a broader sense than spatial relationships, but he adds a scheme stressing scale in space and time. 'Community and ecosystem phenomena occur over longer time spans and more vast areas than suborganismal and organismal-level process and entities. (after Anderson (1986) after Osmund et al.)'

Begon, Harper and Townsend distinguish organisms, populations and communities. That distinction looks like a distinction of scale, but is primarily a distinction between different kinds of ecology:

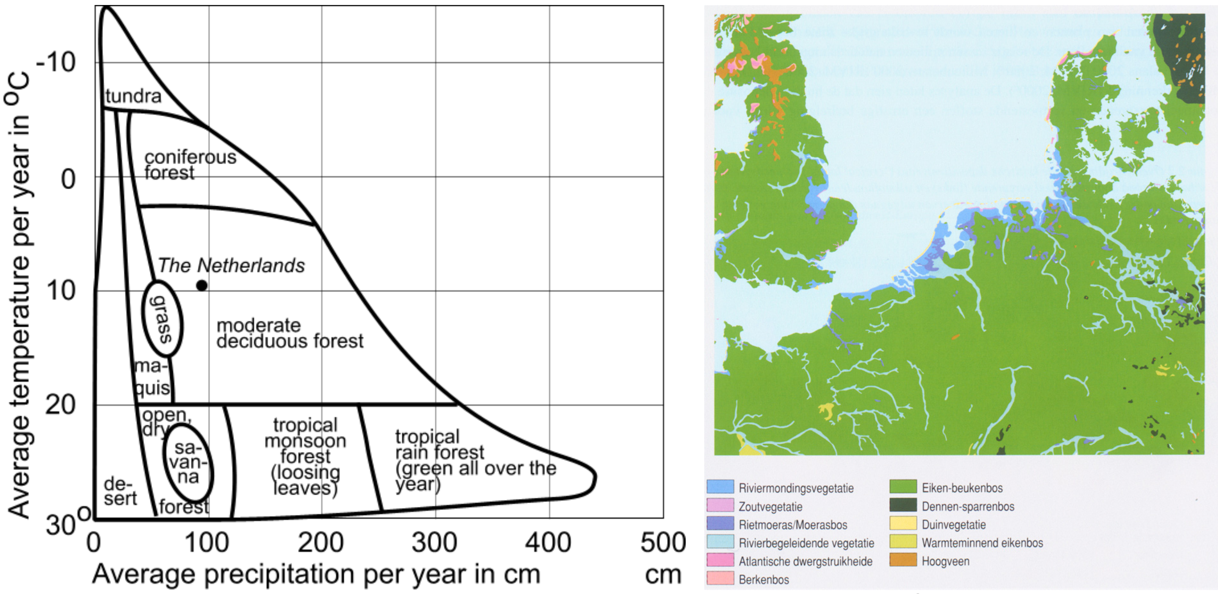
- autecology concerning populations of one species at a time within their 'habitat' and
- synecology concerning the community of different species in the same 'biotope'.

On the level of organisms one could speak about 'ecological behaviour' as for instance Grime, Hodgson et al. (1988) elaborated as plant species bound 'strategies for survival' like 'competitors', 'ruderals' and 'stress tolerators' as rôles in a play concerned less predictable than communities reaching a well described 'climax'.

5.2.5 300km continental vegetation areas

Global and continental

Ecological typology is scale-sensitive. On a global level (r=10 000km) year average temperature and precipitation determine so-called ‘biomen’. On a continental level (r=3 000km) areas of vegetation like estuaries, salt vegetations, reed marsh, river accompanying, Atlantic heather, birch forest, oak-beach forest, pine-spruce forest, dunes, warm oak forest and high moor land are distinguished. On a map types in a typology appear like legend-units in a legend (see Fig. 696).



Myers (1985)   Bohn, Gollub et al. (2000); Bohn (2001)

Fig. 696 *Global and continental ecological typology*

In The Netherlands, Northern Germany and Southersn Denmark, the distinction of Fig. 696 (right) corresponds with geological categories like Pleistocene (until 1 000 000 years old) and Holocene (until 10 000 years old).

European level

The subdivision of global life in Fig. 696 distinguishes biomen by temperature and precipitation[33]. This variation is recognisable on a smaller level of scale vertically in mountains.
On a European level of scale different distinctions were made. Fig. 696 gave the most recent one based mainly on forest types and Fig. 697 an earlier one based on species[34].

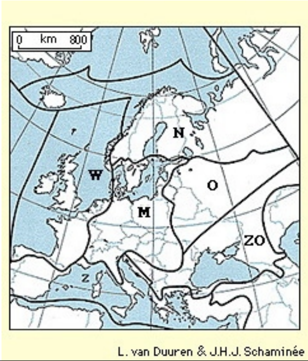
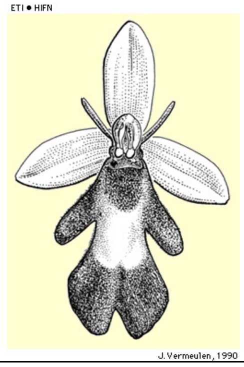
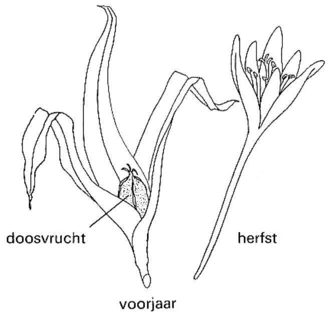
			
Mennema, Quene-Boterenbrood et al. (1980) , p. 16	Meijden (1999)	Kelle and Sturm (1980)	Meijden (1999)
Continental vegetation areas,	*Vliegenorchis H43*	Herfsttijloos	*Kleine Kaardebol*

Fig. 697 *Plants, characteristic for Middle-European vegetation areas (M)*

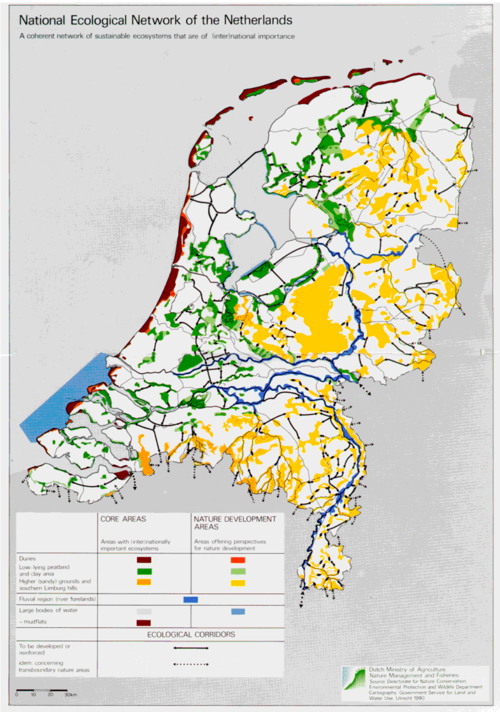
Mainly West European vegetation in The Netherlands

In The Netherlands the distinction of Fig. 696 (right) corresponded with geological categories like Pleistocene (until 1 000 000 years old) and Holocene (until 10 000 years old).
Fig. 697 distinguishes grounds mainly older than 1 000 000 years in Limburg as 'Middle European vegetation area' (M). Pleistocene and older grounds in South Limburg are nearly fully covered by löss alternating with rock on surface, primarily consisting of chalk, marl and limestone sometimes turning up elsewhere in The Netherlands as well. The rest of The Netherlands as part of 'West European vegetation area' (W) is younger.

5.2.6 30km national counties

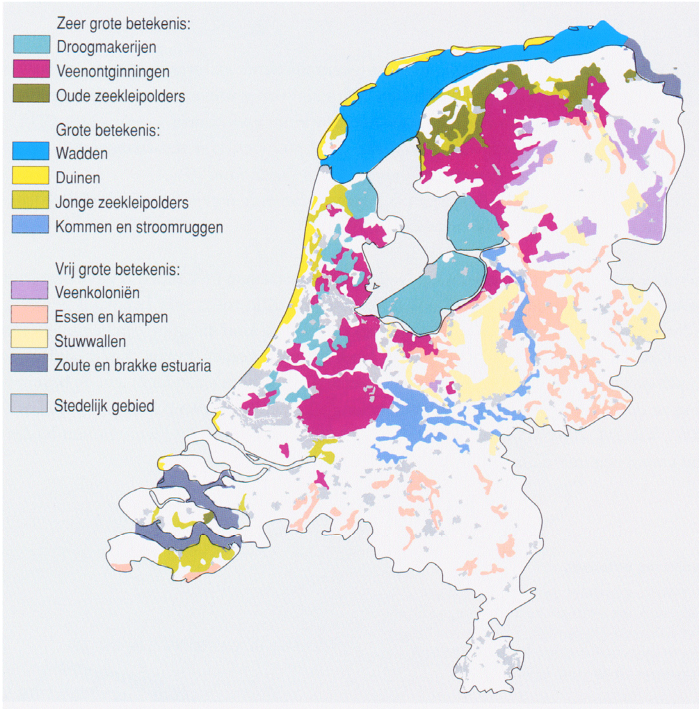
Holocene and Pleistocene

On a national level in The Netherlands Holocene and Pleistocene are the most enclosing categories approximately separated by the 5m altitude or clay (with peat and dunes) versus sand (intersected by river clay or locally filled by high moor land). The most urbanised Holocene estuary area, botanically indicated as 'lagoon county' is highly influenced by man and in the same time an internationally rare cultural-natural monument of polders. It is ecologically divided further in many ways representing its dynamic and unpredictable wet ecological diversity.



From an earlier version of LNV (2002)

Fig. 698 *Planning Ecological Infrastructure*



RIVM (2001)

Fig. 699 *International rarity of landscapes*

Based on the synecological typology of Westhoff and Held (1969) and Held (1991), Bal, Beije et al. (1995); Bal, Beije et al. (1995) defined 132 (in Bal, Beije et al. (2001) reduced into 92) nature target types of the national ecological infrastructure (EHS). However, Clausman and Held (1984) earlier had proved them to be inadequate for the Holocene Zuid-Holland area. Too many transitional stages between sand, clay and peat, influenced by a historical local diversity of cutting peat and water management produced a variety of nature types nearly equalling the number of grounds itself.

Different plants on Pleistocene and Holocene grounds

Apart from the sandy dunes, the lower Holocene with clay from sea and rivers and low (wet) and high (acid) peat has a very different vegetation compared with the higher and dryer pleistocene covered with coarser sand and gravel.[35] The ecological difference between low Holocene and high Pleistocene is clearly illustrated by dispersion of two species: meadow barley (veldgerst, Fig. 700) and wavy hair-grass (bochtige smele, Fig. 701).

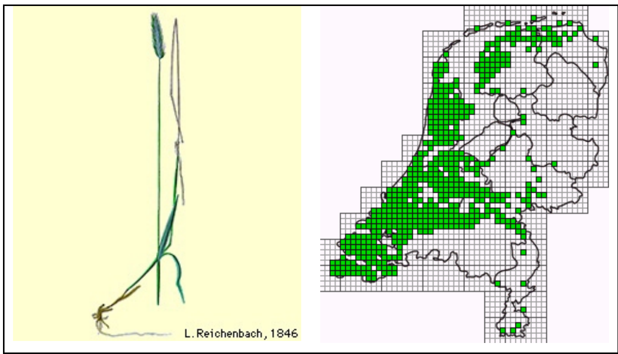
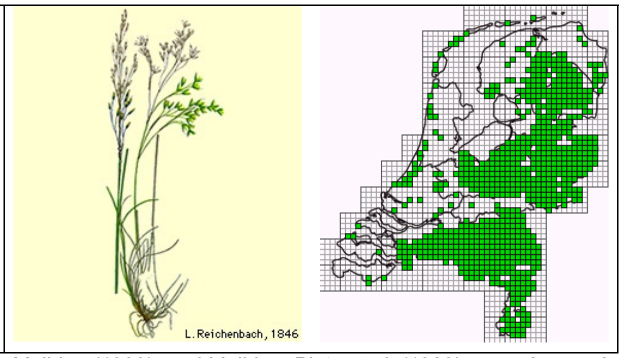


Fig. 700 *Dispersion of meadow barley (veldgerst)*

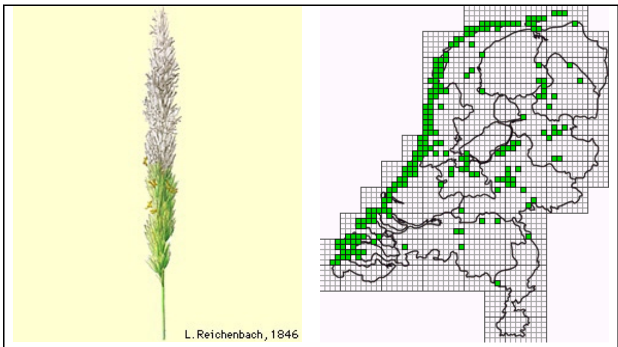


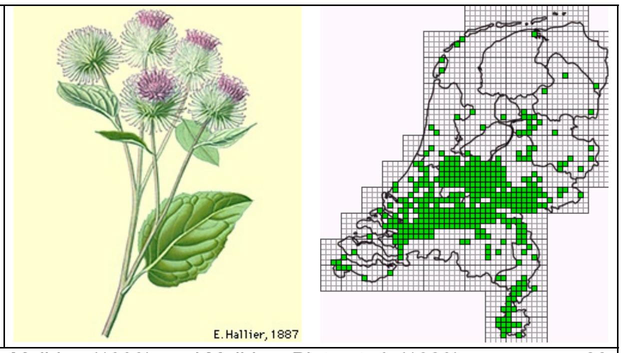
Meijden (1999) and Meijden, Plate et al. (1989) page 84 en 58

Fig. 701 *Dispersion of wavy hair-grass (bochtige smele)*

Different plants in dunes and rivers

Holocene is subdivided in dune and river county, illustrated by the dispersion of two other species, marram (helm, Fig. 702) and greater burdock (grote klis, Fig. 703). The remainder is called Haf county with sea clay and peat.





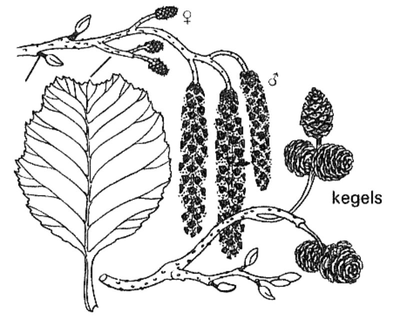
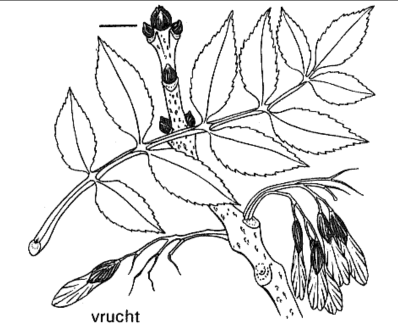
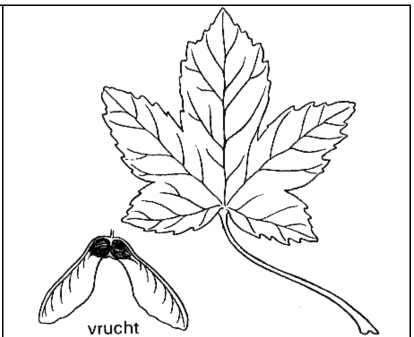
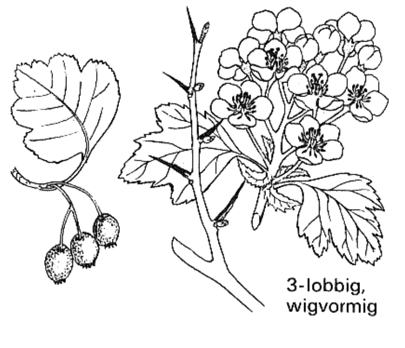
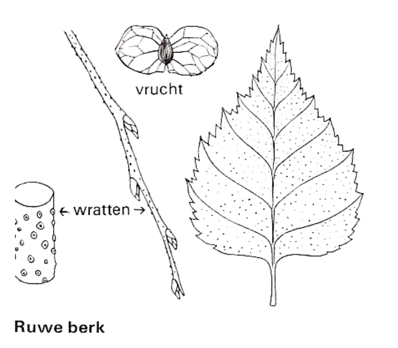
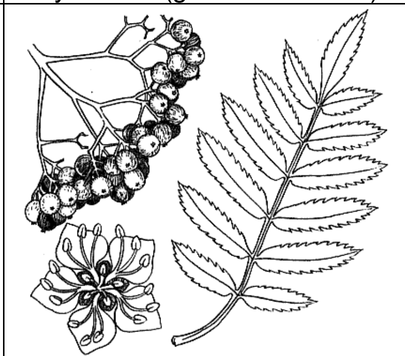
Meijden (1999) and Meijden, Plate et al. (1989) page 44 en 28

Fig. 702 *Dispersion of marram (helm)*

Fig. 703 *Dispersion of greater burdock (grote klis)*

General trees in The Netherlands

General trees in The Netherlands are alder (els), ash (es), sycamore (esdoorn), hawthorn (meidoorn), birch (berk), rowan or whitebeam (lijsterbes).

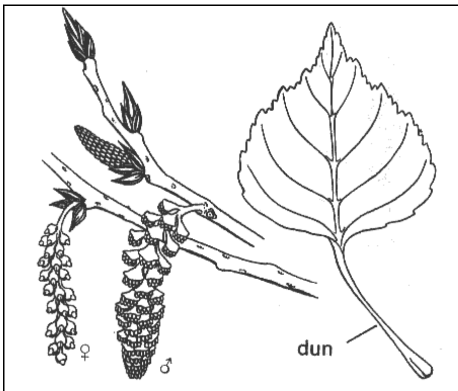
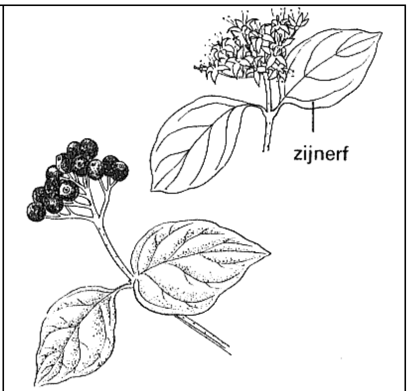
		
Alder (zwarte els)	Ash (es)	Sycamore (gewone esdoorn)
		
Midland hawthorn (tweestijlige meidoorn)	Birch (berk)	rowan or whitebeam (wilde lijsterbes)

Kelle and Sturm (1980)

Fig. 704 *General trees in The Netherlands*

Trees specific for Holocene and river grounds

Holocene and rivers are characterised by black poplar (zwarte populier), willow (wilg), dogwood (rode kornoelje) (Fig. 705).

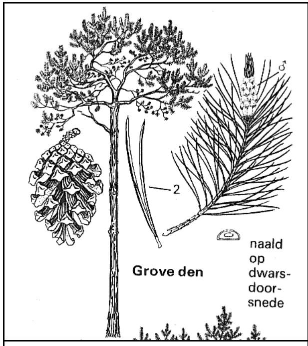
		
Black poplar (zwarte populier)	Crack willow (kraakwilg)	Dogwood (rode kornoelje)

Kelle and Sturm (1980)

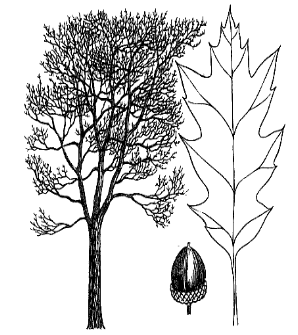
Fig. 705 *Trees of Holocene and rivers in The Netherlands*

Trees specific for Pleistocene and dunes

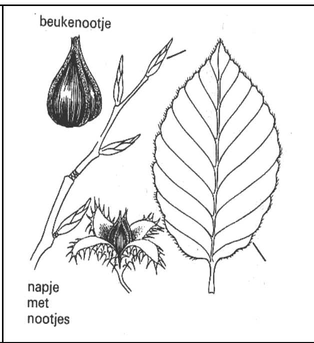
Peistocene and dunes are characterised by scots pine (grove den), red oak (amerikaanse eik), beech (beuk), aspen (ratelpopulier), hazel (hazelaar), holly (hulst), locust tree (robinia pseudo-acacia) and rum cherry or black cherry (amerikaanse vogelkers)



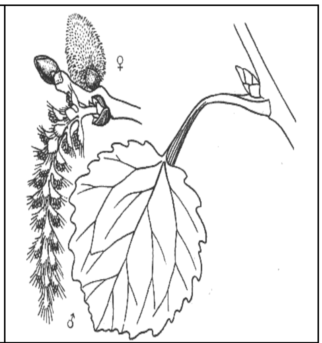
scots pine (grove den)



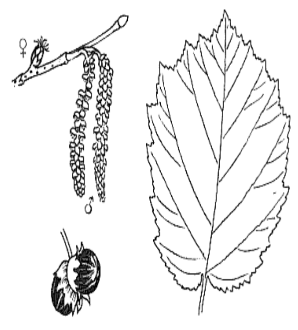
red oak (amerikaanse eik)



beech (beuk)

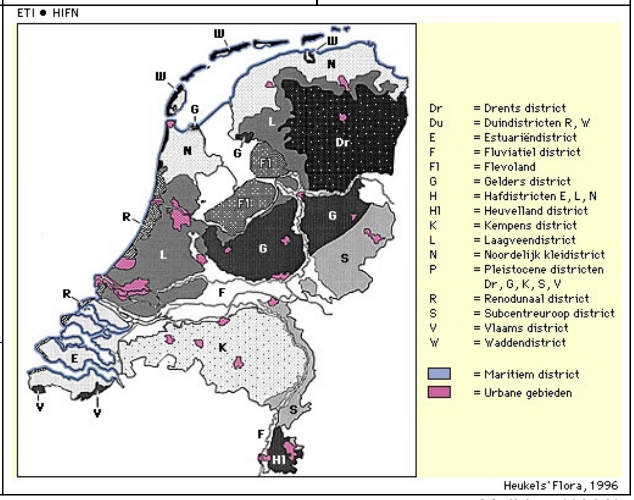


aspen (ratelpopulier)



hazel (hazelaar)

holly (hulst)



Kelle and Sturm (1980)

Fig. 706 *Trees of Pleistocene and dunes in The Netherlands*

Meijden (1999)

Fig. 707 Flora districts according to Van Soest

Further elaboration of ecological counties (districten) (Fig. 707) is given by Van Soest (1929/32)[36]

5.2.7 3km Landscape formations

Undisturbed 'definitive' vegetations

Obviously any region in The Netherlands that has got the time for succession of vegetation types gets a more or less 'definitive' vegetation. Coincidences of first establishments are filtered out.
This vegetation is not only dependent on soil, but also on climate, position in respect to sea and ground water level. For example, peat will only remain at high ground water level. In dry conditions it will settle, oxidate to CO_2 en H_2O and disappear leaving a lower mineral surface level.

In this paragraph we will discuss landcape formations and typical forest landscapes that would appear without impact of man at last. Agriculture and the use of fertilizers caused a homogeneous landscape. But the agricultural surface being reduced by economic conditions, an ecologically well-considered choice of vegetation and management could restore regionally characteristic forest, kept open partially by wild grazing cattle. You can consider this paragraph as a guide to planting, because trees occurring naturally in the region will grow better. You can obtain regional knowledge about soils from soil maps 1:50.000 with explanatory discriptions of landscapes.

Natural forest types

Following descriptions are derived from Leeuwen and Kraft (1959). With regard to these elaborations Van Leeuwen's nomenclature is obsolete but simple, useful and clarifying for urbanists and not yet exceeded in that respect.

Forest	Natural	Reclamated
	Holocene	
salicion	Willow and poplar forests, often found on *nutricious flooded areas like river forelands*. As coppice wood and wickers, willows are planted on 'grienden'. Temporarily you will find these woods on other nutricious grounds as pioneer vegetation.	Grass land on river forelands and 'grienden'.
alnion incanae	Alder and ash forests with densely shrubs on *clay or sandy nutricious grounds with high and often somewhat changing ground water level or in the neighbourhood of streaming water*. These forests often contain some oaks and poplars as well.	Moisty grass land (meadows) sometimes with hedges (Rubion, alder), pollard willows or poplars.
ulmion	Oak, ash (somtimes elm or maple) forests on *moisty, nutricious sandy and not too heavy clay grounds with ground water level in reach of roots*.	Settlements, horticulture, orchards, fields, grass land, elm lanes, country estates and dune woods.
sambuco-berberidion	Hedges and thickets on *most limy grounds* of Ulmion.	
	Pleistocene	
rubion	Hedges and thickets (hawthorn, sloe, roses, blackberries) on *nutricious, but not expicitly limy grounds*.	Settlements, orchards and fields on rather dry grounds; grass land on more moisty or very limy grounds.
carpinion	Oak, ash (sometimes maple or beech) forests on *nutricious, not too wet loam grounds*. In coppice wood thickets you wil find hazel and hornbeam.	
carpino-berberidion	Hedges and thickets on *most limy grounds* of Carpinion.	
violeto-quercion	Oak (seldom birch or beech) forests or coppice wood on *acid but not extremely poor, ofthen loam containing or somewhat moisty sandy grounds*.	Fields
vaccinio-quercion	Oak (sometimes birch or beech) forests or coppice wood on on *acid extremely poor, sandy (sometimes loamy) grounds*.	Prehistoric (neolithic) settlements, heath often later planted with coniferous wood (drifting sand) or crops (if dry) or meadows (if wet).
	Peat	
betulon pubescentis	Rarefied birch forests on *somwhat dehydrated peat grounds* (very rare).	Digged out or drained and manured meadows sometimes planted as Alnion incanae.
sphagno-alnion.	Birch (sometimes alder) forests with shrubs of alder buckthorn, willows, bog myrthle on *acid peat grounds* (rare).	Bluegrass lands, later usually drained and manured, sometimes planted as Alnion incanae.
irido-alnion.	Alder or willow (mostly coppice wood) in *peat areas with very hing, stagnating not too poor ground water*, usually with rarified shrubs.	Moisty grass land, digged out or drained and manured meadows mostly planted as Alnion incanae.

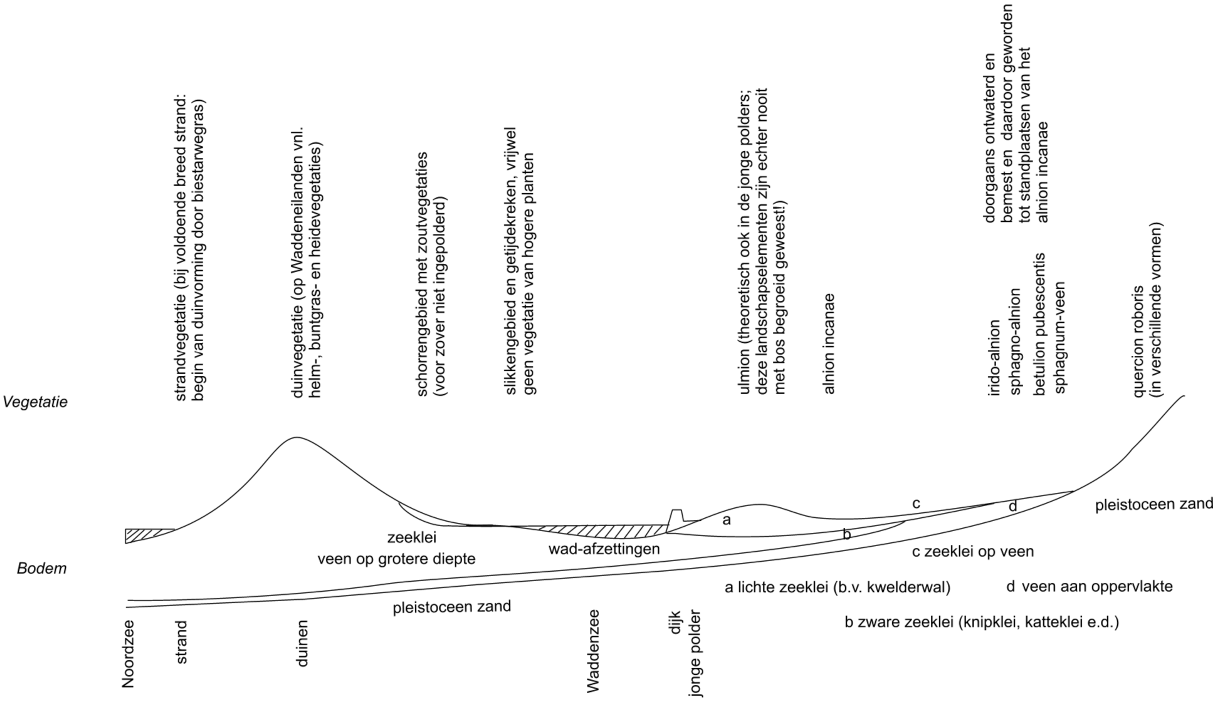
Leeuwen and Kraft (1959)

Fig. 708 *Relation between original natural forest type and reclamated landscape.*

Ideal typical profiles

The situation of most important soils and corresponding vegetation is represented in ideal typical profiles Fig. 709 to Fig. 712 never appearing in reality. Corresponding forest types have been mostly disappeared since long and replaced by grass and crops. They illustrate mutual arrangements of Dutch original or natural landscapes. Soil maps give more detailed and realistic images.

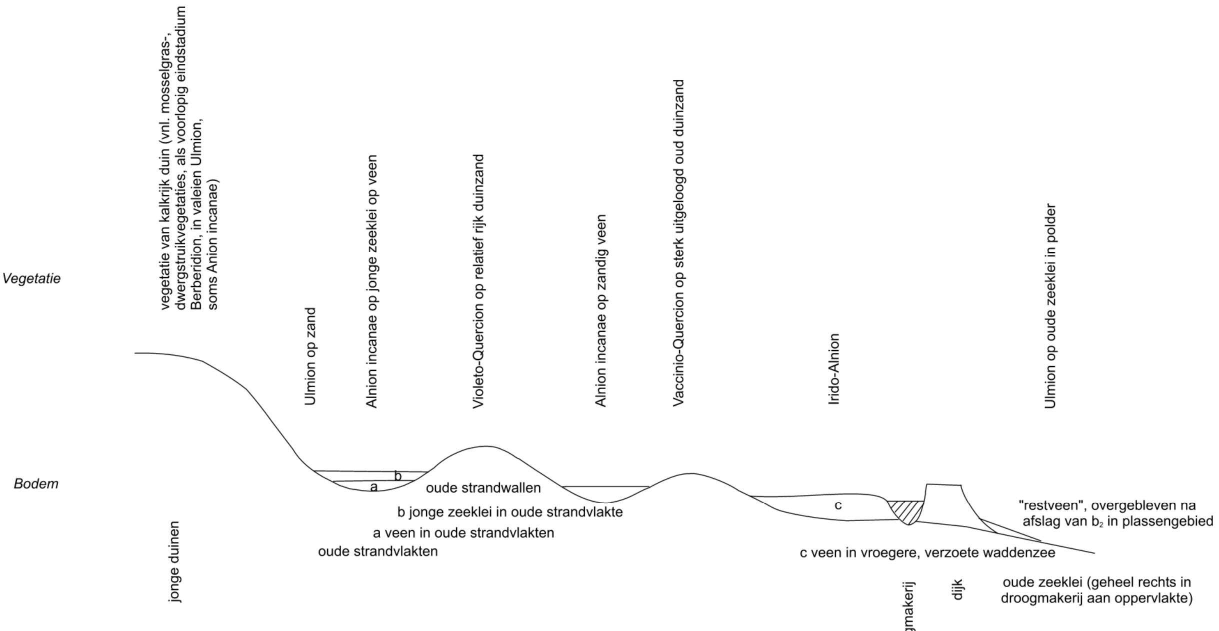
The Northern coast formation of The Netherlands



Leeuwen and Kraft (1959)

Fig. 709 *Ideal typical coast formation in Northern part of The Netherlands*

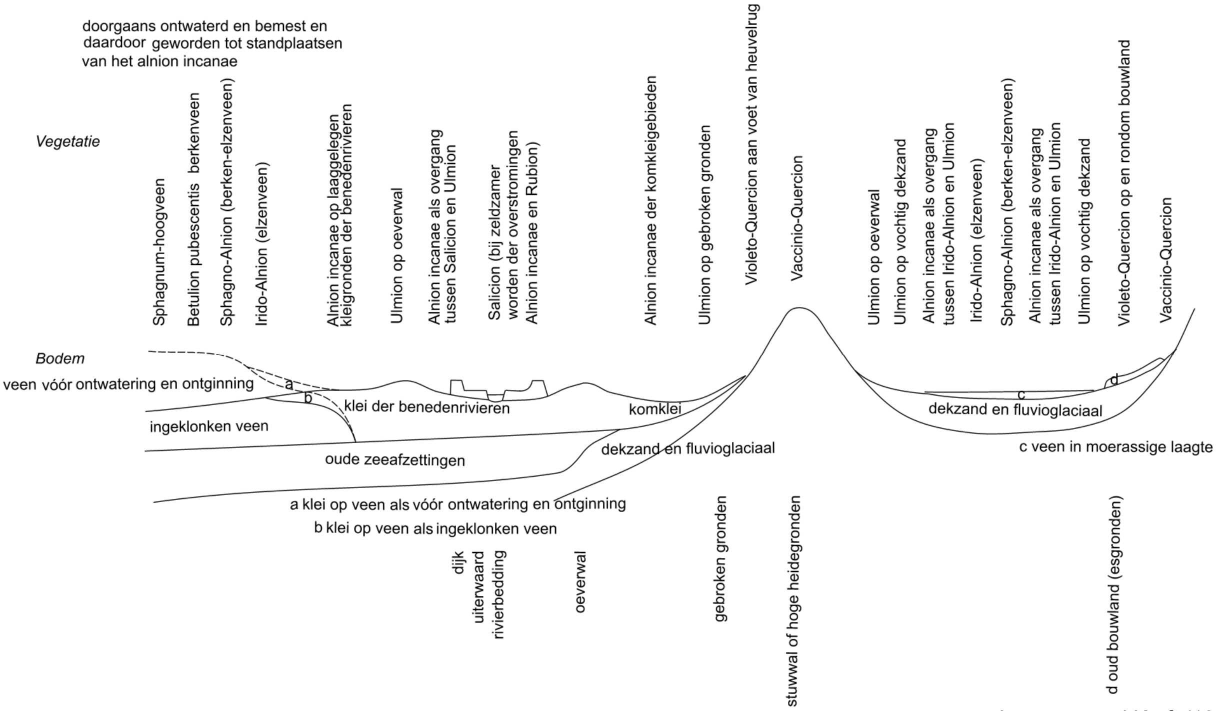
Mid-West cost formation of The Netherlands



Leeuwen and Kraft (1959)

Fig. 710 *Ideal typical coast formation in mid-West of The Netherlands*

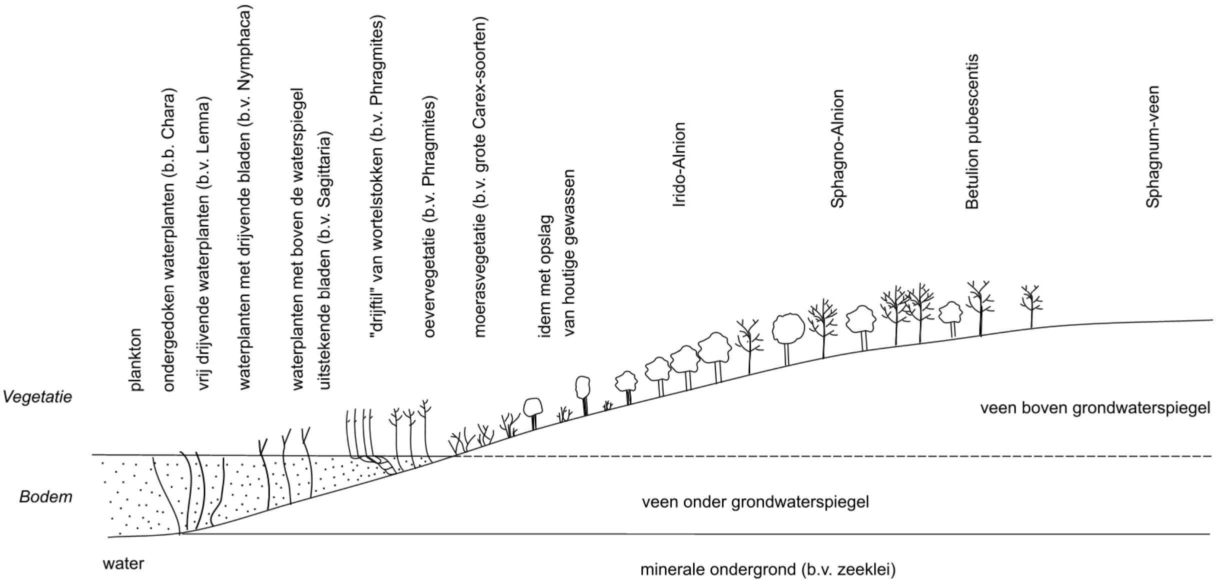
Peat, river and pleistocene sandy formations



Leeuwen and Kraft (1959)

Fig. 711 *Ideal typical peat, river and pleistocene sandy formations*

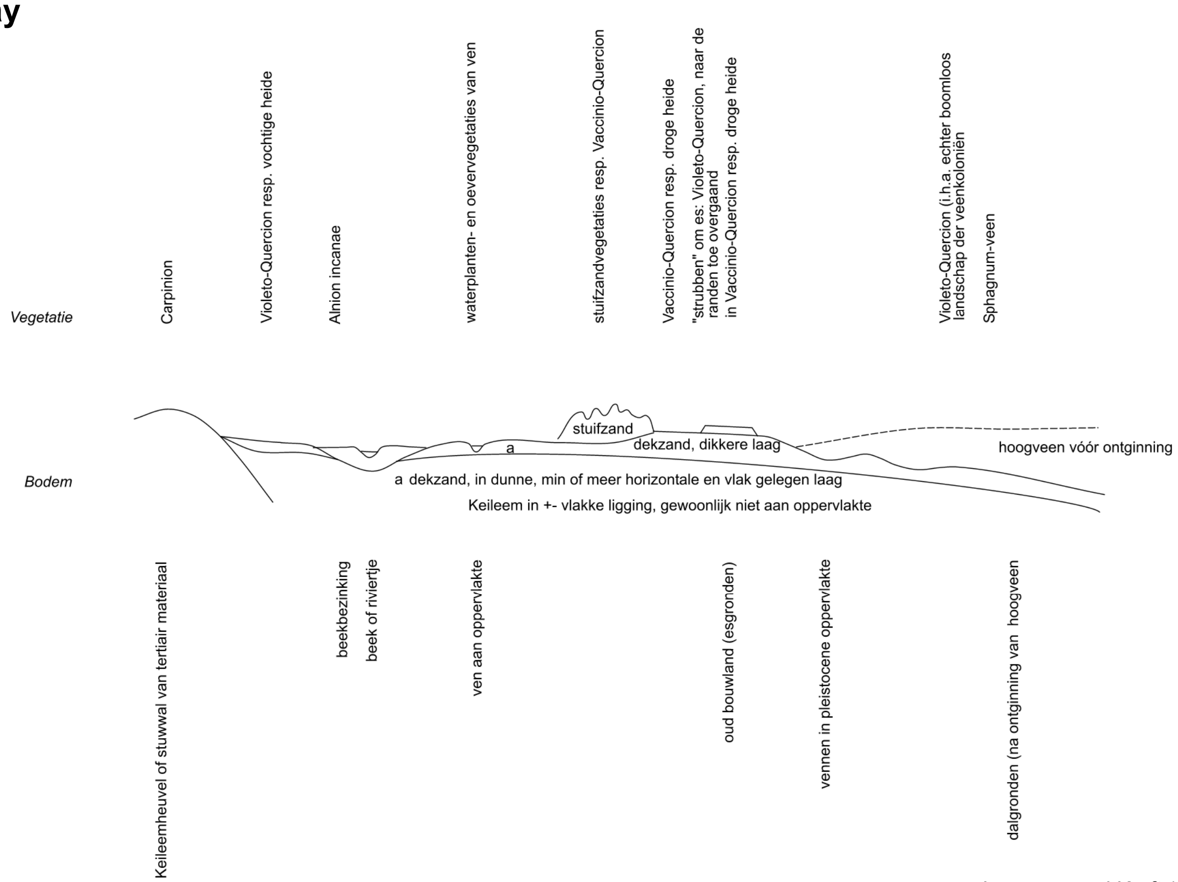
Growing Peat



Leeuwen and Kraft (1959)

Fig. 712 *Ideal typical 'verlanding' in nutricious environments*

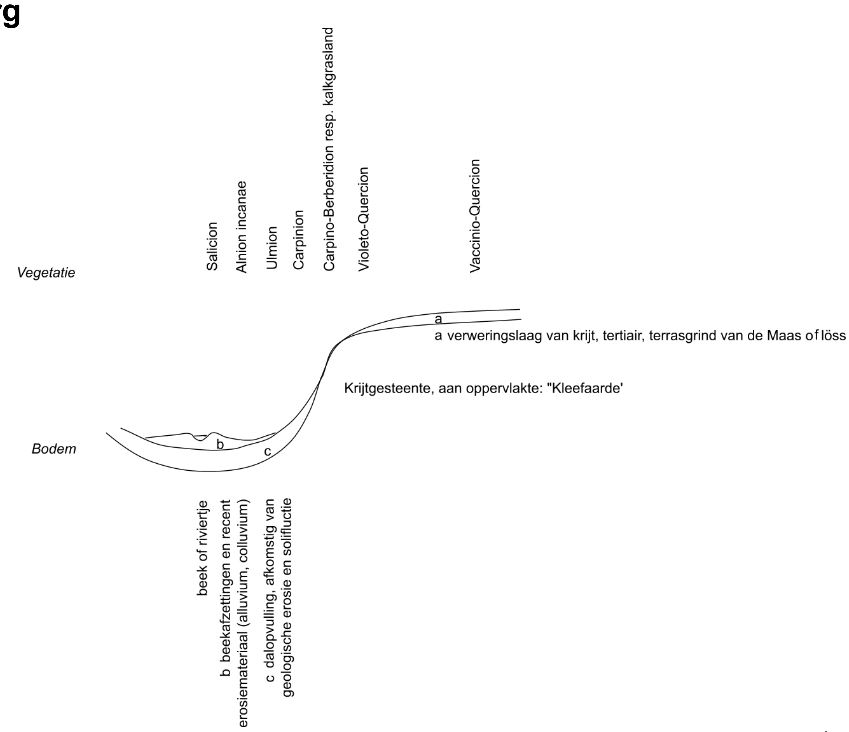
Clay



Leeuwen and Kraft (1959)

Fig. 713 *Ideal typical boulder clay formation*

South Limburg



Leeuwen and Kraft (1959)

Fig. 714 *Ideal typical formation of South Limburg*

'Original landscape' is not the same as the 'natural landscape' appearing when human impact would stop, especially when agricultural measures were very radical.

5.2.8 300m local life communities

Succession

Organisms influence eachother. In the beginning competition in fast growing homogeneous pioneer vegetation is dominant. In the next phase of succession different species alternate their use of sun, water and minerals over the year and differentiate them over the area in increasing specialisation. Primarily establishing plants cause a micro climate and soil structure creating conditions for other species. Under these conditions some newcomers get the opportunity to built up reserves and become more competitive than their fast growing predecessors. For exampe, they grow higher catching sunlight from their neighbours or grow deeper surviving dry periods better by their longer roots. In their shadow slow growing specialists settle.

Differentiation and regulation

The differentiating life community prevents large fluctuations of temperature and moist, retains water and nutrients attracting new animals. Specific insects pollinate specific plants and clear up plants weakened by competition in homogeneous vegetation. Birds control insect overloads, disperse seeds. Large grazing animals keep spaces open, predators keep their number limited. Reproductive cycles of every participating organism with its own consumptive, productive and reproductive periods are geared to one another and find for every phase the environmental circumstances they need, or die out. The rise of mutual relations into a climax stage (Fig. 730) requires coordination in space and sychronisation in time. In general it takes time.

Differerent communities in the same biotope

In the same type of biotope different life communities can develop, according to the history of their development. Different (weather) histories after all, change the biotope itself in different ways and select species differently. For example, if papillionaceous flowers with their specialised algae established in an early stage to combine nitrogen in the soil, an other series of succession would follow then when they established later or never. If not, vegetation is dependent on nitrogen manure from outside. And the reverse, if there is an external nitrogen source in the beginning, papillionaceous flowers would not survive competition.

Equal communities in different biotopes

On the other hand the same type of vegetation can disperse over different biotopes as well. So, there is not always a one-to-one relation between biotopes and life communities.
Especially man plants on his fields and gardens species he wants to, regardless the existing biotope accomodating it to his needs. He mostly reduces a mature system into its pioneer stage to get homogeneous highly competing productive crops. Then ecosystems do not reach their climax stage because human dynamic (grazing, mowing, burning and digging) prevents succession into more differentated stages.

A first taxonomy of communities

Mutual relations between species produce recognizable plant communities listed in 38 synecological classes from Westhoff and Held (1975) summarised by Held (1991), subdivided in orders, unions and associations (partly elaborated in Fig. 715)[37]. Classes 32 to 38 elaborate forests more in detail than Fig. 708 did obsoletely but simply. Some scientific names like Salicion (32Aa and 33Aa), Alnion (35Aa) remain the same, other forest types named in paragraph 5.2.7 changed.

code	class 01-38 ~ea	order A-C ~alia	union a-d ~ion	associatiion 1-99 ~tum	Dutch name class
01	Lemnetea				Eendekroos-klasse
02	Zosteretea				Zeegras-klasse
03	Ruppietea				Ruppia-klasse
04	Charetea				Kranswieren-klasse
05	Potametea				Fonteinkruiden-klasse
....					
29	Oxycocco-Sphagnetea				Klasse der hoogveenbultgemeenschappen en vochtige heiden
30	Nardo-Callunetea				Klasse der heiden en borstelgrasanden
31	Trifolio-Geranietea sanguinei				Marjolein-klasse
32	Franguletea				Klasse der sporken-wilgenbroekstruwelen
32A		Salicetalia auritae			
32Aa			Salicion cinereae		
32Aa1				*Myricetum gale*	
32Aa2				*Frangulo-Salicetum auritae*	
32Aa3				*Alno-Salicetum cinereae*	
32Aa4				*Salicetum pentandro-cinereae*	
32Aa5				*Salicetum pentandro-arenariae*	
33	Salicetea purpureae				Klasse der wilgen-vloedstruwelen en bossen
33A		Salicetalia purpureae			
33Aa			Salicion albae		
33Aa1				*Salicetum triandro-viminalis*	
33Aa2				*Salicetum arenario-purpureae*	
33Aa3				*Salicetum albo-fragilis*	
34	Rhamno-Prunetea				Klasse der eurosiberische doornstruwelen
35	Alnetea glutinosae				Klasse der elzenbroekbossen
35A		Alnetalia glutinosae			
35Aa			Alnion glutinosae		
35Aa1				*Carici elongatae-Alnetum*	
35Aa2				*Carici laevigatae-Alnetum*	
36	Vaccinio-Piceetea				Klasse der naaldbossen
36A		Vaccinio-Piceetalia			
36Aa			Dicrano-Pinion		
36Aa1				*Leucobryo-Pinetum*	
36Aa2				*Dicrano-Juniperetum*	
36Ab			Betulion pubescentis		
36Ab1				*Betuletum pubescentis*	
37	Quercetea robori-petraeae				Eiken-klasse
37A		Quercetalia robori-petreae			
37Aa			Quercion robori-petreae		
37Aa1				*Querco roboris-Betuletum*	
37Aa2				*Fago-Quercetum*	
37Aa3				*Convallario-Quercetum dunense*	
38	Querco-Fagetea				Eiken-beuken-klasse
38A		Fagetalia sylvaticae			
38Aa			Alno-Padion		
38Aa1				*arici remotae-Fraxinetum*	
38Aa2				*onsortium van Carex remota & Populus nigra*	
38Aa3				*runo-Fraxinetum*	
38Aa4				*acrophorbio-Alnetum*	
38Aa5				*iolo odoratae-Ulmetum*	
38Aa6				*raxino-Ulmetum*	
38Aa7				*nthrisco-Fraxinetum*	
38Aa8				*rataego-Betuletum*	
38Aa98				*lmion carpinifoliae*	
38Aa99				*ircaeo-Alnion*	
38Ab			Carpinion betuli		
38Ab1				*Stellario-Carpinetum*	
code	klasse 01-38 ~ea	orde A-C ~alia	verbond a-d ~ion	associatie 1-99 ~tum	Nederandse naam klasse

Fig. 715 *Taxonomy of life communities according to Westhoff and Den Held.*

The next taxonomy

However, that taxonomy was adapted again by Schaminee, Stortelder et al. (1995); Schaminee, Weeda et al. (1995); Schaminee, Stortelder et al. (1996); Schaminee, Weeda et al. (1998) . Fig. 716 gives an impression of the first classes only.

	class 01-11 ~ea	**order A-C, DG, RG ~alia**	union a-d ~ion	*association 1-99 ~tum*	*subassociatiion a-b*
01	**Lemnetea minoris**				
02	**Ruppietea**				
03	**Zosteretea**				
04	**Charetea fragilis**				
05	**Potametea**				
06	**Littorelletea**				
07	**Montio-Cardaminetea**				
08	**Phragmitetea**				
09	**Parvocaricetea**				
10	**Scheuchzerietea**				
11	**Oxycocco-Sphagnetea**				
……………..					

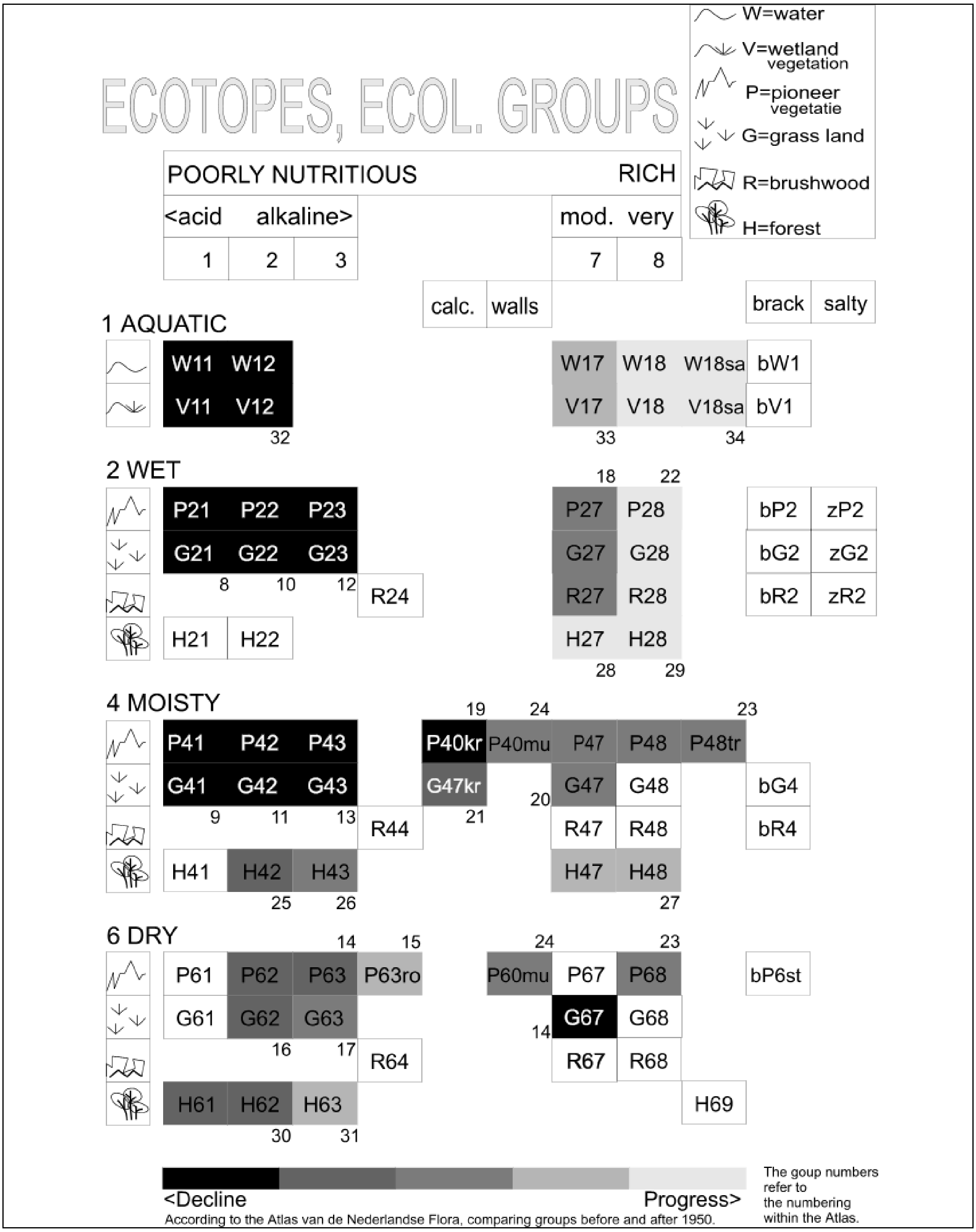
	klasse 01-11 ~ea	**orde A-C, DG, RG ~alia**	verbond a-d ~ion	*associatie 1-99 ~tum*	*subassociatie a-b*

Fig. 716 *Taxonomy of life communities according to Schaminee.*

This taxonomy at last was used in nature conservation, simplified in nature target types we will discuss in 5.5.1 more in detail.

5.2.9 30m ecological groups

Based on ideas of Van der Maarel (1971), Runhaar, Groen et al. (1987) divided Dutch plant species in ecological groups (Fig. 717), suitable for estimating impacts of technical measures and ecological potencies.



Runhaar, Groen et al. (1987)

Fig. 717 *Ecological groups*

Fig. 717 below shows which ecological groups made progress in the last century and which declined. It is clear that oligotrophe groups declined substantially[38].

Ecological groups classified by directly working conditions

This subdivision restricts itself to conditions directly working on plants like sunlight, moist and acidity. It avoids taking into account underlying causes like soil type and water management complicating this classification. These are important factors estimating the impacts of technical interventions indeed, but they are originating in very different ways from higher levels of scale.[39] For example, salty or brackish groups could not only be caused by surface water but also by seepage. Seepage on its turn can cause very different vegetations dependent on its chemical composition. Keeping classification as close as possible to the plant, the number of subdivisions and their presupposed explanation is limited. Moreover, the difference between ecotope and vegetation fades away and classification concerns both.

A hierarchy in classification

The used characteristics show a certain hierarchy by which a higher characteristic may not have to be subdivided further. For example within salty and brackish environments salt proportion (salinity) is so dominant that no further subdivisions into nutriciousness are necessary. On the other hand lower characteristics like soil spray (st) do not always have to be added to higher characteristics.
Moreover, hierarchy could cause different definitions of lower characteristics depending on current higher characteristics. For example the degree of acidity in water depends strongly on its proportion of bicarbonate (HCO_3^- ions as buffer against acidification). On land other buffers are active. So, by distinguishing land and water vegetations first you can combine both buffer systems in the concept of acidity without losing their distinction but without explanation of causes[40].

Main classification in water, wetland and land vegetations

This classification distinguishes primarily water (W), wetland (V) and land vegetations in freshwater (if heavily loaded by organic pollution marked by ‘sa’, brackish (b) and salty (z) environments). Land vegetations are subdivided further according to succession stages of pioneers (P), grass land (G), brushwood (R), and forest (H), all of them subdivided in wet (2), moisty (4) and dry (6).
Then a distiction is made according to different degrees of nutriciousness from poor (oligotrophe) to rich (eutrophe). Within rich groups acidity does not make much sense, but within poor groups it is essential because it regulates the availability of present nutrients. In acid conditions existing organic material can not be digested by any organism (pickled gherkins, dead bodies in peat).

More sp/ecific indexed vegetations

Other subdivisions are indicated by indexes. Wall vegetations (Fig. 718) like procumbent pearlwort (sagina procumbens, liggende vetmuur), yellow corydalis (pseudofumaria lutea, gele helmbloem) or ivy-leaved toadflax (cymbalaria muralis, muurleeuwebek) get the index ‘mu’. Within moderately nutricious environments pioneer and grass land vegetations can get the index ‘kr’ to indicate lime. Pioneer vegetations can get indexes like ‘st’, ‘ro’ and ‘tr’ to indicate soil spray, digged and treaded soil, often present in towns.

Some examples of coding ecological groups

For example treaded soil is densified and relatively unaccessibe by water and air. Some plants are specialised to such conditions. So, on pathways you will find well known P48tr plants (Fig. 718) like plantain (plantago maior, grote weegbree), shepherd's-purse (capsella bursa-pastoris, gewoon herderstasje), knotgrass (polygonum aviculare, gewoon varkensgras), annual meadow-grass (poa annua, straatgras) or pineapple weed (matricaria discoidea, schijfkamille)[41].

procumbent pearlwort P40mu

yellow corydalis P40mu

ivy-leaved toadflax P40mu

plantain P48tr

shepherd's-purse P48tr

knotgrass P48tr

annual meadow-grass P48tr

pineapple weed P48tr

Meijden (1999)

Fig. 718 *Some wall and tread plants well known in urban areas*

Plants indicating an ecological group

Most plant species appear in different ecological groups simultaneously. Plants appearing in many ecotopes can live in many conditions, they have a wide ‘ecological tolerance’ and are less appropriate as indicators of specific conditions. Runhaar, Groen et al. (1987) distinguish two classes of tolerance. Class 1 occurs in one or two very related ecotopes only; class 2 occurs in more types. Best indicators live in one ecotope only (class 1), but they are often rare and difficult to recognise by laymen. So, to recognise an ecotope you can best identify several species living together indicating the same ecotope. The wider the tolerance the more species you have to identify to be sure about the ecotope[42]. In the ecotope system a species is classified in as many ecological groups as necessary to explain 2/3 of its presence. If species would be classified to all accidental ecotopes they ever were found the classification would be little specific.

Less specific indicators

To filter out less specific ecological groups taking up a major part of The Netherlands the classification calculates all ecotope types back to the same surface. For example sweet vernal-grass (anthoxanthum odoratum, gewoon reukgras) appears optimally in poor grass lands (G22, G42), but in a lower abundance and coverage also in more nutricious grass lands (G27, G47). However, nutricious grass lands are very common in The Netherlands and poor grass lands are rare. The consequence is sweet vernal-grass occurs most in nutricious grass lands in spite of its preference for poor grass lands. By departing from relative occurrence per ecotope type commonness of nutricious grass lands plays no rôle in classification.

5.2.10 3m symbiosis and competition

Dependencies

Most animal species are location bound by their dependency on specific plant species. That is why we primarily concentrate on plants. For example the large copper butterfy (lycaena dispar, grote vuurvlinder) feeds only from june until half august on its host plant loosestrife (lythrum purple, kattestaart) and lays its eggs only on its breeding plant a water dock (rumex hydrolapathum, waterzuring) in weak condition (a healthy specimen defends itself against damage by insects). This typical combination is found in The Netherlands in peat counties between Friesland and Overijssel only. So, large copper butterfy is rare in The Netherlands.

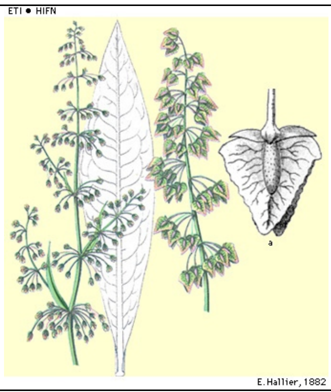
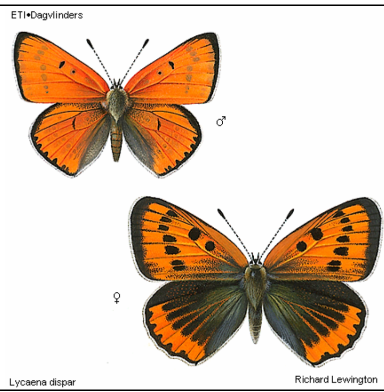
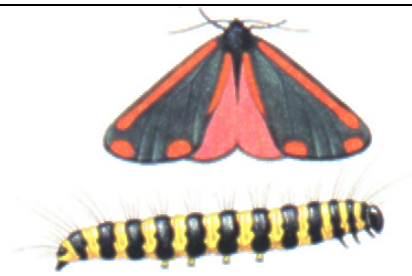
		
Meijden (1999)	Halder, Wynhoff et al. (2000)	Meijden (1999)
water dock (waterzuring) V18,V19	*large copper butterfy (grote vuurvlinder)*	*loosestrife (kattestaart) R27,R28, H27,H28,V17*

Fig. 719 *Symbiosis of copper butterfy with breeding and host plant*
Interactieve ETI CD-ROMs Heukels flora en vlinders

An other example of specific dependency is a common night butterfly tyria jacobaeae (jakobsvlinder, Fig. 720) laying its eggs on common ragwort (senecio jacobaeae, jakobskruiskruid).



Chinery (1988)

Fig. 720 *Tyria jacobaeae and its breeding plant common ragwort on the roof of the faculty*

Common ragwort is very poisonous except for Tyria jacobaeae's caterpillar. It stores the poison. So, the caterpillar and the butterfly are poisonous for their enemies.

Rare plants on poor grounds

If presence or digestibility of minerals are a limiting factor, only rare specialists can survive. By manuring exactly these rare species loose competition of common and fast growing species. A nutricion poor environment not only selects rare species but also diminishes defence of plants. Weak plants are better digestible by herbivores and insects. One often recognises rare vegetation by a multitude of insects and their predators like birds.To avoid leakage of catched ions on poor grounds plants build cholesterol in their membranes instead of sitosterol. However, sitosterol makes cell walls stronger and plants less digestible by herbivores (from cow to caterpillar). Where less herbivores survive the ecosystem supports less species.[43] Cows on a richly manured meadow bend as far as they can over the fence to eat grass from a neighbouring unmanured meadow, leaving the manured grass uneaten. A farmer gladly puts an ill cow on an unmanured meadow.

Salt and acid diminish digestibility of minerals leaving space for specialist plants and peculiar ecosystems. Soured forests are rich in parasites. The abundance of great titmouses increased in soured forests though they suffered lack of calcium. Their eggshells became thin[a].

Plants and insects

The relation of every Dutch plant species with animals - particularly insects – is described in Weeda, Westra et al. (1985); Weeda, Westra et al. (1987); Weeda, Westra et al. (1988); Weeda, Westra et al. (1991); Weeda, Westra et al. (1994) . The autoritive Meijden (1996) (see Fig. 672) refers to this publication naming volume and page.
The question how animals recognise 'their' plants depends on perception of smell, colour and form. The recognisability of plants for their matchmakers, the insects, culminates in their reproduction organs, their flowers. The question how pistils recognise 'their' pollen is a vast area of mircoscopical research. Fertilisation requires coordination in space and synchronisation in time between plant and animal.

Small populations at risk

After the problem of fertilisation the problem of seed dispersion follows. These problems occur on different levels of scale. Topographic, demographic and genetic isolation of populations decreases genetic biodiversity and increases risk of dieing out. On a minimum population area after 50 generations 10% of genetic material may be left, decreasing adaptability and probability of survival. Genetic deterioration becomes a big problem. A minimum population area is not sufficient for conservation of genetic variation and impels making gene banks of threatened species.

Connections between populations

This is an important subject for nature conservation and spatial planning. The Dutch Nature conservation plan LNV (1990) and its succesors stimulate a main ecological infrastructure (EHS, see paragraph 5.5.1) to connect important natural areas by corridors for genetic exchange. This is more important for mammals and reptiles than for birds, insects and plants. However, for mammals and plants narrow corridors are very species-specific. Depending on their lay-out they work for one species and not for other ones. For plants - the basis of any food chain - isolation could even be preferable to avoid invasion of fast growing common species. Rare species often grow and disperse slowly. So, ecological infrastructure will haven little favourable botanical impact and sometimes even negative[44]. For vegetation local diversity is a better investment than connections.

5.2.11 30cm individual strategies for survival

According to Grime, Hodgson et al. (1988) plants have three differerent strategies for survival:[45]

1 growing fast, reproduce and evacuate ("ruderals" like chickweed, stellaria media, vogelmuur);
2 develop competition power, then reproduce ("competitors" like rosebay willowherb, chamerion angustifolium, wilgenroosje);
3 endure difficult circumstances other species avoid and reproduce when possible ("stress-tolerators" like cowslip, primula veris, gulden sleutelbloem)

Growing fast or slow

Cickweed can produce seed a fortnight after gemination. It is record-holder of Dutch plants in that respect. The rosebay willowherb goes up fast to compete with other plants, but can weaken by shortage of minerals and fall down. The cowslip is a specialist surviving in circumstances other plants do not.

[a] "Koolmees zwelgt in verzuurde bossen", Bio Nieuws nr. 5, 22 november 1991.

ruderal

Chickweed (vogelmuur)
P48,P68

competitor

Rosebay willowherb (wilgenroosje)
R47,R67, H47,H62

stress-tolerator

Cowslip (gulden sleutelbloem)
G43,G47kr,H43,H47

Meijden (1999)

Fig. 721 Three strategies for survival according to Grime (1988)

Ruderals are found in newly occupied areas (pioneer stage, see Fig. 730), stress tolerators in developed ecosystems (climax stage) with less minerals.[46] Agricultural activity aims at fast growing crops like ruderals and competitors. So, human impact is often not in favour of stress-tolerators. Stress-tolerators are often protected plants.[47]

5.2.12 Identifying plants species

Naming

Identifying plants to find a biological genius loci of the location and its rarity is a difficult job for laymen. However, on http://team.bk.tudelft.nl clicking 'databases' you will find an extract from Duuren (1997) CBS Biobase containing all wild plants of The Netherlands with many characteristics. You can sort this Excel sheet on any characteristic. Fig. 722 shows the first four columns. The sheet is currently sorted on occurrence of urban wild species in the urban area of Zoetermeer. Wild parsnip occurs in nearly any km^2 of the town.

Species number	Scientific name	English name	Dutch name
000922	Pastinaca sativa	Wild Parsnip	Gewone pastinaak
000101	Artemisia vulgaris	Mugwort	Bijvoet
000135	Bellis perennis	Daisy	Madeliefje
000188	Calystegia sepium	Hedge Bindweed	Haagwinde

Fig. 722 *First columns of Biobase extract on Excel sheet*

Primary identification criteria

By next 17 (yellow or grey headed) columns (Fig. 723) you can make your own rough selection to identify plant species quickly. Suppose you find a herb (Growth form = kr) without prickles growing up to your middle flowering in august. Wild parsnip (000922) will appear somewhere in your selection.

Species number	Growth form	Prickles	Until knee (<50cm, low)	Up to middle (<100 cm)	Above middle (>1m, high)	January	February	March	April	May	June	July	August	September	October	November	December
000922	kr			1								1	1	1			
000101	kr			1	1							1	1	1			
000135	kr		1						1	1	1	1	1	1			
000188	lk				1						1	1	1	1	1	1	1

Fig. 723 *First identifying characteristics of Biobase extract on Excel sheet with rows of* Fig. 722

If you like to identify a tree you should choose 'bo' as growth form. You also can choose grass like (gr); bush or shrub (st); dwarf shrub (dw); woody liana (lh); herby liana (lk) and epiphyte, which is a plant growing on other plants (ep).

Secondary identification criteria

If your selection is still too large you can select further on leaf form and flower colour (Fig. 724).

Leaf season	Leaf form	Calyx / kelkbladen	Petals / kroonbladen	Flower colour	Second flower colour	Pistils / stampers / stijlen	stamens / meeldraden	Sex / geslacht bloem	pollination / bestuiving	Seed form	Fruit type / vruchttype	Fruit colour / vruchtkleur	Light minimal	Light maximal	Moist minimal	Moist maximal
Z	5		5	F		2	5	C	IC	9	41	o	LS	VL	3	3
Z	6			F	B	1	5	D	IH	1	32	o	LS	VL	3	4
W	3			A	F	1	5	D	I1	1	32	o	LS	VL	3	3
Z	4			A	R			C	IH	1	43	o	HS	L	2	3

Fig. 724 Second identifying characteristics *of Biobase extract on Excel sheet with rows of* Fig. 722

Some plants keep their leaves in winter (W), most have leaves in summer only (Z). You can not rely fully on leaf form or flower colour because one plant may have different leaf forms or colours simultaneously. If you doubt you can select two characteristics simultaneously chosing 'or'. Fig. 725 shows used codes for leaf form with proportion of length (L) and width (W), colour, required light and moist.

leaf form	colour	sex	light	moist
1 line L>10W 2 lancet 3W<L<10W 3 elongated 2W<L<3W 4 (nearly) round B<L<2B 5 hand (compound or not) 6 feather 7 compound feather	A = white B = brown C = blue F = yellow G = grey H = colourless M = multicoloured N = back O = without flower P = purple, violet, lila R = red, rose U = orange V = green	A = monoecious B = dioecious C = herma-phrodite D = polygamous E = spore plant	VL = full sun L = light LS = light shadow HS = half shadow S = shadow VS = full shadow	1 = aquatic 2 = wet 3 = moist 4 = dry

Fig. 725 *Codes used in second identifying characteristics from Fig. 724*

The orange or dark grey heads of columns in Fig. 724 are not very useful for identification, they give characteristics to check your selection.

Environmental information derived from plant species

After identifying plant species next 16 columns give interesting information about the environment (Fig. 726). The last row of Fig. 726 shows community type according to Westhoff and Den Held from Fig. 715. The ecotope columns show the code from Fig. 717 *Ecological groups*. Inbetween these columns their classes of tolerance discussed in paragraph 5.2.9 are shown.
The last columns show additional characteristics summed up in Fig. 728.

Food minimal	**Food maximal**	**Acidity**	**Salt minimal**	**Salt maximal**	**Zinc**	**Groundwater**	**Root depth**	**Root depth 2**	**Flow maximum**	**Flow minimum**	**Ecotope 1**	**Ecotope 2**	**Ecotope 3**	**Ecotope tolerance**	**Community Westhoff**
2	3	x				7	3	4	9	9	G47	G48		1	25Ba01
3	3	x				7			9	9	P48	P68	R48	2	17Aa01
2	3	x				9	1	1	9	9	G47	G48		1	25Ba
2	3	x				5	4	4	9	9	R27	R28	R47	2	17B

Fig. 726 *Environmental information derived from plant species*

nutrients	acidity	salinity	dependency ground water	root depth	water flow
1 = poor 2 = moderate 3 = nutricous x = indifferent	1 = acid 2 = moderate 3 = alkaline x = indifferent	0 = fresh 1 = between 2 = brackish 3 = between 4 = salt	1 = hydrofyt 2 = wet freatofyt (obligatory) 3 = moisty freatofyt (obl.) 4 = moisty freatofyt (fac.) 5 = local freatofyt 6 = lime afreatofyt 7 = afreatofyt 8 = salt plant 9 = dune freatofyt	1 = < 10 cm 2 = < 20 cm 3 = < 50 cm 4 = < 100 cm 5 = > 100 cm	0 = unknown 1 = stagnant 2 = slow 3 = streaming 4 = fast 5 = very fast 9 = no sense

Fig. 727 *Codes used for environmental information in columns of Fig. 726*

Additional characteristics per plant species

Column head	description
Height belt / hoogtegordel	typical height belt of species
Areal position / areaalligging	position in European dispersion
Use 1 / gebruik 1	agricultural or herbal use
Germinating time / kiemtijd	month when growth starts
Life span / levensduur	1, 2, 3 or more years
Family Heukels' flora	page number in authoritative Dutch flora of Fig. 672 and Fig. 678
Genus Heukels' flora	subdivision of preceding family
Species / soort Heukels' flora	subdivision of preceding genus
UFK_1940	occurrence in The Netherlands in 1940 per $5x5km^2$
UFK_1990	occurrence in The Netherlands in 1990 per $5x5km^2$
Protection rode lijst	member of Dutch list of rare and declining plant species
Protection Natuurbeschermingswet	protected by Dutch law
Protection EHS doelsoort	target species in Dutch ecological policy (see paragraph 5.5.1)
Protection Bern Convention Protection	protected by European law
European blue list	member of European list of rare and declining plant species
Change in the Netherlands since 1950	Difference between UFK_1940 and UFK_1990
Abundance per 25km2 1980	Number of $5x5km^2$ squares species was found in The Netherlands 1980
Abundance per km2 Zoetermeer	Number of $1x1km^2$ squares species was found in the urban area of Zoetermeer 2000
Buytenwegh 2002 305723/24	found in the urban area of a $2x1km^2$ district of Zoetermeer 2000

Fig. 728 *Additional characteristics per plant species*

For example Fig. 768 used columns Abundance per 25km2 1980 and Abundance per km2 Zoetermeer to compare national and local rarity in a graph.

5.2.13 References to Diversity, scale and dispersion

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5.3 Ecologies

5.3.1 Generalisation

Generalisation is dangereous, especially if small differences can produce great effects. That is the case in ecology. Biodiversity between species and between specimens within any species is multiplied by the number of contexts they live in. And the physical and social context of any location is different from any other location because every location is unique if only because of its location between the other locations of the Earth's surface. That diversity is a risk cover for life. But there are different differences. Some of them we call 'equality'. Equality is the basis of expectations. The ecological expectations of our common future are gloomy. However, our imagination covers more than expectations, it opens up possible futures as well as probable ones. The modality of possibility requires an other way of reasoning than probability.

In the advanced technology of pattern recognition the emphasis on similarity shifts into a focus on dissimilarity (Pekalska, 2005). Following that track broadens the view into unexpected, improbable possibilities, opened up by difference. Differences are observable at boundaries. So, it's worth the effort to study boundaries rather than homogeneous areas. They determine the areas, not the reverse. Perhaps it produces cross-border insight.

5.3.2 Six kinds of ecology

Besides autecology and synecology we know environmental science emphasising human society and health, cybernetic ecology emphasising space-time relationships, system dynamics ecology stressing abiotic points of departure and chaos ecology stressing unpredictability from minor earlier events. Their approach and terminology differ substantially:

	naming abiotics	**naming biotics**
environmental science	environment	human society
autecology	habitat	population
synecology	biotope	life community
cybernetic ecology	abiotic variation	biotic variation
system dynamics ecology	ecotope	ecological group
chaos ecology	opportunities	individual strategies for survival

Fig. 729 *Ecologies*

The sequence in this summary may reflect a decreasing human centred approach as we ask from urbanists on their way from environmental scientists into designers of biotope cities or even further. In that perspective of urban ecology, it is important to understand the differences to avoid debates that paralysed thinking about nature policy in the Netherlands for years.

Jong (2002) describes in her thesis the strikingly separated Dutch development of the last four categories in Fig. 729 during the 20th century. The clearest controversy - between the 'holistic-vitalistic' synecology and the 'dynamical' systems ecology - represents a beautiful example of spatial dispersion in one species causing scientific diversity. Synecology primarily developed in the Catholic University of Nijmegen (Westhoff) extending to Wageningen University of Agriculture in the higher East of The Netherlands while 'dynamic' ecology originated from the National University of Leiden (Baas Becking, Odum) in the wet lower West area.

System dynamics

	PIONEER	CLIMAX
Energy		
Net production	high	low
Food chains	linear	web
Community structure		
Total amount of organic material	small	large
Inorganic nutrients	extrabiotic	interbiotic
Species diversity	low	high
Spatial diversity	low	high
Life characteristics		
Niche specialisation	wide	narrow
Sizes of organisms	small	large
Life cycles	short, simple	long, complex
Nutrient cycles		
Mineral cycles	open	closed
Nutrient exchanges	fast	slow
Reuse	unimportant	substantial
Selection pressure		
Growth strategy	fast	controlled
Production	quantity	quality
Homeostasis		
Symbiosis	undeveloped	developed
Nutrient conservation	small	substantial
Coicidence	high	low
Information	little	much

Odum (1971) page 252

Fig. 730 *System dynamic stages*

5.3.3 Scale classification

A number of scale classifications summarised by Haccou, Tjallingii et al. (1994), Klijn (1995), Kolasa and Pickett (1991) preceded Fig. 731. Such a classification is required to weigh rarity, replacebility, potential of territory and planned human artifacts. The biological nomenclature is less articulated than the urbanistic as yet, but it proceeds to smaller measures. That is why we fill the gaps by abiotic nomenclature as coincidentally larger frames of smaller biotic components to get comparable urban units (3km radius towns, 1km districts, 300m neighbourhoods and so on). So, we consider the earth to be subdivided in biomen, a continent in areas of vegetation, a geomorphological unit in flora counties, a formation in landscapes, a hydrological unit in communities described by Westhoff and Held (1969) and Meijden (1996), a soil complex ecological groups described by Runhaar, Groen et al. (1987) and Meijden (1996), a soil unit or its structural parts by cooperating or competing organisms. In passing ecologies of different focus get their own level of scale supposed to be optimal for their application. However, this supposition is still arbitrary.

Territorial and taxonomic classification

The synecological classification of communities and the system ecological classification of ecological groups have their own levels of scale but their intention is more taxonomic than territorial. So, biotic components have a larger scale span than the scale classes employed here to be comparable with urbanistic classes of smaller span. Synecological ‘classes’ can take up kilometres, their subdivisions in ‘orders’, ‘unions’ and ‘associations’ metres. An ecological group (see Fig. 717) like P48 (pioneer vegetation on moisty, very nutricious soil) can have a radius of 1km, but a vegetation P40mu (on moisty walls) could be restricted to 100mm. An example of large scale span on species level is known from fungi. Some of them are the largest organisms on Earth, their mycelium extends to hunderds of metres.

Ecologies per scale

However, to be able to compare different locations we keep up these names with the supposed modal size (30m for ecological groups) as nominal measure.

nominally	abiotic frame	nominally	biotic components	ecologies
kilometres radius				
10000	earth	3000	biomen	Geography
1000	continent	300	areas of vegetation	
100	geomorphological unit	30	flora-counties	
10	landscape	3	formations	landscape ecology
metres				
1000	hydrological unit, biotope	300	communities	synecology
100	soil complex, ecotope	30	ecological groups	systems ecology
10	soil unit, boundaries	3	symbiosis and competition	cybernetic ecology
millimetres				
1000	soil structure and ~profile	300	individual survival strategies	autecology
100	coarse gravel	30	specialization	biology
10	gravel	3	integration	
1	coarse sand 0,21-2	0.3	differentiation	
micrometres (μ)				
100	fine sand 50-210	30	multi-celled organisms	microbiology
10	silt 2-50	3	single-celled organisms	
1	clay parts < 2	0.3	bacteria	biochemistry
0,1	molecule	0.30	virus	

Fig. 731 *Ecological units*

Fig. 731 is a preliminary and rough attempt to name abiotic and biotic components by scale. Any level of scale has its own nameable diversity and dynamics. It has to be discussed, elaborated and renamed by ecologists more precise. Perhaps different approaches in ecology appear to have their own level of scale, accessible to designers giving measure to the urban context on that scale.

On different levels of urban scale we could need different approaches; for example:

- R=300m Communities in biotopes
- R=30m Ecological groups in ecotopes
- R=3m Symbiosis and competition
- R=30cm Individual survival strategies

5.3.4 Cybernetics

This paragraph[a] discusses the one-sidedness of an emphasis on ecological connections in nature conservation and spatial planning. It traces back the track of Dutch nature conservation thinking, into the typical Dutch ecologist Van Leeuwen stressing separations to restore the balance.

The emphasis on boundaries apart from areas

As a student at the Faculty of Architecture in Delft my favourite lectures were those of architect Aldo van Eijck and ecologist Chris van Leeuwen.

[a] Based on a lecture for the Dutch-Flemish association of ecology NECOV 2005-01

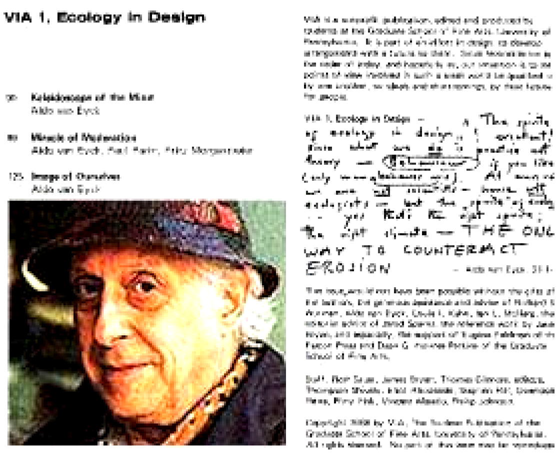


Fig. 732 Aldo van Eyck *(Eyck, 1986)*

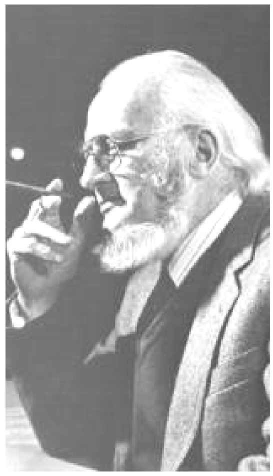


Fig. 733 Chris van Leeuwen *(Schimmel, 1985)*

Both emphasised the boundaries between spaces instead of the character of the spaces intself. 'The boundary makes the difference; that's where it happens' they argued.
After all, the task of urban and architectural designers is to draw boundaries. Designers cannot do much more than drawing boundaries to make spaces visible and usable.

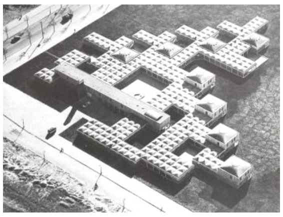


Fig. 734 Van Eyck (1955-1960) Burgerweeshuis (Amsterdam) (Ligtelijn, 1999)

Fig. 735 Van Eyck (1965) Sonsbeek paviljoen (Arnhem) (Ligtelijn, 1999)

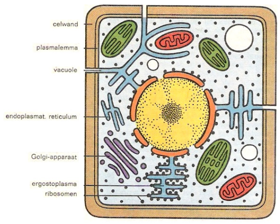


Fig. 736 The cell and its membranes (Vogel; Günter; Angermann and Hartmut, 1970) page 18)

In the seventies Aldo van Eijck could give a lecture without a break for six hours on only a few images from Mali reporting his experiences of Dogon architecture (A.E.v. Eyck, et al., 1968). The Dogon live at a spectacular landscape boundary. Nobody wanted to miss his rare and fascinating lectures and nobody in the overcrowded classroom was bored for one moment by his humorous and furious criticism of Western culture.

Inbetween realms

I remember an image showing the entrance of a hut with thick walls. The entrance had the form of a tree or fungus. So, you could sit in this boundary environment without being forced to choose between inside or outside. You got coolness from the shade or warmth from the sun simply by changing position. Van Eijck called such locations not forcing us to choose 'in between-realms' or 'twin phenomena'. He reproached our culture for forcing choices between false alternatives: "Would you like to breathe in or out?".

Fig. 737 An entrance as a seat: a 'twin phenomenon' or 'in between realm'

Van Leeuwen

The emerging environmental awareness of the seventies made the lectures of Van Leeuwen popular as well. Many remember them. Shortly before his death he attended a conference dedicated to his work (D.J. Joustra, et al., 2004), organised by former students in urbanism and architecture. However, the speeches of that conference showed very different applications, (especially in the field of urban renewal) based on vague interpretations contrasting with Van Leeuwens own usual precision.

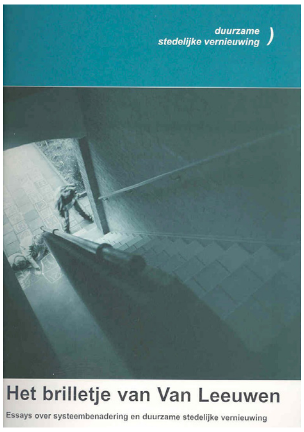


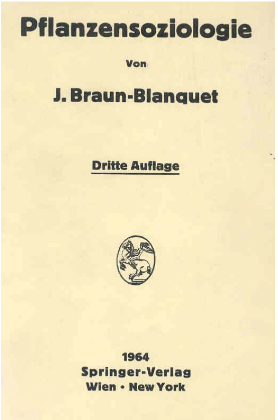
Fig. 738 Conference 2004 (D.J. Joustra, et al., 2004)

Fig. 739 Van Leeuwens references (Ross Ashby, 1957, 1965; Bateson, 1980, 1983)

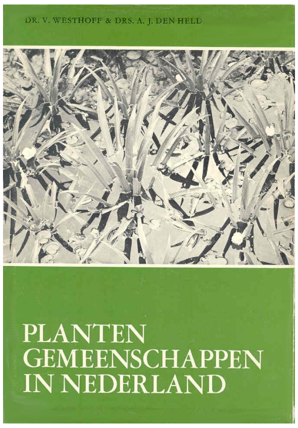
He knew the outdoor nature like no one else, but at the same time he was an armchair scholar, writer of many dispersed articles and lecture notes (C.G. van Leeuwen, 1971) surprising colleagues and fascinating designers.

Open-closed theory

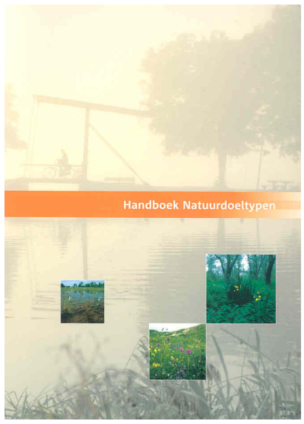
His 'open-closed theory' (Leeuwen, 1964) was the subject of dispute with his friend and close colleague Westhoff from the University of Nijmegen at the former national institute of nature conservation (RIN). Westhoff, et al. (1975) developed according to Braun-Blanquet (1964) a Dutch synecological system of life communities now elaborated by his successor (Schaminee, et al., 1995) and translated to nature target types (Bal et al., 2001) applied in the actual policy of the Dutch ecological network (NEN). However, that operational approach now loses foundation in the perspective of climate change.



Source:
Fig. 740 Braun Blanquet (J. Braun-Blanquet, 1964)



Source:
Fig. 741 Westhoff's synecology… (Westhoff, et al., 1975)



Source:
Fig. 742 …translated into Dutch nature target types (Bal, et al., 2001)

Van Leeuwen made field inventories himself for many years. Based on that experience he emphasised transitions between such supposed life communities rather than determining the communities themselves (Leeuwen, 1965). Precisely there he saw most rare species, especially if such a transition was spun out along a broad strip (gradient) into an infinite range of unnamed particular environments on a smaller scale. There the ecologically most interesting specialists settled.

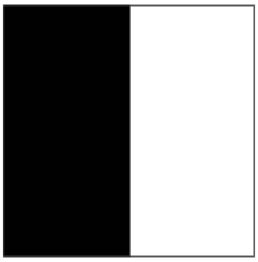


Fig. 743 Limes convergens

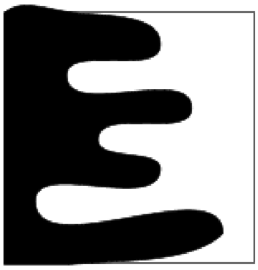


Fig. 744 Boundary rich

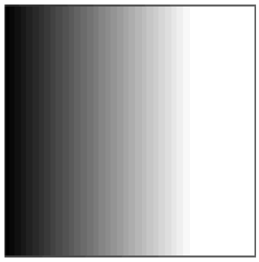


Fig. 745 Limes divergens (gradient)

Gradient map in national planning

This line of thought was the guideline of the Dutch Second National Policy Document on Spatial Planning (RPD, 1966), by which Van Leeuwen's 'Gradient map' was published (see *Fig. 746*).

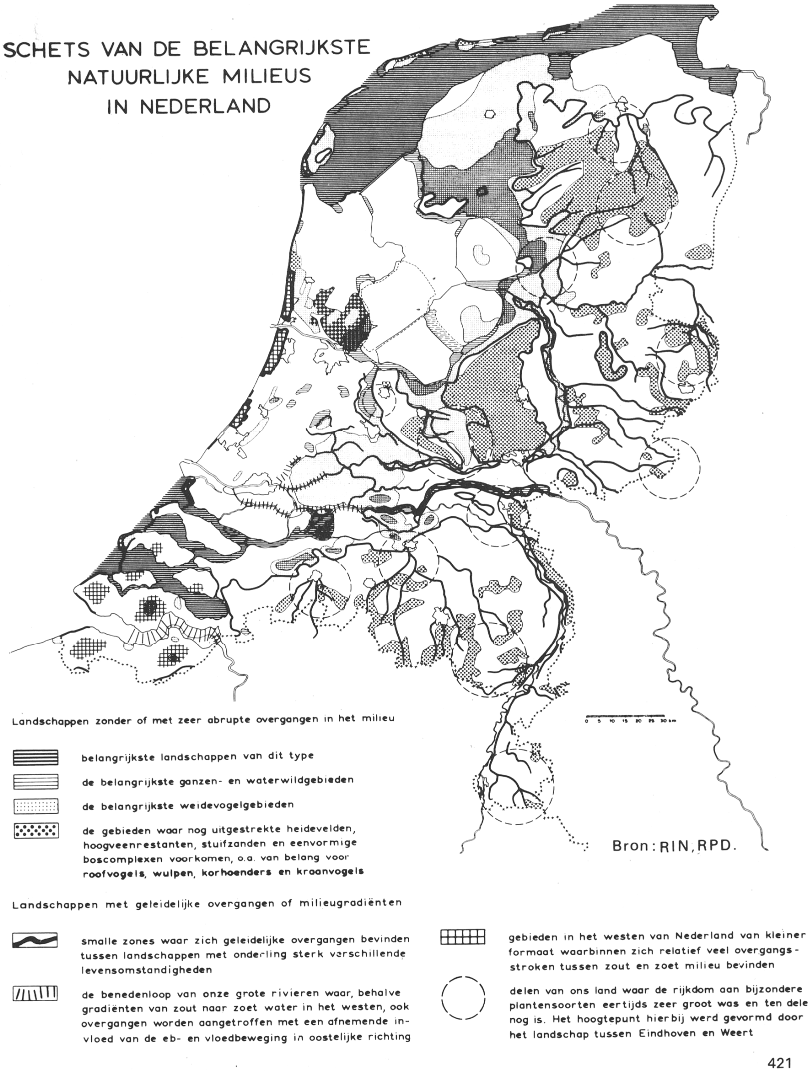


Fig. 746 'Gradient map' in the Dutch Second National Policy Document on Spatial Planning (Leeuwen, Gradientenkaart RPD, 1966)

Citing RPD (1966) :'Gradients are narrow zones with gradual intermediate stages between landscapes with mutual strongly different life circumstances. Examples are contact zones between salt and fresh water environments, between relatively dry and wet areas, between poorly and richly nutricious landscapes and slopes in high areas. Within or directly near these gradual zones one finds a great gradation of environmental types in small compass and as a result a large richness of plant and animal species. To this richness belong nearly all rare plant species in our country. Moreover, here are the regions where in the Netherlands natural edge of wood thickets can develop.
Furthermore, the 'conservative' character of these transitional environments is typical. This assures continued existence of species concerned at these locations, subject to not disturbing the transitional environment fully by changes caused by modern agricultural methods.'

Van Leeuwen surprised colleagues by predicting the square metre where a specific rare plant species could be found. For example I witnessed him when he was already at an advanced age looking around and indicating the place where the Carex pulicaris ('flea sedge', 'vlozegge') should grow. However, the manager of the area never found that species on his territory. The bystanders went on their knees and found the predicted flea sedge. Van Leeuwen did it intuitively, based on 'phenomenal' field knowledge.

5.3.5 Regulation theory

Relation theory

However, Van Leeuwen could not record that experience in writings otherwise than by sketching a very theoretical framework known as 'relation theory'. That theory is dispersed in many articles and elaborated in different separate directions, always surprising by unexpected relations between 'down to earth' examples. It led to his being made an honorary doctor of the University of Groningen (1974), but the same University published a doctoral thesis judging that theory to be invalid on mathematical grounds (Sloep, 1983). However, the same critique applied also to other ecological theories not studied by Sloep. Opposite that most readers and certainly listeners got the feeling of a crystal-clear and simple framework, relevant to many questions concerning design, spatial planning, urban renewal and nature conservation. At last Van Leeuwen agreed to name his theoretical framework more precisely 'regulation theory', according to his cybernetic references of steering and disturbing.

Spatial and temporal variation

One of the first schemes I remember from Van Leeuwen's lectures shows some basic notions of that theory (see *Fig. 747*). Firstly it shows the possibility of a negative relation between pattern and process in ecosystems in terms of spatial and temporal variation. So, in general difference correlates to stability (often found near vague boundaries), equality to change (often found near sharp boundaries). However, I realised many years later this rule cannot be applied on any level of scale if you take the scale paradox (see Fig. 814) into account.

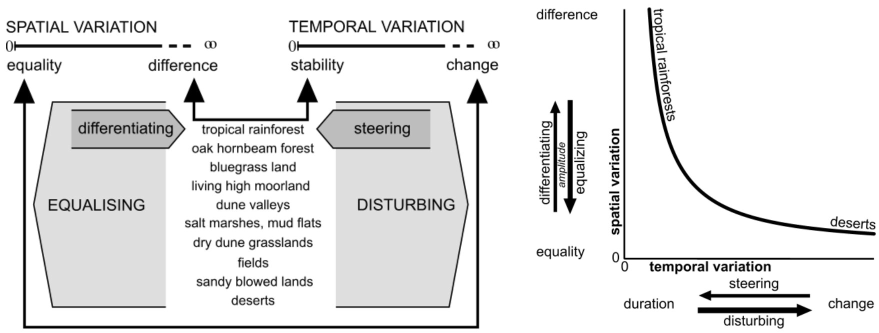


Fig. 747 Spatial and temporal variation in the theories of Van Leeuwen
(author, derived from the lectures of van Leeuwen in 1972)

According to Ross Ashby (1957, 1956) 'equality' is not regarded as the opposite of 'difference' but as its near-zero-value. After all, any imagined difference can always be made more different by adding attributes of difference (for instance difference of place, distance), but it cannot always be made less different. A difference less than the least difference we can observe or imagine is called 'equality'. So, 'difference' and 'change', 'equality' and 'stability' in the scheme are all taken as values of 'variation' (the variable to be distinguished spatially and temporally).

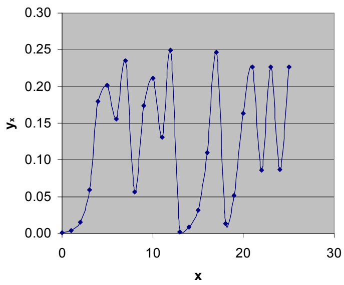


Fig. 748 Chaotic behaviour of $y_{x+1}=a\cdot y_x-(a\cdot y_x)^2$ where $y_0=0.001$ and a = 4

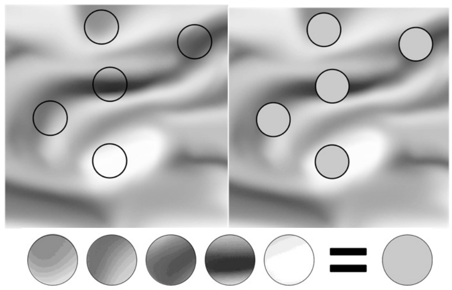


Fig. 749 Reduction to the average

To concern equality as a special kind of difference is contrary to the main presuppositions of usual mathematics, the science of equality (you cannot count different categories) and equations. However, chaos equations like $y_{x+1}=a\cdot y_x-(a\cdot y_x)^2$ where a>3.6 produce chaotic behaviour even different on different computers using different roundings off (see *Fig. 748*).
The same applies to very small differences of initial values in complex models producing very different results.
The main problem is, mathematical treatment of quantities presupposes qualitative categorisation reducing differences to an 'average' (see *Fig. 749*), tacitly supposed in set theory.

Disturbing and steering

Proceeding that way, Van Leeuwen supposed processes of a second order on both pattern ('process on pattern') and process ('process on process') called 'differentiating' and 'steering' with 'equalising' and 'disturbing' as zero-values (see the grey arrows in left *Fig. 747*). Because these processes are changes as well, they are disturbing and equalising by definition. Stopping a process of disturbing is disturbance as well. Suddenly cleaning a ditch or decreasing the number of grazers could deteriorate the condition of the ecosystem unexpectedly. The consequence of this view appeared to be a recommendation not to change the condition too sudden: clean the ditch or decrease the number of grazers slowly according to the adaptation speed of the system.

So according to Van Leeuwen it is easier to break down differences (equalising) then create them (differentiating) and at the same time it is easier to introduce changes (disturbing) than to guarantee duration (steering). This is a simple verbal expression of the second law of thermodynamics in the perspective of cybernetics. Within that interpretation 'life' is represented as a phenomenon climbing up into local diversity and duration at the cost of global disturbance located elsewhere.

5.3.6 Separation and discontinuity

Second order patterns and processes

Regulation theory became more complicated as soon as Van Leeuwen started to look for a second order of *patterns* as well: 'pattern on pattern' ('structure', ranging from 'separation' causing difference, into its zero value 'connection' causing equality) and 'pattern on process' ('dynamics', gradual ('continuity') or sudden ('discontinuity') changes and stops, causing stability or change). Later I realised distinguishing levels of spatial and temporal scales might simplify the argument and put it into perspective. Perhaps the primary supposition about a negative relation between pattern and process is limited to certain levels of scale explaining exceptions. Perhaps concepts like 'pattern on pattern' are simply a question of scale. 'Difference' is a scale sensitive concept after all (see Fig. 814). Moreover, difference, equality, separation and connection are direction-sensitive.

Ligitimate questions

Anyway, many legitimate questions remain. I will summarise some, but not answer them here. The very first question is: "Is this science?". How could you make categories as general as difference and change or separation and connection operational for tests by empirical research? Should you not distinguish different kinds of difference (for example abiotic, biotic differences, differences observed on different levels of scale) to find mutual relations? What causes what? Are the second order variations dominant? Does separation cause difference or the reverse? How could you imagine separation without difference?

Elaborating these questions you come across fundamental epistemologic questions similar to those I know from the debate about academic design (Jong and Voordt, 2002). They go beyond critics like those of Sloep because equality itself is disputed. Consequently the use of categorisation presupposed in any variable is attacked. The very core of that debate in practice is the question how to generalise solutions of context-sensitive problems bound to specific unique locations and contexts. That question applies to ecology as well, confronted with a confusing diversity of species multiplied by a diversity of specimens and contexts. Management theory also struggles with the inapplicability of reduction into the 'average' (see *Fig. 749*) from empirical science (Riemsdijk, 1999).

From a designer's point of view many design decisions in specific contexts cannot be supported by empirical research aiming at generalisation. "That conclusion does not apply to this specific location!" designers complain. Van Leeuwen's approach offered a terminology directly fitting to design acts par excellence: separating and connecting. It functioned as a great heuristic tool, but many applications fell prey to confusion of scale by lack of scale articulation. Let us now go back to ecological practice.

Meadowland as a fringe laid out

Shortly before his death Van Leeuwen offered me a clarifying example.
Between meadowland and forest in natural circumstances a fringe emerges through herbivore grazing (see *Fig. 750* and *Fig. 751*).

These animals mow with their long necks over the boundary of their reach without treading or manuring (floating head). By doing so, they create prototypes of meadowland. In meadowland (a fringe laid out) without manuring, mowed without treading of note ('hooiland', an alternative etymology of 'Holland') you find species like Serratula Tinctoria ('saw-wort', 'zaagtand') not to be found elsewhere. Species rich steppe grasslands like in the Ukraine and Russia are comparable with meadowlands. Why are there species rich (hundreds per m^2) and species poor (one per ha) grasslands? Instability of a specific temporal scale between dry and wet, cold and warm, fresh and salt seems to be the most important factor.
Such an instability reinforces itself: a dense, solid soil emerges with Plantago Major (the tread plant 'common plantain', 'weegbree'). Water remains there, but also flows away easily.

Fig. 750 Metaphors of wilderness (Vera, 1997)

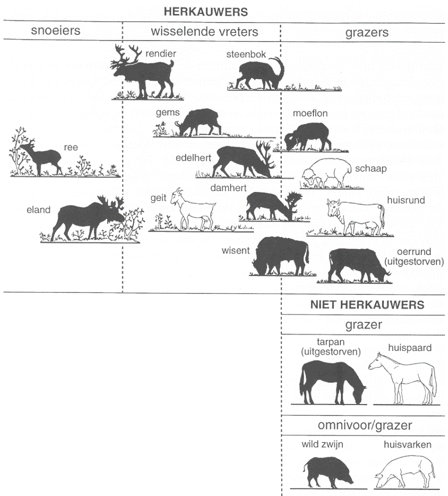


Fig. 751 Pruners, alternating grubbers, grazers (Vera, 1997)

That is why even more powerful alternations between wet and dry, cold and warm arise, which cannot to be endured by many plant species. In Moscow dryness is locally suppressed by the fire brigade, again reinforcing disturbance and condensation of the soil. However, a slope stabilises. In the Netherlands plantago major never grows on a slope, because the contrast between wet and dry is too small. There, other plant species can survive stabilising the environment even further. The Russian species rich steppe has, unlike a desert a stable water balance horizontally and vertically. A desert becomes brackish by evaporation and consequently rising water (ascending moist flow). Salinisation by irrigation is a well known phenomenon. So, a linking between wet-dry, cold-warm, salt-fresh alternation arises there, which does not happen in species rich steppes. Against temporal changes there are stable spatial transitions based on selective separation.

5.3.7 Selectors and regulators in the landscape

Connection supposes separation

What I would like to bring to the fore is the importance of inaccesibility, isolation, in this case for large mammals. As the concept of ecological networks (ecologische infrastructuur) started its triumphal progress in the Netherlands (D.de Bruin et al., 1987, 'Plan Ooievaar'; primarily based on separation), connections are primarily emphasised.

Fig. 752 The 'Plan Ooievaar' (Bruin et al., 1987)

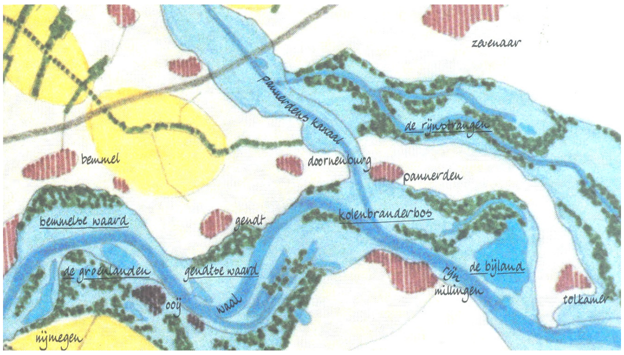


Fig. 753 Separation of nature and agriculture: zoning, selection, regulation, 'ecological networks' (Bruin et al., 1987)

I would like to set against that emphasise for a while one-sidedly, the importance of separations to arrive at the middle (mi-lieu). The concept of 'structure' (litterally 'brickwork') comprises both separation and connection. Exactly their combination produces particular environments where specialists are at ease. Researching that kind of environment could be named 'structure ecology'. In terms of regulation theory both isolation and connection are a value of separation. Connection is solely a zero value of separation. Connection supposes separation, not the reverse. There are no windows without walls. But there is 'difference in separation', always a combination of separation and connection while separation directs connection.

Selectors and regulators

The first notable combination follows on the 'basic paradox of spatial arrangement' as Van Leeuwen named it: the phenomenon of separation perpendicular to connection.

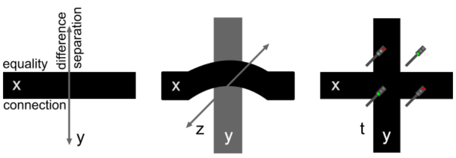


Fig. 754 Basic paradox of spatial arrangement

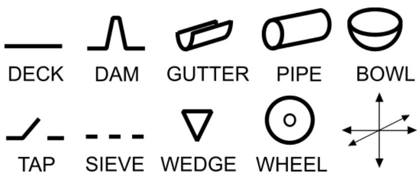


Fig. 755 Selectors (*Leeuwen, C.G.v. (1979-1980) Ekologie I en II. Beknopte syllabus)*

A road is laid out to connect, but perpendicular to that connection it separates. That is painfully felt at crossings. The solution to connecting perpendicularly to the other connection is separating vertically (viaduct) or in time (traffic lights, see *Fig. 754*). However, there are more combinations of separating and connecting. Deck, dam, gutter, pipe and bowl are examples of 'selectors' in one, two, three, four and five directions, selectively connecting into the other directions. That direction-sensitive connection quality cannot be imagined without separation into the other directions. Selectors take care not *everything is going anywhere*.

Taps, lids, valves, wedges and wheels are regulators taking care not *everything is always going somewhere*. Living organisms are complex combinations of selectors and regulators known in technology as mechanisms on different levels of scale (see *Fig. 756*, *Fig. 757* and *Fig. 758*).

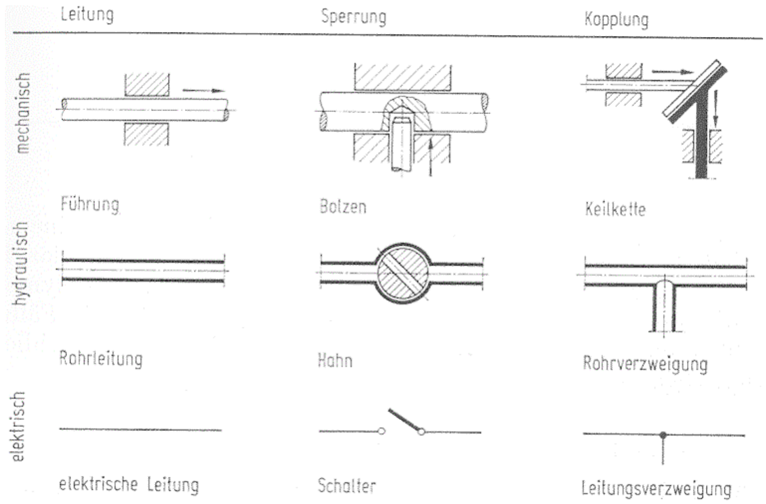


Fig. 756 Mechanical forms of selection and regulation by separating and connecting (Rodenacker , 1970)

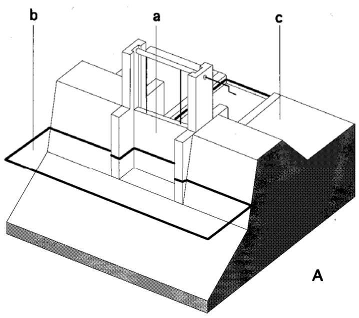


Fig. 757 Sluice closed (Arends, 1994)

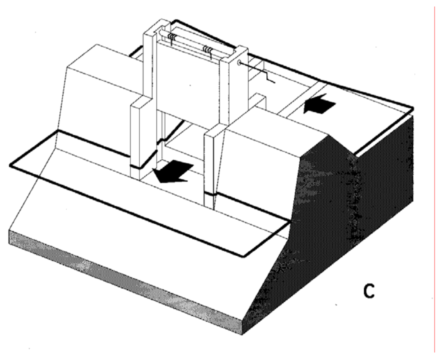


Fig. 758 Sluice open (Arends, 1994)

5.3.8 Ecological networks

In the doctoral thesis of Van Bohemen (H.D.v. Bohemen, 2004) strikes that the hundreds of millions (!) spent on ecological connections are hardly judged on their ecological effect.

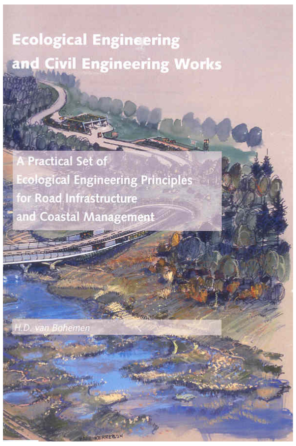


Fig. 759 Technical ecology (Van Bohemen, 2004)

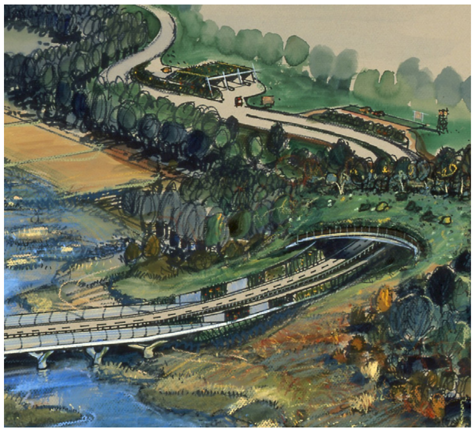


Fig. 760 Ecological connections (Van Bohemen, 2004)

The argument is: you have to build a wildlife viaduct before you can measure the effect. That phase is now upon us, but it is recognised that just as in epidemiological research cause and effect are difficult to separate. And then we still focus solely on the effect on populations of some species. Which effect the constructed connections show on other species is even more difficult to determine. The deteriorating effect of positive discrimination is well known from hanging on nesting-boxes: other bird species were ousted, insects died out and the plant species having them as postillions d' amour disappeared.

The impact of connections is sometimes demonstrably negative. Examples include the import of alders from Eartern Europe in the seventies or the connection of the Main-Danube canal. The connection of all parts of the world to each other (globalisation) may be the greatest danger. Connecting genetically different races could cause loss of biodiversity. That leads to the subject fascinating me most: levels of scale. At what level of scale connecting is the best strategy, and at what level of scale separating? The best argument for separating areas is the emergence of subspecies, though it takes a lot of time. A crucial question is: are we in the Netherlands in need of other large mammals than grazers if they have better and more sustainable conditions elsewhere? Could not we create in our wet country much more interesting 'ecological conditions' by separation (Tjallingii, 1996), conditions lacking everywhere else? Holland hooiland!

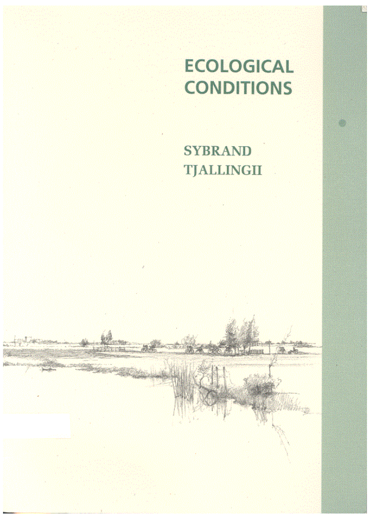


Fig. 761 Ecological conditions (Tjallingii, 1996)

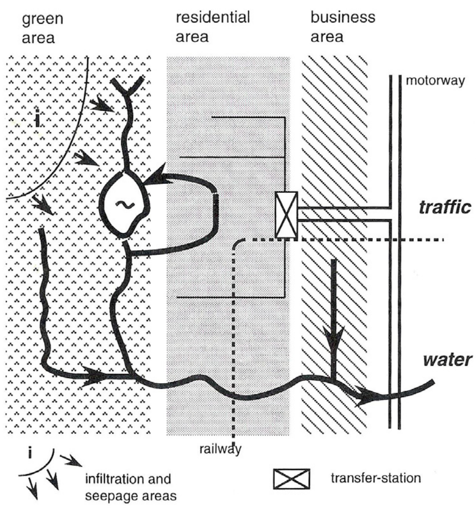


Fig. 762 Separating flows (Tjallingii, 1996)

A more moderate conclusion is that ecology cannot produce general statements, though politicians would like to seduce you that way. That is what I learned from the doctoral thesis of Mechtild de Jong (2002, see *Fig. 763* and *Fig. 764*).

That methodological problem of scientific generalisation in the context-sensitive relations between one and a half million of species from which we know so little, is something shared by ecology with context-sensitive design (Jong and Voordt, 2002) and management sciences.
The problem of the classical empirical ideal to produce generalising statements (out of bits and pieces, to deduce subsequently from these statements conclusions for specific cases) increases if you realise any species comprises differently reacting individuals. That problem increases even more so, if you realise that any individual arrives in a different context. The urbanist or architect knows the problem only too well.
An ecologist is not invited to copy solutions, but to bring a local field of problems into a common solution by a unique concept. That is not solely an ecological network, but a more complete ecological infrastructure.

Fig. 763 Separations in Dutch ecological thinking (Jong, M.D.T.M.d., 2002)

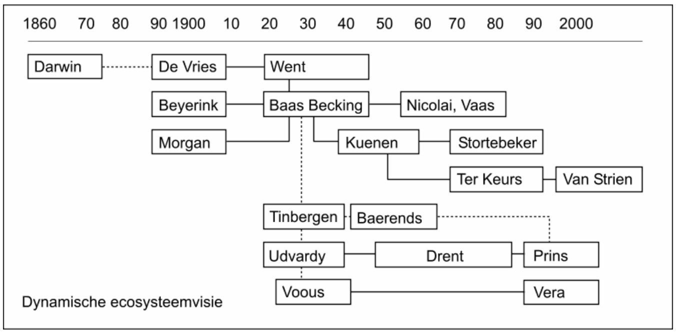


Fig. 764 A genealogy of theories (Jong, M.D.T.M.d., 2002)

5.3.9 Urban ecology

Biodiversity in towns

Since 19th century's Dutch hygienic developments in the urban area founded by Cohen (1872) and historically described by Houwaart (1991) - the very source of public housing policy and urban design - biodiversity in spaced towns outruns rural biodiversity.

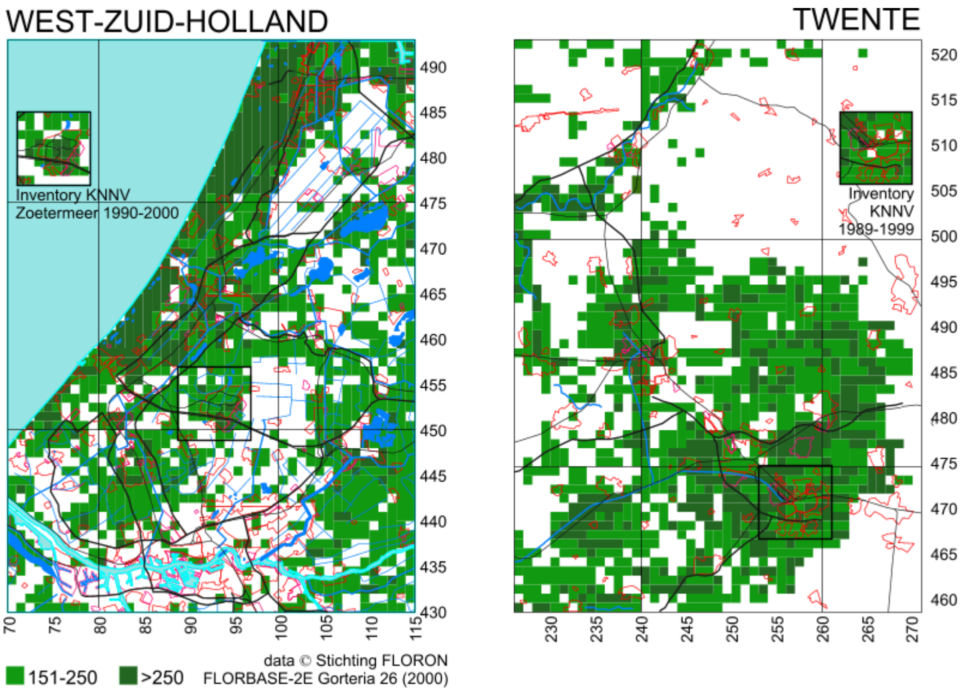
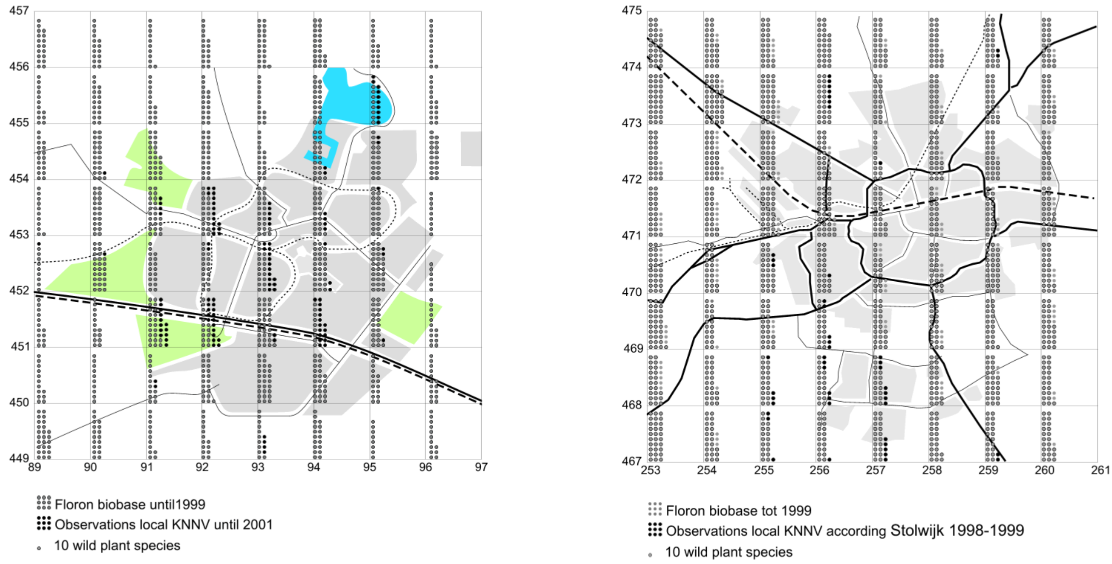


Fig. 765 *Number of wild plant species per km2 in the lower and higher part of The Netherlands*

Fig. 765 shows that some square kilometres in the urban area of Zoetermeer indicated in the left picture have more that 250 wild plant species per km^2. Local observers (like KNNV Zoetermeer, reported by Jong and Vos (1995); Jong and Vos (1998); Jong and Vos (2000); Jong and Vos (2003)) counted even more than national ones (counted by FLORON, reported by Groen, Gorree et al. (1995).



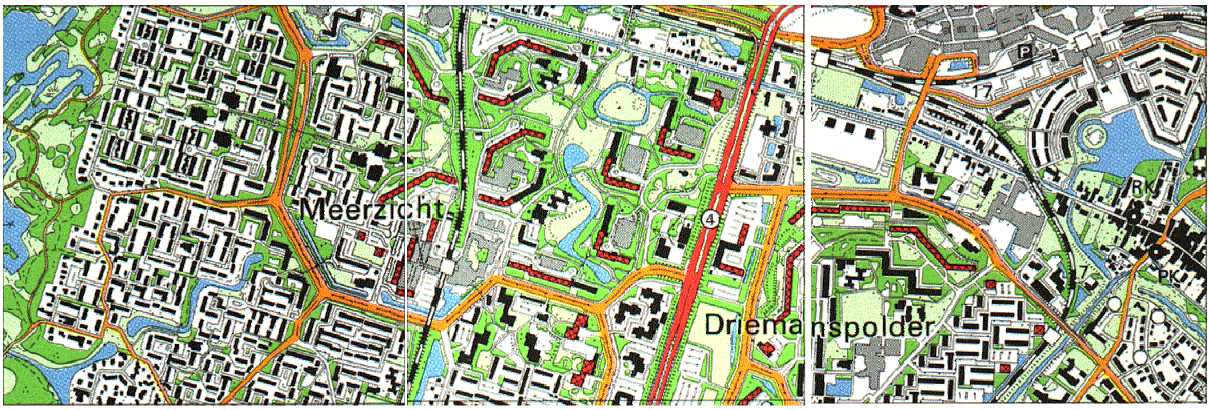
Jong (2000)

Fig. 766 *Number of plant species per km2 in Zoetermeer and Enschede*

The urban area of Zoetermeer is more in contrast with the rural environment characterised by cattle breeding than Enschede (indicated in the right picture) surrounded by more natural equally rich areas. Fig. 766 shows both in more detail. Here we can see that infrastructure and industrial areas contribute more than we would expect by intuition. Their verges, slopes and rough grounds are less visited and disturbed by man and pet.

Counting species per km^2

The number of species per km2 is added up over several years. So, many species could have been disappeared, they then only show the urban potential. Moreover, some square kilometres could have been observed better than other ones, for example the outskirts.



180 low-rise outskirts | 200 high-rise | 330 wild plant species centre

Fig. 767 *Number of wild plant species in 3 km^2 of Zoetermeer*

Even when in the centre the plant observations were better than in the outskirts, Fig. 767 warns us for the intuitive view that biodiversity always decreases from the outskirts into the centre. The large number of observed species in the central km^2 could also be explained by urban age, abiotic variation like seepage, drainage, water level or intersection by infrastructure with verges and slopes, less influence of adjacent agriculture and manure of cattle breeding dispersed by water or wind.
So, some of these possible causes could be varied as means of design aiming urban biodiversity.

Rarity in the urban environment

Fig. 768 arranges some 500 urban plant species from the 1500 known in The Netherlands in a sequence of national rarity, naming 50 of them only. Their national presence in % of the 5x5km observation squares is recognisable in the rising line. The spots show the urban presence in % of 1x1km observation squares in Zoetermeer. So, the spots above the line are more common in Zoetermeer than in The Netherlands, the spots below less so.

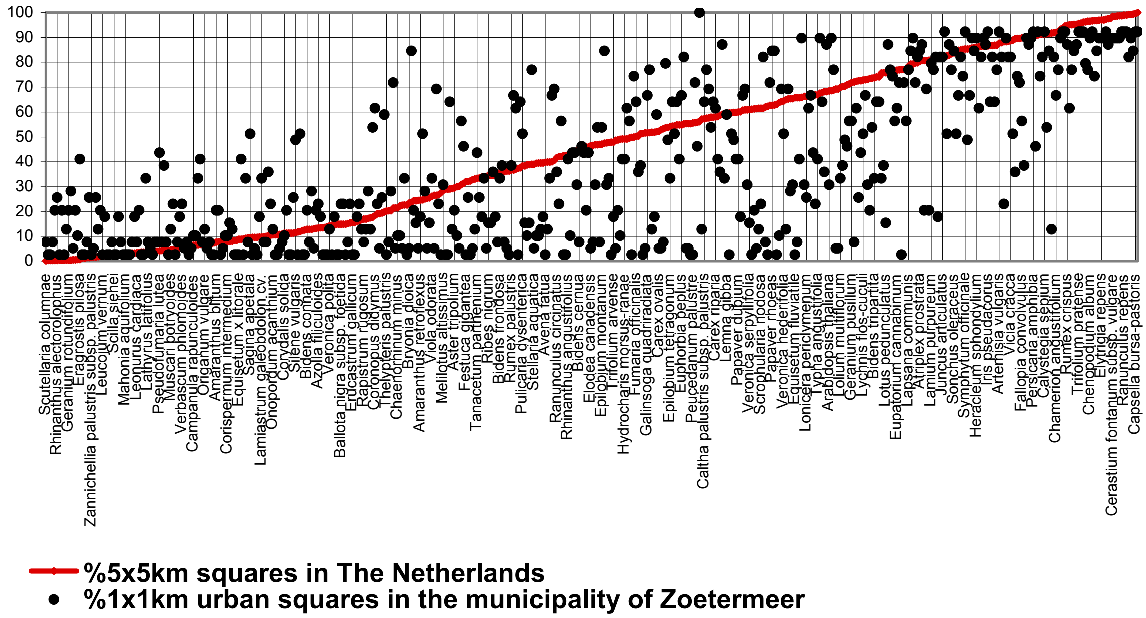


Fig. 768 *Local rarity (100% is very common) of approximately 500 plant species (only partly named) in a sequence of national rarity*

A number of nationally rare plant species in the left side of Fig. 768 evidently found their place in urban ecotopes. In the wake of urban plants and ecotopes rare insects and fungi have been observed in Zoetermeer, but seldom nationally rare vertebrates.

In 1994, it was established for the first time that the biodiversity per km^2 in Amsterdam. By Denters, Ruesink et al. (1994) and Vos (1993; Vos (1996) and Zoetermeer (Vos 1993, 1998) is up to five times higher than in the agrarian surroundings of these cities. In saying this, of course, it should be noted that the richness of species in urban ecosystems differs from that of the classical nature areas[48]. The agrarian surroundings of Amsterdam and Zoetermeer are not nature areas, but are a series of monocultures closely oriented to economic production. It is no wonder that the large cities show a more diverse range of species. Nevertheless, the potency of the ‘urban district’ should not be underestimated.

5.3.10 Distribution and abundance of people

Open space in the Netherlands is reduced by 12.5% urban and rural built area for 16 000 000 inhabitants with ample 300 m2 average built area per person. When these inhabitants were concentrated in 16 conurbations of 1 000 000 inhabitants each within 10km radius (see Fig. 693) - regularly dispersed over the country - 10 open large landscapes with a free horizon of 30km radius would be available as open space. They would be accessible within 10km from everybody’s house. In empty spaces of that measure bears and eagles could find their habitat and the weekends could be filled by survival journeys we now look for in other countries once a year.

Landscapes (geomorphological units)

However, agriculture and urban sprawl have filled these potentially open landscapes. If we name an area of 30km radius still a landscape as long as there are less than 1 000 000 inhabitants, The Netherlands still have 10 landscapes (see Fig. 769). But not for long, because there are landscapes with nearly 1 000 000 inhabitants and great pressure of urban sprawl. The size of spots in Fig. 769 meets the average urban density in The Netherlands. So, where they overlap the density is higher than average.

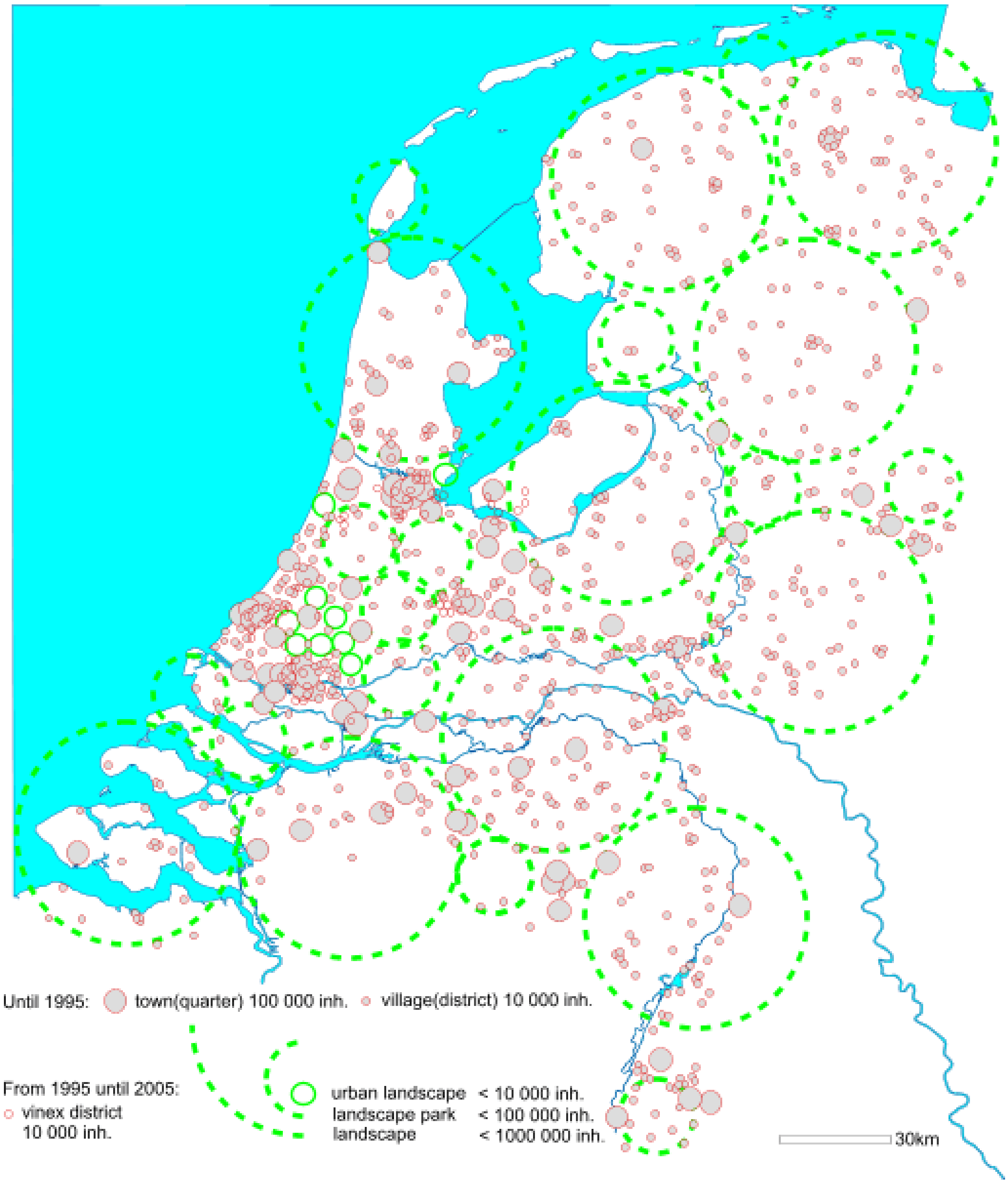


Fig. 769 *Built and open space in The Netherlands*

Keeping landscapes open

From Fig. 769 we can conclude that concentration within conurbations (r=10km) does not help much in keeping landscapes open. Regional concentration (r=30km) does. Regional deconcentration breaks landscapes up into landscape parks or urban landscapes like happened in the Green Heart of Randstad (recently named Green Metropolis or Deltametropolis). However, deconcentration within conurbations (r=10km) could help making biotope cities. What kind of biotopes are they?

Possibilities of size

Form, size and structure of components are conditions for the function of open areas though urban functions on their turn can be the historical cause of form and structure. The landscape consultancy H+N+S in Utrecht visualised the functional charge for nature as a function of size and altitude in Fig. 770 .

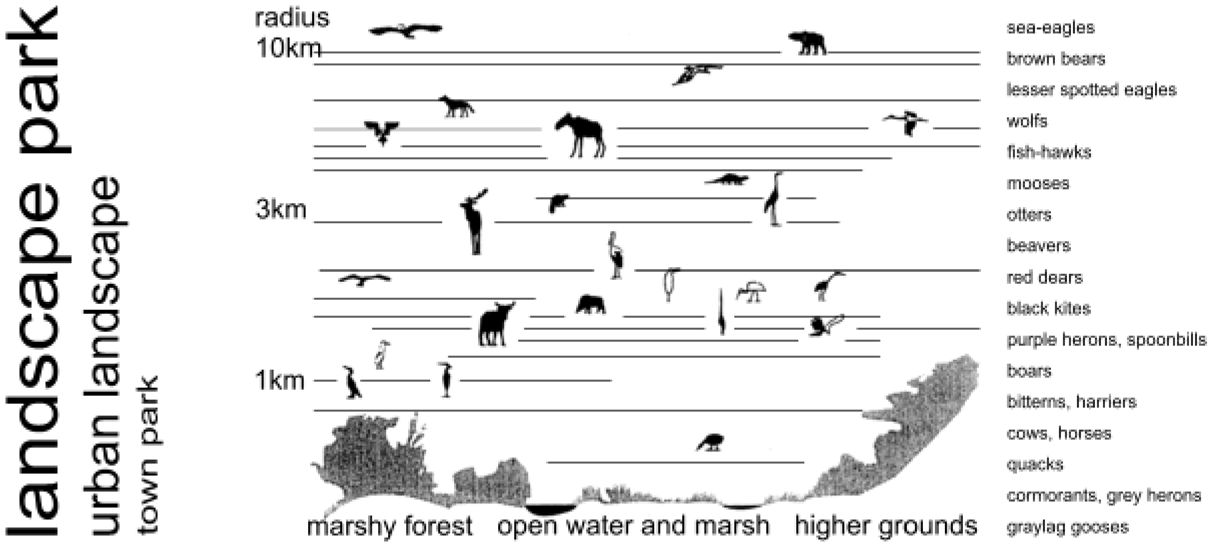


Fig. 770 Possibilities for nature by size and altitude

In Fig. 771 they summarised possibilities of human recreation as well.

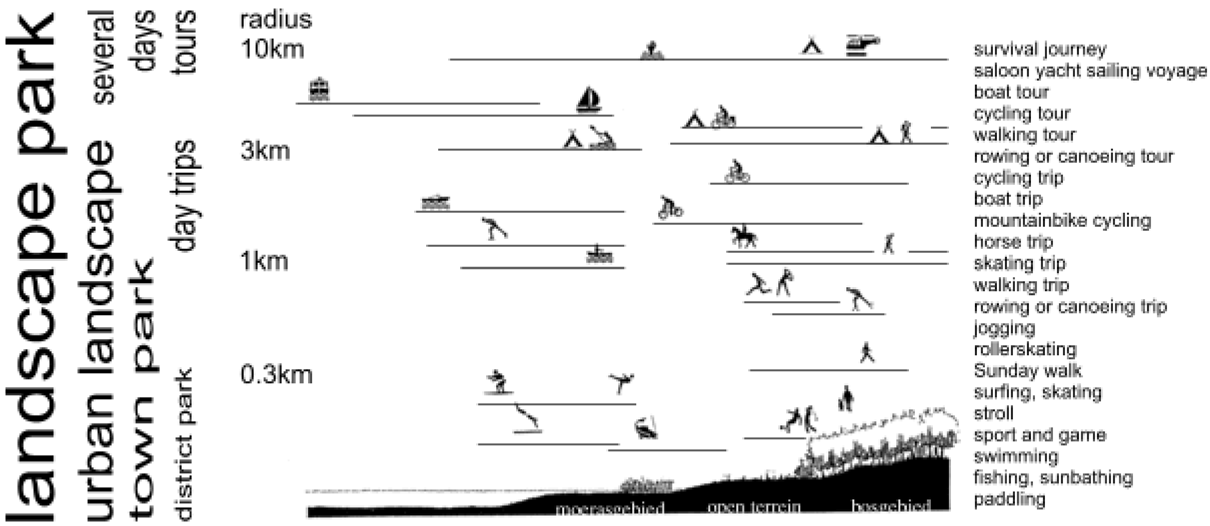


Fig. 771 *Possibilities for recreation by size and altitude*

The smaller the area the less animals could find a habitat, but that is not the case for botanical biodiversity as far as their distribution is not dependent on animals.

Parks, size and distance from residential areas

A crucial space-time dilemma of urban planning is priority for either small open spaces nearby residential areas or remote larger ones with more travel time but a better survival of animal populations and recreational possibilities.

Open area	within	radius
• Landscape	100km	30km
• Landscape park	30km	10km
• Urban landscape	10km	3km
Town park	3km	1km
District park	1km	300m
Neighbourhood park	300m	100m
Ensemble green	100m	30m

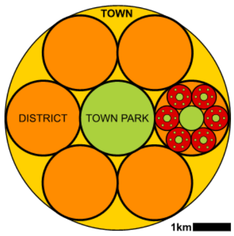


Fig. 772 *Standard green structure*

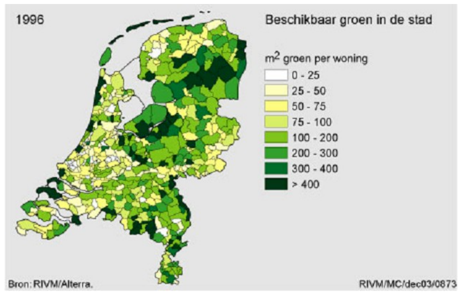


Fig. 773 m^2 Green area per dwelling

If on any level of scale in a town the green area has a size equal to the maximal walking distance (standard green structure, see Fig. 772), then the green area counts 1/10 of the total area. In that case every inhabitant of a town (approximately $30km^2$, about 100 000 inhabitants) would have $30m^2$ town park. The same applies on a district and neigbourhood level of scale for district parks and neigbourhoodparks. If that reasoning is extended into ensemble green every inhabitant would have have disposal of approximately 70 m^2 public green area. In the Dutch context that is a maximum (see Fig. 773), but it is an easily manageable target standard. Now you can work out how much a town deviates from that standard and which level of scale is favoured.

5.3.11 Comparing and applying standards for green surfaces in urban areas

Both green surfaces in urban areas and their distance to inhabitants can be expressed as a radius. In that case a radius r represents a walking distance *or* an area $a = \pi r^2$, equal to a circular surface of the same size. That representation of surface is more directly imaginable than huge numbers of hectares fastly increasing by a growing scale. A radius grows slower, and by doing so it indicates *orders* of size more easily. *Fig. 774* shows some standards for green surfaces and their distance to the served inhabitants that way. In that figure we can observe that 'English Nature max.' proposes larger green areas at a distance below 1000m and smaller areas further away than what we will explain here as a ‘Standard Green Structure’. Furthermore, we can conclude that all other mentioned (Dutch) standards are below that standard.

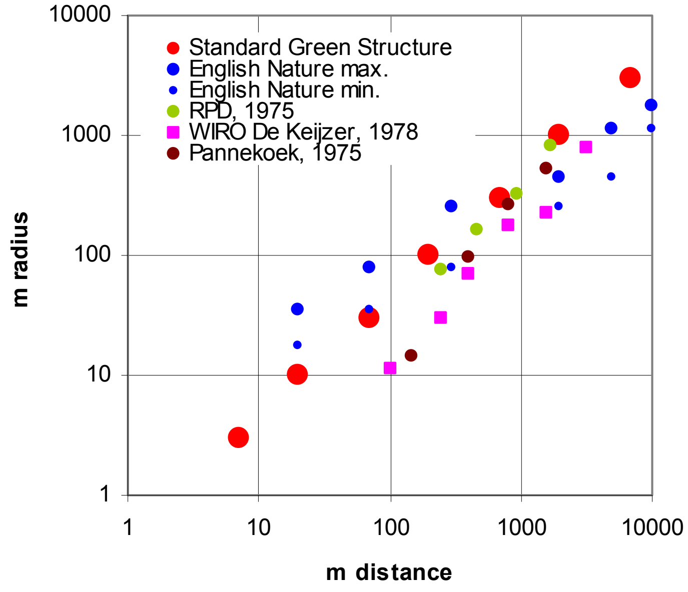


Fig. 774 Some standards for green surfaces in urban areas

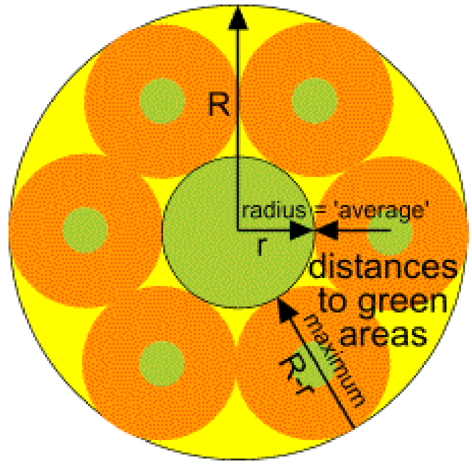


Fig. 775 Optimally accessible green surfaces

The figures are calculated in a way explained in this section[a]. Greenery standards expressed in m^2 per inhabitant require suppositions about densities for comparison. These densities are taken from the 'Standard Green Structure' to be explained below.

Nominal orders of size

If in a range of radiuses, you take after 'r' the next radius 'R' ample three times larger (R≈3.16·r), then the next area *A* is ten times larger (A≈10r). It could encompass 7 smaller circles (70%) in closest packing, and a surface proportional to ample 3 circles (30%) as 'tare' (see *Fig. 775*).
If you take an easily nameable range of 'nominal' radiuses = {1, 3, 10, 30, 100, 300, 1 000, 3 000, 10 000, 30 000m}, then the surface increases at average with a factor 10.
In this paper 'nominal' means, that if I *name* a surface '10m', then I will mean something in between 3 and 30m. So, 'nominal measures' are not exact, they are 'elastic' between their neighbours, indicating an *order* of size.

Standard Green Structure

But, greenery standards expressed in m^2 per inhabitant are still incomparable to those expressed in surfaces and distances. Within R they suppose densities, and densities determine the amount of users and the costs of maintenance. I will use a 'Standard Green Structure' to provide densities on different levels of scale for comparison. Green surfaces are optimally accessible if they are located in the centre of the urban areas they serve. In that optimal case the distance from the boundary of an urban area involved (radius R) to the boundary of a central green surface (radius r) is the maximum walking distance R-r (see *Fig. 775*). The 'average' distance is approximately half R-r (depending on different densities within the residential area). If the *average* distance to the green area is the same as its radius, then in this paper we call that distribution of green areas over these levels 'Standard Green Structure' (see *Fig. 776*). Moreover, in *Fig. 776* some common names are added. In this paper they are used to interprate other standards.

[a] The spreadsheet is downloadable from http://team.bk.tudelft.nl/ > Publications 2007 > Jong, T.M. de (2007) Standard Green Structure (Zoetermeer) .xls

nominal green area r m	name	nominal urban area R m	nominal 'average' distance r m	nominal max. distance R-r m
10000	landscape park	30000	10000	20000
3000	urban landscape	10000	3000	7000
1000	town park	3000	1000	2000
300	district park	1000	300	700
100	neighbourhood park	300	100	200
30	small public green	100	30	70
10	common garden	30	10	20
3	private garden	10	3	7

Fig. 776 A Standard Green Structure

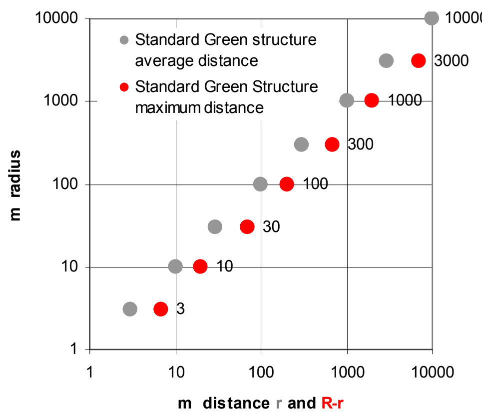


Fig. 777 Shift from average into maximum distance

In Fig. 777 the Standard Green Structure is given in grey. However, most standards are based on the maximum distance. So, for comparison we have to shift the dots half R-r to the right (red dots) as used in *Fig. 774*.

Inhabitants

In this concept of a Standard Green Structure the spatial distribution of green surfaces is determined, but not yet the number of people served. They determine the density or its reciprocal value, the land use in m^2 per inhabitant. However, if a village of 10 000 inhabitants grows into a town of 100 000 inhabitants, it will probably need a town park and if it grows into a conurbation of 1 000 000 inhabitants it will probably need a town park for every township and an urban landscape for the conurbation. That amount of desired untilled land was earlier provided as countryside around the village. In a first approximation that will increase the land use of green surface within the urban area.

Urban R(m)	Green r(m)
30 000	10 000
10 000	3 000
3 000	1 000
1 000	300
300	100
100	30
30	10
10	3

	Ambition	Inhabitants
	countryside	
	countryside	
	countryside	
1	**village**	10 000
6	neighbourhoods	1 667
36	urban islands	278
216	building complexes	46
1 296	buildings	8

	Ambition	Inhabitants
	countryside	
1	**conurbation**	1 000 000
6	townships	166 667
36	districts	27 778
216	neighbourhoods	4 630
1 296	urban islands	772
7 776	building complexes	129
46 656	buildings	21

Fig. 778 Different ambition levels

However, in the same time the price of land will increase and the inhabitants will accept higher residential densities. So, for example a neighbourhood park will be surrounded by higher neighbourhood densities in a conurbation than in a village, resulting in a lower land use per inhabitant. Keeping the average distance to the green area the same as its radius, a higher neighbourhood density applies in a conurbation compared to a village. To determine these densities, we need to suppose different ambition levels for growth. To keep it easy we take 10 000, 100 000, 1 000 000 inhabitants and so on as starting points and divide them according to *Fig. 775* by 6, 6x6, 6x6x6 and so on to derive the number of inhabitants per level (see *Fig. 778*). These starting points can easily be changed by taking percentages applying to densities as well.

Densities

Now you can derive different gross and net densities according to any ambition level dividing the appropriate number of inhabitants by the appropriate urban surface. The density of dwellings is calculated by dividing the density of inhabitants by the average number of inhabitants per dwelling (for example 2.25). The floor/surface ratio (FSI) is calculated by dividing the density of inhabitants by the average floor surface per inhabitant (for example $30m^2$). However, any level of scale has its own gross and net densities. The 'net' of the higher level equals the 'gross' of the lower level (see *Fig. 779*).

Higher level	**gross**				
	tare = green	+ rest	**net** (residential)		
Lower level			gross		
			tare: green	+rest	net

Fig. 779 Net of higher level equals gross of lower level

The difference between gross and net is 'tare'. Net density concerns the residential part of the total urban area covered by 'R'. However, on a lower level that residential part contains again non-residential components to be distinguished by the reciprocal value of 'land use'.

ambition	**density**	
	gross	net
	inh/ha	inh/ha
village	32	59
neighbourhoods	59	88
urban islands	88	164
building complexes	164	246
buildings	246	455

land use			
gross	- green	- rest =	**net**
m^2/inh.	m^2/inh.	m2/inh.	
314	28	116	170
170	19	38	113
113	10	42	61
61	7	14	41
41	4	15	**22**
	68		

Fig. 780 Standard Green Structure densities and land use on the ambition level of a village

Taking a closer look on the resulting land use profile of a village for example (see Fig. 780), the tare components can be added, while the gross and net cannot. By adding the green components per inhabitant we find the m^2/inhabitant green area (68m^2). The same calculation for a conurbation (see Fig. 781) produces a figure not much different from that of a village because of higher densities on the lower levels of scale (72m^2). The Standard Green Structure has a rather stable use of approximately 70m^2 green area per inhabitant, little dependent on the ambition.

ambition	**density**	
	gross	net
	inh/ha	inh/ha
conurbation	32	59
townships	59	88
districts	88	164
neighbourhoods	164	246
urban islands	246	455
building complexes	455	682
buildings	682	1263

land use			
gross	- green	- rest =	**net**
m^2/inh.	m^2/inh.	m2/inh.	
314	28	116	170
170	19	38	113
113	10	42	61
61	7	14	41
41	4	15	22
22	2	5	15
15	1	5	**8**
	72		

Fig. 781 Standard Green Structure densities and land use on the ambition level of a conurbation

In both cases the gross density on the highest level is the same, because the number of inhabitants increases each level of scale with approximately the same factor 10 as the surfaces of the Standard Green Structure. However, the net residential area on the lowest level (buildings) is different. It equals the m^2 built area per inhabitant. If the average floor surface per inhabitant (for example 30m^2) is nearly four times that figure, the average number of stories has to be 4.

Comparing greenery standards expressed in surface, distance or m^2 per inhabitant

Fig. 782 shows the m^2 green area per inhabitant of different standards distributed over different levels according to levels and densities supposed in the Standard Green Structure. Figures for common and private gardens are added for comparison.

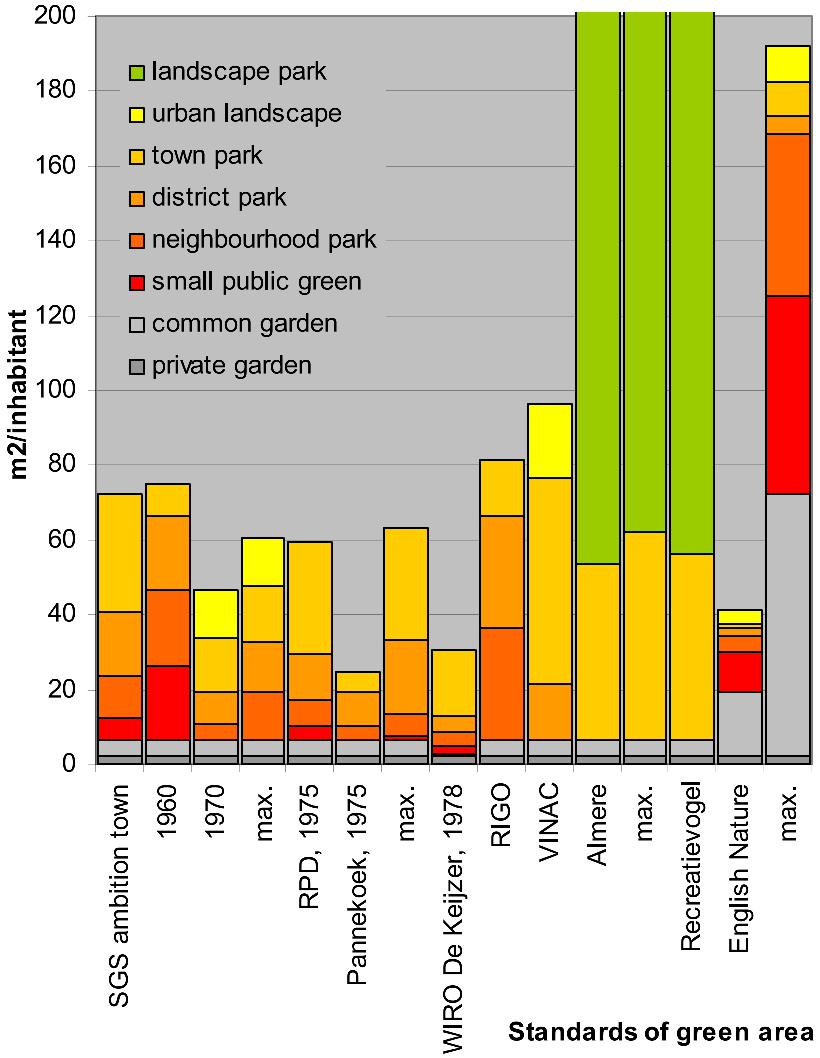


Fig. 782 Standards of green area expressed in m^2 per inhabitant on different levels of scale

If figures are given for the 'urban landscape' (yellow) the ambition is apparently a conurbation with higher densities than a town. However, most standards do have the ambition of a town. So, the Standard Green Structure shown here is calculated with the ambition of a town. To change that, use the spreadsheet mentioned earlier. That sheet shows how densities are calculated for different ambitions. Moreover, it enables you to make your own programme for urban green space according to the identity of the location.

Making a specific programme for urban green space

Given the ambition chosen in an other part of the spreadsheet, the worksheet shows the result of your choices asking radiuses of the urban and green area on two levels of scale (for example town and district, see *Fig. 783*), and the number (1 to 6) of green spaces on the lower level.

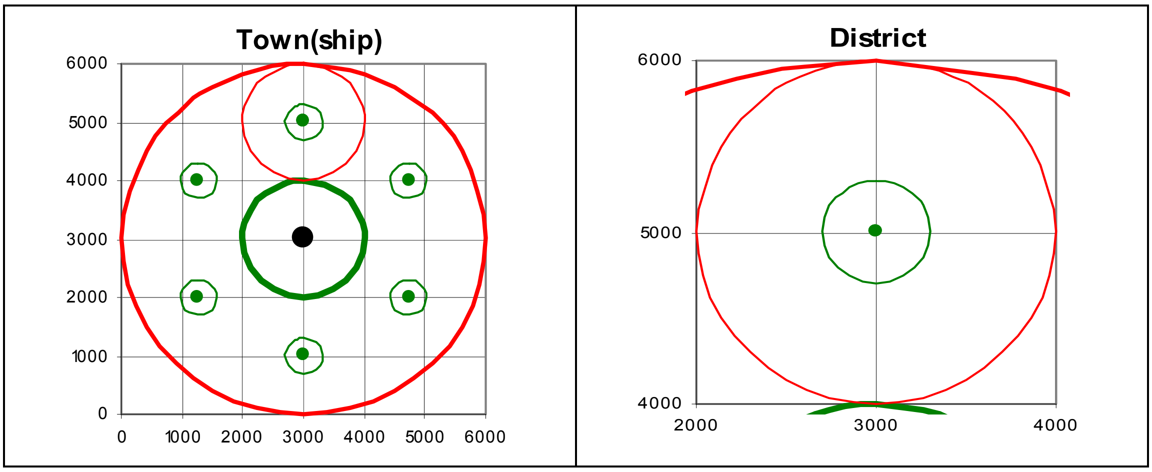
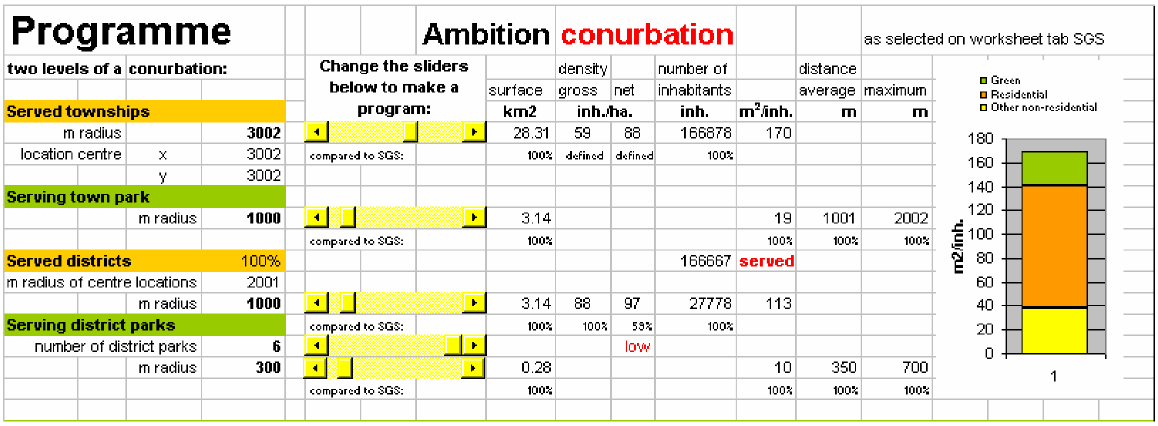


Fig. 783 Two levels of scale represented in a 1000m grid

These choices can be made by five sliders and the spreadsheet informs you directly about the consequences (see *Fig. 784*). On a copy of *Fig. 774* two new green spots show how your programme is in the proportion of the other standards.



Programme			**Ambition**	**conurbation**					as selected on worksheet tab SGS	
two levels of a conurbation:			**Change the sliders below to make a program:**		density		number of		distance	
				surface	gross	net	inhabitants		average	maximum
Served townships				**km2**	**inh./ha.**		**inh.**	**m²/inh.**	**m**	**m**
m radius		**3002**		28.31	59	88	166878	170		
location centre	x	3002	compared to SGS:	100%	defined	defined	100%			
	y	3002								
Serving town park										
	m radius	**1000**		3.14				19	1001	2002
			compared to SGS:	100%				100%	100%	100%
Served districts		100%					166667	**served**		
m radius of centre locations		2001								
	m radius	**1000**		3.14	88	97	27778	113		
Serving district parks			compared to SGS:	100%	100%	53%	100%			
number of district parks		**6**				low				
	m radius	**300**		0.28				10	350	700
			compared to SGS:	100%				100%	100%	100%

Fig. 784 Choosing a programme

Distributing green areas according to the programme

The next worksheet shows a square with the same surface of the largest circle you chose divided in 90x90 modules, telling you how much modules you need of each category to fulfill your own programme (see *Fig. 785*).

Draw green areas by giving negative values to cells in the square below needed

100	M Serving town park	giving value: -1	realised:	100
54	M Serving district parks	giving value: -2	realised:	54
154	total	Don't replace modules, just change contents		154

metres *if drawn square 10 x 10cm, scale 1 : 53207*

metres																														
5321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5143	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
4966	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
4789	0	0	0	2	2	2	2	2	1	3	3	3	3	3	3	3	3	3	3	3	3	1	2	2	2	2	2	0	0	0
4611	0	1	1	2	-2	-2	-2	2	1	3	4	4	4	4	5	5	4	4	4	4	3	1	2	-2	-2	-2	2	1	1	0
4434	0	1	1	2	-2	-2	-2	2	1	3	4	0	0	0	0	0	0	0	0	4	3	1	2	-2	-2	-2	2	1	1	0
4257	0	1	1	2	-2	-2	-2	2	1	3	4	0	0	-1	-1	-1	-1	0	0	4	3	1	2	-2	-2	-2	2	1	1	0
4079	0	1	1	2	2	2	2	2	1	3	3	0	0	-1	-1	-1	-1	0	0	3	3	1	2	2	2	2	2	1	1	0
3902	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
3725	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
3547	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
3370	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
3192	0	1	1	2	2	2	2	2	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	2	2	2	2	2	1	1	0
3015	0	1	1	2	-2	-2	-2	2	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	2	-2	-2	-2	2	1	1	0
2838	0	1	1	2	-2	-2	-2	2	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	2	-2	-2	-2	2	1	1	0
2660	0	1	1	2	-2	-2	-2	2	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	2	-2	-2	-2	2	1	1	0
2483	0	1	1	2	2	2	2	2	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	2	2	2	2	2	1	1	0
2306	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
2128	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
1951	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
1774	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
1596	0	1	1	1	1	1	1	1	1	2	3	0	-1	-1	-1	-1	-1	-1	0	3	2	1	1	1	1	1	1	1	1	0
1419	0	1	1	2	2	2	2	2	1	3	3	0	0	-1	-1	-1	-1	0	0	3	3	1	2	2	2	2	2	1	1	0
1242	0	1	1	2	-2	-2	-2	2	1	3	4	0	0	-1	-1	-1	-1	0	0	4	3	1	2	-2	-2	-2	2	1	1	0
1064	0	1	1	2	-2	-2	-2	2	1	3	4	0	0	0	0	0	0	0	0	4	3	1	2	-2	-2	-2	2	1	1	0
887	0	1	1	2	-2	-2	-2	2	1	3	4	4	4	4	4	4	4	4	4	4	3	1	2	-2	-2	-2	2	1	1	0
709	0	0	0	2	2	2	2	2	1	3	3	3	3	3	3	3	3	3	3	3	3	1	2	2	2	2	2	0	0	0
532	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
355	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
177	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	**177**	355	532	709	887	1064	1242	1419	1596	**1774**	1951	2128	2306	2483	**2660**	2838	3015	3192	3370	**3547**	3725	3902	4079	4257	4434	4611	4789	4966	5143	**5321**

LEGEND

-1 = Serving town park
-2 = Serving district parks

RESULT

		realised	% of target
	township		
	inh/ha gross density	59	
	ha residential	1717	
	inh/ha net density	97	
	m²/inh floor space	30	see tab SGS
	m2 floor space	5006328	
township	gross %floor	18%	
	gross FSI	0.18	
districts	net %floor	29%	
	net FSI	0.29	
	inh/dwelling	2.25	see tab SGS
	dwell/ha gross density	26	
	dwell/ha net density	43	
	ha Serving town park	314	
	Serving district parks	170	
	a township non-residential	629	

Draw non-residential areas using number 0

Increase net densities using numbers 1 - 15:

2831 ha area
59 inh./ha gross density needed
166878 inhabitants
166878 realised

	inh./ha	average nr. of stories	average m height	M realised	needed
0 =	-			200	
1 =	59	0.4	1	322	
2 =	118	0.7	2	124	
3 =	177	1.1	3	72	
4 =	236	1.4	4	26	
5 =	295	1.8	5	2	
6 =	354	2.1	6	-	
7 =	413	2.5	7	-	
8 =	472	2.8	8	-	

Fig. 785 Distributing categories on a field by numbers

The last problem is to increase the net densities of each module to fulfill your programme.

A first visualisation

This exercise is real time accompanied by a rough visualisation (see *Fig. 786*).

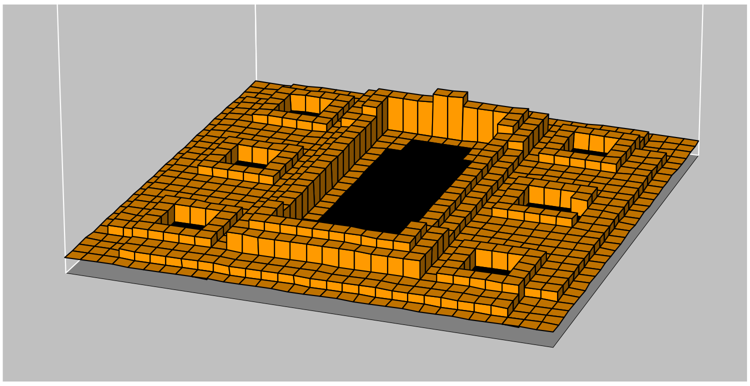


Fig. 786 A first visualisation

This figure does not represent building heights but densities. To get an impression of building heights the vertical exaggeration is estimated depending on the supposed floor surface per inhabitant, the supposed height of a story and the supposed percentage of built-up area within each module.

Connecting or separating

Ecological infrastructure could be important for distribution of animals with a larger feeding ground or reproduction area than the same areas not connected. However its effectiveness is species specific and not convincingly proven. Their surface could be at the expense of larger concentrated areas.

Open area concentrated but isolated The same area connected but deconcentrated

Fig. 787 *The surface dilemma of concentrating or connecting*

Tummers and J.M. (1997) defend central open areas instead of peripheral dispersion.

5.3.12 Urban perspectives

Claims by growth

The urban growth since the industrial revolution culminates, especially in the developing countries where the European hygienic history of towns repeats itself. Restricting ourselves to the present Dutch situation claims on Randstad are bigger than ever and the idea of an open Green Heart fades away by urban sprawl.

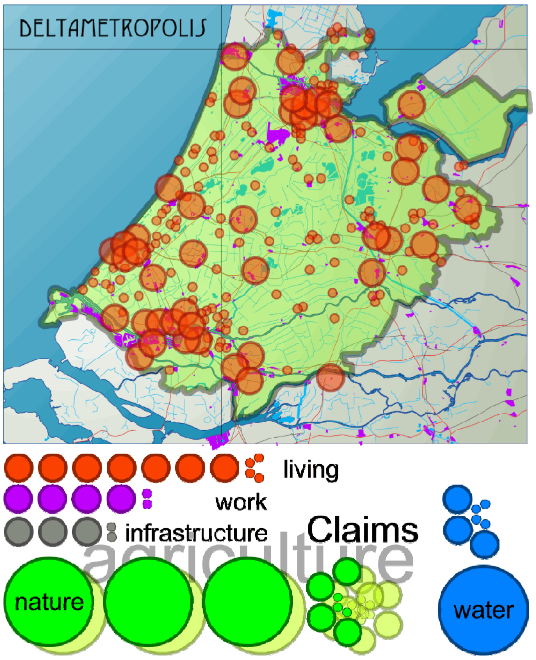


Fig. 788 *Claims on Detametropolis area*

Fig. 789 *The supposed Green Heart*

The 30 years old idea of high density conurbations have not been successful in spite of national strategies like bundled concentration or compact cities. And if so, they would have been not effective (see Fig. 693) in saving surrounding landscape.

Metropolitan ambitions

It is an example of ideas like high tech transportation solutions that have big metropolises as a reference. However, Randstad does not yet reach the capacity of a real metropolis making fast underground systems possible.

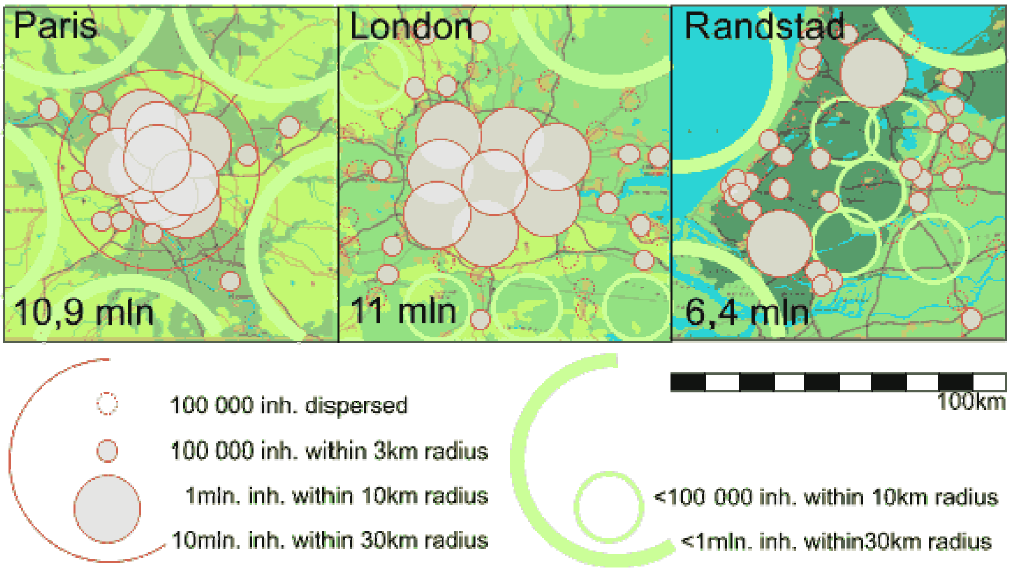


Fig. 790 *The capacity of metropoles*

From an ecological point of view the condition of measure (see paragraph 5.3.3 on page 460) is less important when we concentrate on vegetation rather than on big animals. From a human point of view we should bring nature closer to home (see page 478). That pleads for openness within the conurbation and not for accumulation on every level of scale.

Operational and conditional steering

The complex world of selectively separating and connecting occurs right down to the smallest scale of biology: the cell and its membranes (see *Fig. 736*). On that interfaces substances are selected and allowed to make connections with each other. The conditions for specific connections are created primarily by separating substancies that should not be connected (preselection). That already begins with the external membrane separating the inner environment from the entropic outside world. That makes less probable processes possible inside. This range of conditions and the endoplasmatic apparatus necessary to create the right conditions for the right connection is often forgotten in understanding the isolated process of connection operationally (monocausally).

The endless range of conditional functions in the environment seem to require another, perhaps typically ecological way of thinking than the single function with one clear product. Such processes are imitated in systems of retorts and pipes being the armamentarium of chemistry (in Dutch: ‘scheikunde’, ‘skill of separation’, not the skill of connection). Madame Curie needed four years to isolate 1/10 gramme of radium from tons of pitchblende. To dissolve sugar in our coffee is a daily activity taking seconds, but separating it afterwards takes much more effort. A heap of manure is easily dispersed, but it takes years to get it out of the ecosystem.

In the same way it is easier to destroy the subtle system of selectors and regulators of a living organism than to rearrange and synthesise it. A violent murder means demolishing separations, starting with those of the skin. Suppose now an ecologically rare location is surrounded by a range of conditional functions we still do not understand completely. Is it wise then to make connections for a few cuddly populations with botanically doubtful functions? Their equalising function in small areas could be that of an elephant in a china cabinet. Other (migrating) animals than grazers do not fit in our small nature reserves, but in vast eutrophic areas elsewhere in the world. There they are needed as mineral transporters comparable with pipelines connecting one sided high productive communities. A much larger number of smaller more rare species of animals needing a smaller area could be supported better by diversification of the botanical foundation. You can wait which superstructure develops thereupon instead of taking the summit of a food web as a target in advance. You should not start building a house with the roof.

5.3.13 Human health in the urban environment

Living in high densities

Being no expert on human health the most extensive overview I know in the joint field of medicine and urbanism is edited by Vogler and Kuhn (1957) some 50 years ago. They discuss many kinds of ‘civilisation damage’ in the urban environment from different medical specialist’s points of view. I never found a reference into this comprehensive work and I can understand it considering its size and age. So, I recoil from reviewing it as well, the more so while I am not read up on more recent medical literature. Apart from the disadvantages of living in high densities Vogler and Kuhn emphasise, its benefits Jacobs (1961) some years later referred to were partly confirmed in a psychological sense.

Crowding

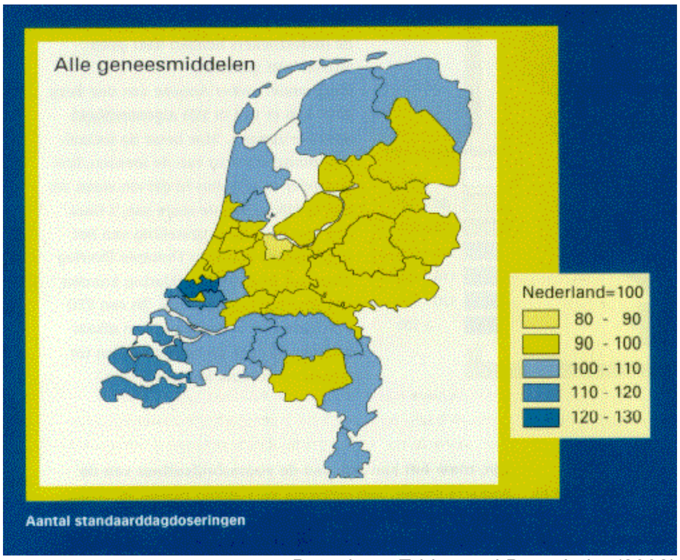
Freedman (1975); Freedman (1977) and Baum (1978) discussed research on crowding and behaviour concluding no other impact of increasing density than intensifying existing negative or positive social-psychological processes. However, by human biodiversity or social diversity - stage in the lifecycle, income or life style - some people like to live in high densities, others do not. People with children mostly like low densities of quiet suburbs. So, forced to live in high densities the impact could be primarily negative. However, learning to live in high densities with children might turn out positive by discovering advantages, adapting, compensating shortages and accommodating new functions.

Adaptation and compensation

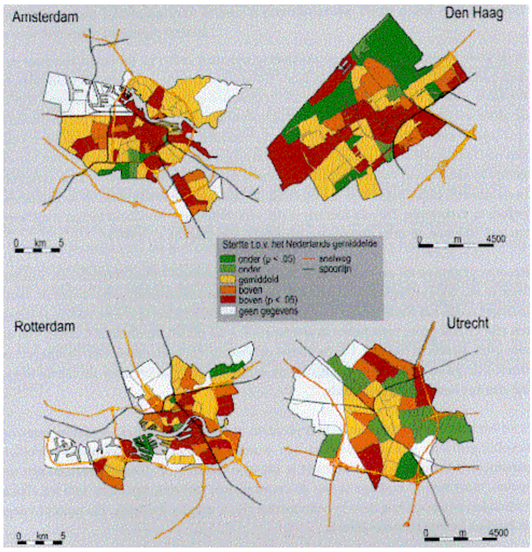
Adapting to an environment and compensating shortages by new accommodations are essential characteristics of life. Life would never have developed without these capacities. The possibility of adaptation and compensation are often forgotten by researchers only interested in forecasting. ‘Arsenic is poisonous’, they predict. The prediction is based on 3x standard deviation from the average (99.7% of the cases) and if arsenic poison would be ever a global problem their solution would be removing the cause only. But in Austria a village population of so called ‘arsenic eaters’ (source unknown) since centuries got used to it. That is the way evolution solved problems by adaptation and compensation increasing diversity, not by global rules reducing diversity. Oxygen was once a global poison, now it is a prerequisite for aerobic life. Adapting, compensating and accommodating are also ways designers study. When low temperature is a problem of living in higher latitudes we compensate (accommodate) by building acclimatised houses. It is unnatural because it disturbs the natural distribution and abundance of homo sapiens. But since we make houses more than 3000 years it appears natural to us. What we call ‘natural’ apparently is time scale sensitive as well.

Regional differences in health

A recent survey into medicine use shows that the most well-to-do sandy region ‘Gooi’ has the lowest use of medicines in The Netherlands (Fig. 791). Insurance companies could decrease their rates for these groups in the same time increasing their wealth (and health). But to which extend Gooi-people owe their health to wealth and life style, to lower housing density, to green area in their direct neighbourhood, dry sandy soil or climate we do not know.



Batenburg-Eddes and Berg-Jeths (2002)
Fig. 791 *Use of medicines*



Garretsen and Raat (1989)
Fig. 792 *Differences in death rates*

Local differences in health

Death rates in the big towns in the nineties were 11% higher than elsewhere in The Netherlands and there are substantial health differences between and within towns (Fig. 792). However, they correlate highly with income differences causing different (un)healthy lifestyles. For example they indicate that in a low-income district the chance to die before the age of 65 is 50% higher than in a high-income district. And rich people move from low-income wet peat and clay districts into high-income sandy districts leaving a less healthy population behind.

Causes of collective disease

Epidemiological research seldom succeeds in convincingly separating causal physical context factors like the urban environment from other coinciding influences affecting health.
The surveyors did not try to explain either comparing regions of The Netherlands because epidemiological research is one of the most tricky disciplines urging expensive longitudinal research extending decades to be convincing. That is a great pity, because as long as statistical evidence fails an even more tricky branch of statistics wins: risk calculation. Risk calculation seems rational, but often it is also the calculation of fears and myths motivated by little more than sharing them in collective fear.

Contributions by design?

Urban design is not always the most effective solution in environmental problems remaining after the great positive health effect of housing itself. Barton and Tsourou (2000) advise 12 key health objectives for urban planners in the context of WHO healthy city project in which Eindhoven participates: healthy lifestyles, social cohesion, housing quality, access to work, accessibility, local low-input food production, safety, equity, air quality and aesthetics, water and sanitation quality, quality of land and mineral resources, climate stability. Evaluating their effectiveness again would urge expensive longitudinal research extending decades to be scientifically convincing.

Stress

The more we know, the more possible threads we become aware of to be calculated. That raises fear and fear raises stress. Stress is suspect in raising or stimulating diseases like cancer. Fear for cancer is so well-known a medical symptom that it got its own name in medical vocabularies: ‘carcinophobia’. Designers in the wake of this uncertainty already try to make solutions for possible problems. That is their task, but they seldom evaluate the effectiveness and possible side-effects of their solutions.

Avoiding risks may be risky

There is something wrong in the state of medicine. King Average rules the kingdom of exceptions human species comprises, but in the same time exceptional occurrences are magnified by television and newspapers. Television and newspapers bomb us by statistical exceptions, distorting our perception of chance and magnifying impact. Risk is popularly defined by chance x impact. The public shame of few physicians involved intimidates the profession as a whole. And we still know little about our body, our own nature yet. Honest physicians remain silent but that is what frightens more.

Avoiding any risk physicians prescribe too many medicines, order too many physical examinations increasing the costs of medical care, increasing slowly appearing side effects. Avoiding any risk raises new risks on other levels of scale. Always avoiding to catch a cold may result in high susceptibility for flu any time we leave a building or a car. Our hygiene drove life out and nature in exile. Our biological resistance fades, the number of immunity deficiency diseases increases. We do not get injuries enough to become vaccinated by nature itself. We like dangerous holydays to flee from our unnatural and boring safety, but we do not know real danger anymore and fall ill by foreign food.

Costs of care

A secret medical survey I heard of by a medical student in the seventies revealed that half of our diseases at that time were iatrogeneous (caused by physicians). I do not know whether that was true or not and what the present state of medicine is in this respect. That is why I fear the worst case. Insurance companies sell fear. We pay more for safety than for anything else: insurance, police, army, preventing fire, burglary and catching a cold. We fear we can not pay all and we double our work until we die from the impacts of stress. The life time we spend on worry is lost well-being, lost health and life time. Our fear for exceptional possibilities raises new diseases of the mind and we fear them as well. In reality our life is safer than ever, but we do not dare to live with life: the risk to die. Life became strange to us and death as well, we fear the unfamiliar because it could be unhygienic.

Carefree nature

In the mean time numerous other organisms are going their own way, not fearing for anything that is not actual and mostly without any apparent fearing at all. They live from very slow to very fast.
I prefer the slow living plants surrounded by their very fast pairing messengers of life-experience, the insects. Plants are the basis of life’s pyramid. Added animal life only selects and regulates like man does as well by harvesting, preserving, mowing and gardening. Sometimes we visit them and walk in something totally else we belong to historically but do not have to understand, something we should not try to plan.

Releasing care

I think it stimulates human health when we bring life close to everybody’s home and living, but nobody knows, it is a hypothesis. Berg, Berg et al. (2001) give an excellent overview in their essay about the relation between nature and health concerning history, possible impacts on stress, fear, physical resistance and personal growth. Nature puts the stressing concept of our own importance into a relative perspective of one species between 1 700 000 ones or more. They differ more from us than any people we tend to reject in social conflict. Nature tempers forced choice as architecture should do as well according to Eyck, Parin et al. (1968) .

The challenge of diversity

The intellectual challenge of this century is to handle diversity instead of generalising it by statistical reduction. Generalising research has diminishing returns, on the other hand design is promising, generating study. Evolution and ecological succession is its model. Studying nature heals social disappointment by disappointing presuppositions, prejudices. It stimulates an active form of modesty. The more we know about nature the more we appear to know not, and the more we want to know, to see, to experience. In any town of The Netherlands specialised study groups of nature associations contribute to atlases of birds by Hagemeijer and Blair , Bekhuis, Bijlsma et al. (1988), Beintema, Moedt et al. (1995), butterflies by Tax (1989) and Bink (1992), bats by Limpens, Mostert et al. (1997), amphibians and reptiles by Bohemen, Buizer et al. (1986) , mammals by Broekhuizen, Hoekstra et al. (1992), fishes by Nie (1996), plants by Mennema, Quene-Boterenbrood et al. (1980), Weeda, Schaminée et al. (2000) and mushrooms by Nauta and Vellinga (1995) multiplying our shrinking world of holiday destinations by growing local universes we tended to overlook. In any town nature writes a history of war and peace far more thrilling than television and newspapers could do.
Nature looks for its journalists because it only exists by the grace of those seeing it.

Suggestions concerning spatial human rights

A. Any human has a right on 300m^2 residential area in a radius of 10km, work and services included.
B. Any human has a right on all necessary sources of living within a radius of 30km. These sources have to give access to products of 2000m2 agricultural land per person. This land should be accessible within a radius of 1000km concerning the risk of stagnating logistics.
C. Agriculture has to be located in areas with highest supply of water, minerals and sunlight. Towns and untilled natural areas have to be located in areas with less minerals.
D. Any human has a right on untilled natural ground uninhabited by man within a radius of x from her or his place of residence measuring at least a radius of x/3; x being {0.3, 1, 3 … 100 000 metre}.
E. Dutch cities belong to the most healthy in the world. So, any attention given to health in Dutch cities is distressing in a perspective of the hygienic condition of cities in the second and third world.

5.3.14 References to Ecologies

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5.4 Valuing Nature

'Nature' is treated as a concept in this chapter and thus as part of a culture that values nature (see *Fig. 1001*). This chapter gives some insight into the types of natural area that can be distinguished. It is the task of the (regional, urban architectural or architectonic) designer to choose and, in the appropriate scale size, those combinations of these forms as a key unit, that make a clear, understandable, comprehensive and feasible plan possible.

5.4.1 Assessing biotic values

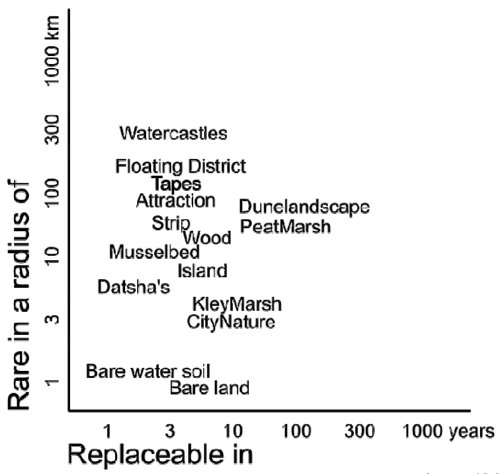
Biodiversity is the 'risk coverage for life'. The loss of biotopes for human beings, animals and plants is the framework within which the seriousness of the environmental problem is assessed. We will not dispute this here, but describe a method whereby these values can be measured. From these points of departure it is simple to evaluate on various scale and time levels to what extent an element of nature is special or unique and replacable.

Heterogeneity is homogeneity on an other scale

In valuing the Dutch flora and fauna on a European level, we should be petitioning for the whole of the Netherlands to be declared a Wadden area, because, at the European level, that is unique feature of our region. But that would create a very undifferentiated picture of the Netherlands. At the Dutch level, perhaps we ought to collect all the ecotopes of our latitude within our national boundary, but if every country was to do that, then there would be homogeneity at the European level. In other words, the question is: What sort of variation do we want, and at which level?

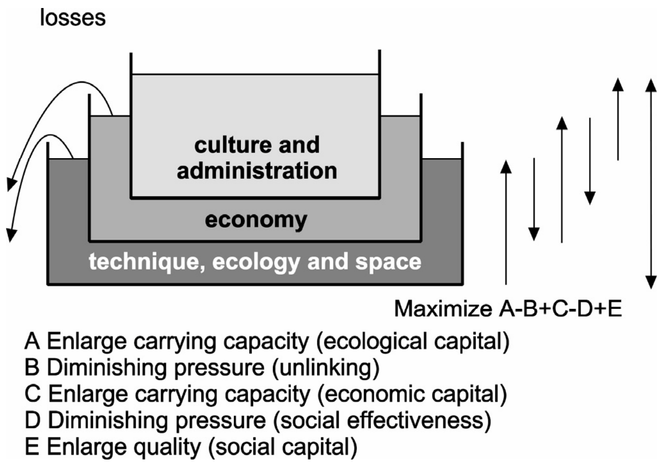
Rarity in space

As our concern is with the biodiversity of the whole world, our priority must be to assess the uniqueness of our nature within R = 10,000 km (the radius of the Earth is approx. 6,000 km). Uniqueness at the continental level can be read off on the scale against the frequency of occurrence of similar areas within R = 1000 km. At the national level, R = 100 km and at the local level, 10 km. Rarity is also culturally useful because it makes cultural values comparable with ecological ones (Fig. 793). Moreover, rarity has a relation with the economic concept of scarcity determining economic value.



Jong (2001)

Fig. 793 *Comparing ecological and urban objects*



Jong and Priemus (2002)

Fig. 794 *Evaluating the incomparable*

Conditional evaluation

Conditionality represented by tanks filled with liquids of different specific gravity clarifies an other possibility evaluating categories of nature and culture (Fig. 794).They could be named as conditional evaluation. This figure shows the relation between increasing carrying capacity of ecological and economic capital while diminishing economic and cultural pressure to avoid losses and to find maximal social capital and quality for future generations.

Replacebility in time

A second consideration could be the extent to which destruction of natural areas can be considered to be irreversible. In other words, 'how long would it take for a similar area to revert to its original state: 1,000,000; 10,000; 100; or 10 years?.

Value as a product of rarity and replacebility

If a certain kind of natural area is frequently found within a given radius, and if it can be quickly brought back to its climax state, less value will be placed on this land than when this hardly ever occurs and when it takes a long time to reach the present quality again. In making a valuation, one should thus take the reciprocal value of the product and count up the scores on each scale level. However, very many variants and specifications are possible. This sort of evaluation has been put forward by Joosten et al. (1992) for the Peel and it would be well worthwhile to work it out in depth.
Interestingly enough, this approach has also been found to be useful in establishing the visual quality of the urban architectural and architectonic aspects of an urban renewal plan (De Jong and Ravesloot, 1995).

5.4.2 Measuring rarity

Expressing rarity in kilometres

The local rarity of 'x' communities, ecological groups, populations, formations, ecosystems *or artifacts* can be expressed as the distance 'y' to the nearest x examples in the neighbourhood.
If the criterium for rarity *x* equals 1, then y is the distance to the next example in the neighbourhood (within this radius <y, it can then be considered to be a unique example). From a given x, a radius can thus be deduced (as a frame) outside of which the object is no longer unique or rare. If these turn out to be the only *x* examples in wider surroundings (a broader frame), then the object with *x* examples with that radius as a grain (unit) is rare again in that wider frame.

Rare on one level, common on an other level

Suppose that, within a radius of 30 km, another 10 examples of the same formation$_{3\ km}$ can be found, but, further away, within a radius of 300 km, none at all, then the regional $_{30\ km}$ rarity of these formations$_{3\ km}$ is low, but the subcontinental$_{300\ km}$ rarity of this district$_{30\ km}$ is high. Conversely, regionally, within a radius of 30 km, a formation can be rare, but, it need not be nationally within a radius of 100 km. This does not negate the fact that the nation may have a responsibility continentally for these sorts of formation.

Involving human artifacts in the comparison

The same applies to artefacts. In Delft there is one, for the Netherlands, rare example of profane-Gothic architecture[a]. There are many more examples from this period in Belgium, but, worldwide, they are only found in Europe. The profane-Gothic example in Delft is thus locally rare within a radius of 100 km; subcontinentally it is not rare, but it is again rare, world-wide.

Determination of the grain of comparison

The question is whether people value this profane-Gothic building in itself or the total urban architectural combination of a profane-Gothic building on a Mediaeval canal. In deciding what is rare, people continue to use a coarser grain when comparing one formation with other examples. To liken this to the production of photographic prints, the distance between the framework and the grains (units) (i.e. the resolution) plays a role in determining rarity.

Rarity resolution

If there were no examples of this type of urban architectural combination in Belgium, then one could also talk of subcontinental rarity. The rarity of combinations$_{30\ m}$ within a subcontinental$_{300\ km}$ framework still has a very high 'rarity resolution' of linear 30/300000 = 0.01%.

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[a] The house of the Hoogheemraadschap Delfland on the Oude Delft 167.

For designers, such precision is greater than that needed for a plan, while 10% is enough to reach a decision on a design sketch. An urban architectural design is not rejected because the wrong bricks have been suggested. For biotic components, in order to reach a rarity resolution that is acceptable for making a decision, a grain must be maintained that bears some relation to the frame

The resolution of plant and animal data

If the number of locations where a species is found, on earth or within the Netherlands, is known, a frame, a grain (unit) and therefore a resolution (the ratio between the two) is implicit. In the Netherlands, the grain, the sampling unit, is usually an 'hour field' of 5x5 km (with a radius of 3 km), which is the average walking distance per hour. For very many species it is known in which hour field and sometimes even in which square kilometer, topographically, they can be found[a] and also partly to what extent.

The rarity resolution of the hour-field frequency measure

The national rarity of a species is then known as the 'hour-field frequency'', the number of hour fields in which the species occurs in the Netherlands. Therefore, it has to do with the quality of the formation For example, for every plant species from different periods, this is fairly well known, so by looking at the development in the hour-field frequency over a number of years it is possible to determine whether a species is threatened within the Netherlands.

The arbitrary boundaries of data

The borders of the Dutch state are arbitrary, because what is measured as rare, nationally, need not be rare regionally or internationally. The rarity resolution of hour-field frequencies in the Netherlands is 3% linear (3 km radius/100 km radius; area-wise it is less than 0.1%: 25 km^2 to 40,000 km^2). In this book we will restrict ourselves to a rough resolution. This can be 10% linear (1% of the area) for nature valuations based on sampling hour fields as large as areas with a radius of 10 km (more than 10 hour fields) in a frame of 100 km (more than 1000 hour fields).

A local policy of rarity

A municipality could, as was considered in Zoetermeer, for example, determine, for its policy on nature, that the accent should be laid mostly on regional and world-wide rarity. If types of ecosystem occur in a municipality that are rare worldwide, then, of course, these deserve to be treated with the greatest urgency. After that, priority is given to things that are regionally rare in preference to national rarities, providing that these occur in abundance elsewhere in the world. In that case, it does not matter whether those things are rare or whether they occur generally in the Netherlands. The aim of municipalities is to create a special identity within their region and not to try to differentiate themselves

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[a]. The plant kingdom is inventorised for the whole country in hour fields. For data, before and after 1950 see Mennema, J., A. J. Quene-Boterenbrood, et al. (1980) Atlas van de Nederlandse flora. Deel 1. Uitgestorven en zeer zeldzame planten (Amsterdam) Uitgeverij Kosmos ISBN 90-215-0847-8.. More recent maps/charts of plant species can be found at the FLORON Foundation Meijden, R. v. d. (1999) Heukels' Interactieve Flora van Nederland Wolters-Noordhoff BV; Biodiversity Center of ETI; Rijksherbarium; Natuur en Techniek; Kosmos-Z&K Uitgevers. en de synecologische CD-ROM Synbiosis van Alterra (Wageningen). The FLORON Foundation has been inventorising the flora per square km. for a number of years. These consist mostly of European distribution maps/charts. For many other groups of species such as amphibians and reptiles, separate national atlases have been published.Groen, Gorree, et al. (1995) Florbase; een bestand van de Nederlandse flora periode 1975-1990 (Bilthoven) CML-rapport nr. 91, RIVM ISBN 90-6960-037-4.. From the toadstools there are approximately 400 mapped per hour-field Nauta, M. and E. Vellinga (1995) Atlas van Nederlandse paddestoelen (Rotterdam) A.A. Balkema ISBN 90 5410 623 9.. The national dispersion of 107 day butterflies is mapped by Tax, M. H. (1989) Atlas van de Nederlandse dagvlinders ('s-Gravenland /Wageningen) Vereniging tot behoud van Natuurmonumenten in Nederland, Vlinderstichting., the European dispersion of much more butterflies by Bink, F. A. (1992) Ecologische atlas van de dagvlinders van Noordwest-Europa (Haarlem) Schuyt & Co Uitgevers en Importeurs ISBN 90-6097-318-6.. From 374 bird species mostly per month the national dispersion is described by SOVON Bekhuis, J., R. Bijlsma, et al., Eds. (1988) Atlas van de Nederlandse Vogels (Arnhem) Sovon ISBN 90-72121--01-5., for cities like Amsterdam Melchers, M. and R. Daalder (1996) Sijsjes en Drijfsijsjes De vogels van Amsterdam (Haarlem) Schuyt & Co ISBN 90-6097-415-8. there are seperate atlases available or inventories like in Zoetermeer Meerendonk, W. W. A. v. (1998) "Vogelwerkgroep Zoetermeer" Jong, T.M. de; Vos, J; KNNV, Kwartaalbericht nr 19. Bird guides like Furgeson-Lees, J. and I. Willis (1987) Tirions Vogelgids (Baarn) Tirion BV ISBN 90-5121-060-4. contain often European maps of dispersion. For many other species groups like amphibians and reptiles seperate atlases are published like Bohemen, H. D., D. A. G. Buizer, et al., Eds. (1986) Atlas van de Nederlandse amfibieën en reptielen (Hoogwoud) KNNV Uitgeverij., vleermuizen Limpens, H., K. Mostert, et al., Eds. (1997) Atlas van de Nederlandse vleermuizen; Onderzoek naar verspreiding en ecologie Natuurhistorische Bibliotheek van de KNNV (Utrecht) KNNV Uitgeverij ISBN 90-5001-091-6., vissen Nie, H. W. d., Ed. (1996) Atlas van de Nederlandse zoetwatervissen (Doetinchem) Media Publishing Int BV ISBN 90-801413-5-6., weekdieren Gittenberger, E. and A. W. Janssen, Eds. (1998) De Nederlandse zoetwatermollusken; Recente en fossiele weekdieren uit zoet en brak water Nederlandse Fauna 2 (Leiden / Utrecht) Nationaal Natuurhistorisch Museum Naturalis, KNNV Uitgeverij & EIS-Nederland ISBN 90-5011-118-1.

from towns outside the region. In simple terms, this can lead to a policy that not only has ecological but also economic significance.

World-wide rarity in The Netherlands

We know that some (sub)species, such as the Zuyder Sea Herring and the small brackish-water jellyfish *Eucheilota Flevensis* became extinct after the closing of the IJsselmeer (Noordhuis (2000). It is known that the core area of the Marsh Fleawort (Weeda, Westra et al. (1991) and the Black-tailed Godwit, a meadow bird (Beintema, Moedt et al. (1995), is in the Netherlands, and that elsewhere they have an uncertain future. Surprisingly, the core area for the Marsh Fleawort is Flevoland, where, after draining the land, it appeared everywhere, spreading rapidly both on land and into the neighbouring waters, but also quickly disappearing again. So we carry a great responsibility when it comes to species like this.

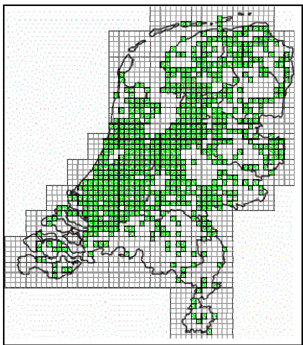
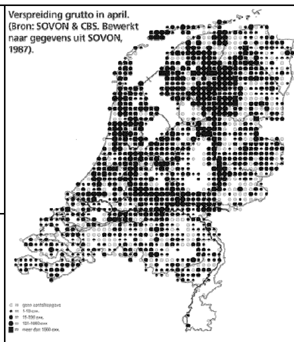
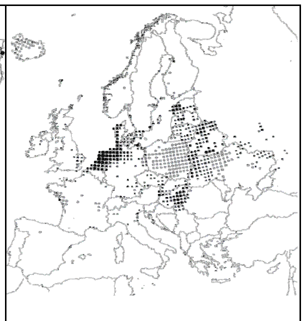
	 29AA02 The association of golden dock (goudzuring) and marsh fleawort (moerasandijvie) in the Oostvaarderplassen		 Hagemeijer and Blair
Marijnissen and Mol (1998)	Foto Alterra, IBN-DLO	Beintema, Moedt et al. (1995)	
Marsh fleawort (moerasandijvie) distribution	29 Class bur-marigold (tandzaadklasse)	Black-tailed godwit (grutto) distribution	European distribution

Fig. 795 *The distribution of two Dutch, world-wide rare species*

Responsibility of The Netherlands in numbers

Reading van Duuren (1997) there are only two of the 35,000 species resident within our national boundaries for which we have the responsibility of a Noah. Of the 1,732,000 known species on earth (only a small part of the probable actual number), 35,000 of them are found in the Netherlands. Expressed in another way, 2% of the total number of species on earth are found within an area that is less than 0.008% of the total land surface on earth. Thus the Netherlands is jointly responsible for a much greater number of species than its area would suggest.

Insects and birds

Of these, the largest number of species are insects. In the Netherlands there are about 17,000 species of insect of which approximately 2,200 are butterflies (most of them only flying at nignt), 4,000 *hymenoptera*, 4,500 are *diptera* and 30 other orders of which most of us have never heard. They are one of the most important sources of food for the 366 species of bird found in this country. There is a nation-wide interest in butterflies, but most of them are linked to rare plants that demand species-rich vegetation. Their distribution can be seen from the various butterfly atlases (M.H. Tax 1989; F.A. Bink 1992; van Halder, Inge and Irma Wynhoff et al. 2000). In addition to the 111, mostly threatened, day butterflies in our country, there are also 1,400 moths and small butterflies, as named in CBS's BIOBASE van Duuren (1997) .

Biodiversity

The insects are part of the phylum *arthropoda*so too are many crabs, lobsters, prawns and water insects that are important for birds.The table below shows ordered lists of the most species-rich phyla of the 50 phyla that biologists have identified, and they are represented according to how species-rich they are in the Netherlands.

BIOBASE CBS Duuren (1997) Name	Species world-wide	Species in the Netherlands	% in the Netherlands	plants or animals	rough 10% estimate
arthropoda	1130000	21000	2	d	
moulds and fungi	100000	3500	4	p	
‘yellow algae’	9200	2200	24	p	
threadworms or elvers	12500	1700	14	d	
green seaweeds	7000	1600	23	p	
the angiosperms	250000	1400	1	p	
lichens	20000	633	3	p	
mosses	23000	533	2	p	
Chordata	52000	470	1	d	
ringworms	8000	350	4	d	
flatworms	14000	330	2	d	
wheel animals	1800	300	17	d	
molluscs	53000	300	1	d	
eye seaweeds	500	250	50	p	
bacteria	1500	150	10	p	*
blue algae	1500	150	10	p	*
Coelenterata	8000	140	2	d	
virus	1200	120	10	p	*
red seaweeds	3500	78	2	p	

Duuren (1997) }.

Fig. 796 *Biodiversity according to the CBS Biobase*

5.4.3 The IJsselmeer case

All these plant and animal phyla play both a qualitatively and quantitatively important ecological role for example in the IJsselmeer region. They are not always given the attention they deserve. An exception to this, for example, is the research carried out by the Mycological Research Work Group for the IJsselmeer Polders (Zanen, Ger van and Piet Bremer et al. 2000) on the approx. 1,600 species of fungi (toadstools) that occur in Flevoland. Also important are the ‘yellow algae’ to which the beautiful siliceous sea weeds (*diatoma*) belong, that, world-wide, have created our oil reserves. In the IJsselmeer region they are an important source of food in the spring and autumn if enough silicates have dissolved in the water to enable these organisms to form their skeletons. Elvers and worms are eaten by fish (e.g *tubifex*). The green seaweeds are a summer source of food, especially in the Markermeer, where, because of turbidity, a few of the oldest organisms, blue algae do less well there than in the IJsselmeer. These processes greatly influence the differences in the fish and bird population between the two lakes. An important member of the green algae for the Mute Swans and Gadwall ducks is the Wreath Seaweed, historically the forerunner of the higher plants and vegetables.

Aquatic and land vegetation

Together with the few gymnosperms (mostly conifers) found here, both aquatic and land vegetation in the Netherlands is made up of angiosperms. Most of the Markermeer and IJmeer are devoid of water plants because the transparency of the water is rather poor, also at depth. However, they have become really well-established at the edges, on the foreshores of the sheltered Gouwzee and inside the dykes, although, on the outer side of the dykes, they are slowly being pushed out by the just-as-valuable Wreath Seaweed. They are very important for aquatic life and for birds in that they stabilise the lake bed. The vegetation on the new land is still rather homogenous, because most of it is made up of heavy clay that, especially in the areas of salt marsh that are not yet ready for agricultural exploitation, does not mature very quickly.

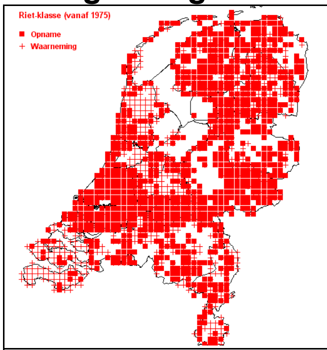
Regionally rare soils

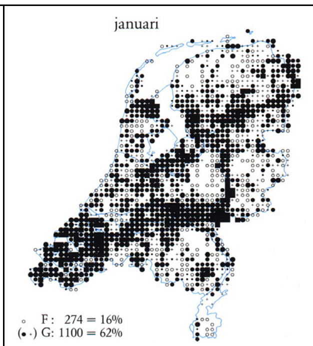
Where the surface soils are sand and loam, as in Pampus-West, an interesting vegetation can develop attracting a rich insect (e.g. butterfly) and bird life. As in all the visionary plans, further research needs to be carried out before these soils are excavated or covered for urban purposes
Dutch vegetation is one of the best researched in the world. Botanically, within the Netherlands, Flevoland is not yet very interesting, but it has great potential, especially along the inner edge of the dykes. Already, in East Flevoland, 50 red-listed (threatened) species are found and summarised by Bremer and Smit (1995) . However, a varied vegetation is in constant competition with productivity which is so valued by the birds of this region. Although clay marsh, as a type of natural area to aim for is doing well there (Bal, D., H.M. Beije et al. 1995), it is an ecological community of few species that only after 20 to 1000 years will grow into a richer peat bog (Londo, G. 1997).

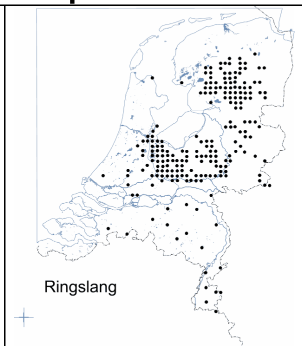
One-sided focus on popular species

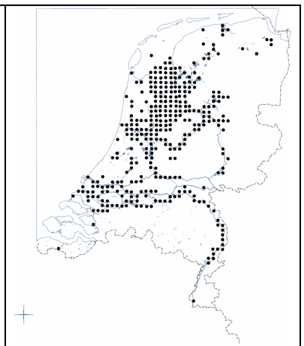
Little attention is often given to mosses and lichens. They will play an important role in the new land if peat formation establishes itself. The *Chordata,* the vertebrates, to which we also belong, can look forward all the more to the active interest of nature work-groups. Of course, this applies primarily to birds. We will return to this topic when we deal with rarity in Europe and the Netherlands. There are very many other vertebrates both now and in the future that can play an important role in the value placed on the region's nature.

Using biological atlases to find relations and potentials









08 Reed class (rietklasse)	*Bean goose (rietgans)*	*Grass snake (ringslang)*	*Smelt (spiering)*

Fig. 797 *Maps from various biological atlases*

In the *Atlas of Dutch Amphibians and Reptiles* (Bohemen, H.D., D.A.G. Buizer et al. 1986) and in the *Atlas of Dutch Mammals* (Broekhuizen, S., B. Hoekstra et al. 1992) one can see what the distribution is with an accuracy of 5 km. From this, it is noticeable that colonisation of the new land from the surrounding old land, for example by the grass snake, is still in its initial phase. Constructing foreshores and islands can stimulate this process. The question is whether, having created such habitats, one should either wait until a breeding pair of the creatures in question make the journey to their new habitat, and by chance survive, so that perhaps in 30 years' time the colonisation can begin, or one should actively introduce them there. Within the category 'mammals', a beautifully illustrated atlas is devoted to bats (Limpens, Herman, Kees Mostert et al. 1997).

The role of fish in the nitrate cycle

Fish, as a group are, of course, of utmost importance to the IJssselmeer region, see the *Atlas of Dutch Freshwater Fish* (Nie, Henk W. de 1996), of which some have the status 'protected species'. There are other species that we would rather be rid of (e.g. bream colonisation). The dubious role of the widely occurring bream could well be reversed if an entrepreneur, for example in Almere, would start using this source of food for the production of cattlefood. In the Netherlands, ten times as much manure is produced as household waste. Currently, the protein in cattle food is produced by blue algae in the root tubers of *vleugelbloemigen* (clover, lucerne and other bean wearing plants) on an area three times as large as the Netherlands, in countries in which children die of protein shortages. However, it is more lucrative to feed these soyabeans to our pigs than to use them to cure children of beri-beri.

Fish ponds

The nitrate-rich decomposition product from protein, manure, finds its way into the Randmeren, partly from Gelderland, where the phyla listed above (but not expanded on further here) make them suitable for the Bream. Elsewhere in the world, to recycle this manure, farms have fish ponds for carp and bream. If we were to follow this example, there would be no better location in the Netherlands than the IJsselmeer region. However, this revolutionary breakthrough for nature in the Netherlands is being hindered by the necessity to adapt the fishing laws: sport-fishermen are unwilling to waiver their right to the bream to professional fishermen, who could supply a substantial source of cattle food.

Mollusks and birds

A variety-rich phyla of mollusks (weekdieren), mussels and the like, 1% of which (approx. 300 varieties!) are found in the Netherlands is, among other things, of great importance for the diving ducks in the area. The basis of this is the enormous success of one exotic variety, the Zebra Mussel that appeared in the Netherlands in 1826 from the Caspian Sea and from 1975 onwards, as the waters became richer in nutrients, spread rapidly. Because of its capacity to colonise so quickly, Zebra Mussels are now common in the Netherlands and in Europe. Their appearance in North America in 1989 and has caused problems there (Gittenberger, E. and A.W. Janssen 1998). They can block cooling water and drinking water systems. Nevertheless, this mussel is the favourite, at the moment, of bird-loving Netherlands. A number of details are important in laying out the bed of the Markermeer. Zebra mussels have a life-span of five years. They attach themselves to hard surfaces and the adults seldom move elsewhere. They begin life as one of the millions of eggs released by the female. The larvae move like plankton by means of vibrating hairs until they develop a shell that makes them sink to the bottom. There they actively creep around until they find a hard, protected anchorage where there is not very much light. They can live at depths (to tens of metres deep) much greater than diving ducks can reach. The larvae eat bacteria, blue algae and very small particles of the sediment in the lakes (detritus). As a mussel, they grow the fastest in nutritious, moving water. They filter the water so actively, that they clean the entire IJsselmeer twice a month. The activities of the Water Flea, a species in the lobster family, have a similar cleansing effect. Mussel beds attract many other forms of life.

European rarity of birds

Percentage of the international bird population Tempel and Osieck (1994) 4) Symbol is similar to presence graph Jan.-Dec. V winter birds Wintervogels M whole year, especially in the winter Π whole year N whole year, especially in the spring of s Λ summer, nesting bird			IJMEER	MARKERMEER	GOUWZEE	IJSSELMEER	OOSTV.PLASSEN	LEPELAARSPLASSEN	TOWN
Water	V carnivore	Goosander				4			
	V carnivore	Smew		2	1	2		3	
	V Zebra mussel	Scaup		5		44			
	V fish	White-tailed Eagle or Sea Eagle					n		
	V plants	Barnacle Goose					2		
	V plants	White-fronted Goose					1		
	V plants	Whopper Swan					1		
	M plants	Greylag Goose					41		+
	M plants	Gadwall (duck)		1		3	4		+
	M plants	Pintail (duck)					7		
	M plants	Wigeon (duck)		3		1	1		+
	M plants	Pochard (duck)	6	2		1			+
	M plants	Teal (duck)					13		+
	Π fish	Grebe				4			+
	Π Zebra Mussel	Tufted (duck)	5	4	2	3	1	2	+
	Π plants	Mute Swan				1			+
	Π plants	Coot				1			+
	N plants	Shoveler (duck)					1		+
	Π fish	Caspian Tern	n				n	n	
	Π fish	Black Tern		n		64	1		
reed	V carnivore	Hen-harrier (breeding)					n		+
	N carnivore	Spoonbill (not breeding)					7	1	+
	Λ carnivore	Spoonbill (breeding)					16	2	
	N fish	Bittern (breeding)					n		
	Λ insects	Spotted Crake				n			
grass	N carnivore	Black-tailed Godwit					1		+
	N carnivore	Ruff					n		+
brushwood	N carnivore	Avocet					6		+
	Λ insects	Bluethroat					n		
	Λ insects	Black-winged Stilt/b					n		
	Λ fish	Common Tern				n			+
forest	Λ fish	Cormorant (breeding)					15	7	
	Π fish	Cormorant (not breeding)				8	3	1	+

Fig. 798 *The European responsibility for birds*

Bird and Habitat Directive

For the benefit of the Bird and Habitat Directive, the European importance of the IJsselmeer region for birds is expressed quantitatively as the percentage of their presence in the European population. The threshold value is 1% of that population. Locations below that percentage, but which nationally are one of the five most important locations for that species are indicated with an 'n' in Fig. 798. In the second column, one can see whether the graph of their presence between January and December peaks in the summer (Λ), the winter (V) summer or whether it is a variant between the two.

Seasonal maxima by bird migration

The seasonal maximum outside the dykes for the Black Tern and the Scaup were 64% and 44% of the European population, respectively. These birds seek the open water. Forty-one percent of the Greylag Goose population winters within the dykes of the Oostvaardersplassen or stays there the whole year round. Of the European Cormorants, 34% breed (/b) in the wooded parts of the Oostvaarders- and Lepelaarsplassen or stays (/nb) either there or on the IJsselmeer. Of the spoonbills, 26% either stay or breed inside the dykes. The Tufted Duck population is found on all the lakes in numbers that together comprise 17% of the European population.

Oostvaardersplassen

The Oostvaardersplassen are indicative of how valuable it is to have still water, reed morass, grass fields, brushwood and woods inside the dykes. There are more species of birds here than anywhere else.

Differences between IJsselmeer and Markermeer

The IJsselmeer is the most important stretch of water in Europe, particularly for carnivores, Mute Swans and ducks.
Despite its large surface area, the Markermeer is still not as important as the IJsselmeer, and, on a European level, is mainly important for ducks of the same assortment.
In the IJsselmeer, ten times more fish can be found than in the Markermeer.
Silt is a problem in the Markermeer. It is restrained by the Houtribdijk to prevent it encroaching on the IJsselmeer. The wind draws the silt up from the bed of the Markermeer. This reduces the entry of light, preventing algae from doing their basic work and the waterplants from expanding, except in the protected waters of the Gouwzee. The Zebra Mussels become covered with silt. The numbers of Tufted ducks and Pochards in the Markermeer are decreasing correspondingly.

Map of the Natural Vegetation of Europe

The conclusion is that also the area within the dykes plays a role of international importance. The *Map of the Natural Vegetation of Europe* (Bohn, Udo 2001) compiled by 102 geobotanists from 31 European countries, is a milestone in international ecology. On this map it can be seen how the narrow coastline between Belgium and Denmark offers botanical potentials that are internationally rare. They are indicated as U2 on the map: 'vegetation complexes of dyked morasses with water-loving oak/ash forests and ash/elm forests'. These cover less than 1% of Europe.

Rarity of Dutch woords

Beech woods are typical of the neighbouring countries, as far as the Alps, and further to the north, the coniferous forests appear: 'More occurs ecologically between the coast and the Veluwe than between the Veluwe and the Urals' (Constandse, A.K. 1967). Indeed, not all the area is covered with tree species with which we are familiar. It is the long-term potentials that are important. In the succession of overlapping ecosystems, this would be merely the natural and varied final stage (climax) with open areas for special vegetation and fauna, kept open by large grazers (Vera, F. 1997).
The forests of the Flevopolders are largely an early reflection of this end stage, but there are also beech and coniferous forests, not characteristic of the region, that foster the establishment of special vegetation such as internationally rare toadstools (Zanen, Ger van, Piet Bremer et al. 2000). This leads to the question of whether, for the benefit of regional diversity, one should allow clay morass, that is rare internationally, to be cut across here and there by forests that are common elsewhere. However, due to manure infiltration and acidity, the undergrowth in our forests does not develop much further than stinging nettles or Wavy Hair-grass (Dirkse, G.M. 1994).

Continental and national rarity

From the view point of European diversity and rarity, the low areas of the Netherlands should be one large wooded morass. Viewed nationally, this would, of course, be monotonous. Throughout the Netherlands, the natural succession towards a final stage is artificially interrupted everywhere. It is held in various, often productive, intermediate stages for the benefit of nature conservation or agricultural goals. The artificiality of nature in the Netherlands as a whole is the result of the simple fact that, without human intervention, half of our country would be sea floor. What is maintained, can be likened to a picture taken of the river delta at the beginning of history with annually changing waterways and pioneering communities. Since 1000 AD, this landscape has been increasingly stabilised by dykes. Since the end of the Würm Ice Age, around 10,000 years ago, when the North Sea was still dry, the seawater rose and fell periodically through the millennia, but it will now rise faster and higher than ever.

Rarity of urban artifacts

Approx. 10% of this landscape is occupied by warmer urban buildings. The Dutch city — on water, with canals and quays — and built on low land is rare internationally. Currently, in modern cities, due to their more open planning, improved hygiene and/or nature friendly policy, one can find a larger number of wild plant species per km^2 than in many natural areas. This vegetation and its insect fauna are mostly inhabitants of more southern, stoney areas, but they form a gene bank for warmer periods and a refuge within the surrounding agricultural wilderness for living creatures such as bats and birds. Many of the birds named can be seen in towns (Melchers, Martin and Remco Daalder 1996). The Grebe and the fox are discovering the town as a new natural area, while the House Sparrow is disappearing.

Architectural rarity

The daring designs and organisation of Dutch environmental planning and architecture as presented in the prize-winning Dutch pavilion by MVRDV at the world exhibition in Hannover is attracting world-wide interest. A growing fascination can be seen in this pavilion for innovative ways of cooperating with nature. Almere has built up a name for itself in the area of architectonic experiments and has become a showcard for architectural designs, but what it misses is an amphibian aquadistrict and water architecture.

Artificial environment

The now freshwater of the IJsselmeer region is maintained by installations such as dykes and sluices. The policy determining the level of this water (high levels in summer and low levels in winter) contravenes what would happen in nature. Within their own territories, the Dutch Ministeries of Transport and Communications (V&W) and Agriculture, Nature and Food Quality (LNV) have developed into nature and environment ministeries: in construction work and in carrying out agrarian management, working together with nature is high on the agenda. Ministry of Transport and Communications constructions such as earthworks, dykes, roads and their verges have become objects for nature engineering (Aanen,P., W. Alberts et al. 1990). Their contours, layout and management have a demonstrable ecological effect within the cities too.

A paradox of environmental and nature policy on different scales

In the past, detergents, and, nowadays, phosphate- and nitrate-rich water from the animal husbandry on the Veluwe reaches the IJsselmeer via the IJssel and the Markermeer via the Randmeren. There, it is transformed by sometimes too rapid growths of, and thereby toxic, algae, grazing, and hunting water-creatures into large quantities of vegetable matter, mussels and fish, which attract large numbers of birds. These birds, that come from far and wide, make this an area not only of international importance, but also a rare area, nationally.

Due to the success of environmental policy (e.g. phosphate-free detergents), less and less nitrate and phosphate is entering the lakes. The reduced availability of these minerals sets an upward limit on food production and allows other, nationally rare, but less productive species to establish themselves. Perhaps the age of migrating birds will be followed by an age of reptiles, amphibians and mammals that, due to the lack of sandy areas and brushwood (foreshores and islands) outside the dykes, have not yet colonised the region. With a view to the future role of the region, it is important to gain insight into the increasing complexity of this system.

National rarity of birds

The table below shows the ecotope of red-listed birds found in the IJsselmeer region (Duuren, L. van 1997). The Red List reflects the national rarity of species. It is a selection made from many other targeted species included in realising a Primary Ecological Structure. The internationally rare species are also represented in this:

		NEST	FOOD	mainly insects
Black Tern	BA	open water	open water	+
Little Grebe	C	open water	open water	+
Garganey duck	C	open water	open water	
Bittern	BD	reed vegetation	reed vegetation	
Sedge Warbler	C	reed vegetation	reed vegetation	+
Savi's Warbler	C	reed vegetation	reed vegetation	+
Spotted Crake	D	reed vegetation	reed vegetation	+
Bearded Tit	DA	reed vegetation	reed vegetation	+
Spoonbill	DA	reed vegetation	reed vegetation	+
Great Reed Warbler	BD	reed vegetation	brushwood	+
Ruff	B	brushwood	grassland	+
Common Tern	C	sandy, open brushwood, pioneer	open water	
Avocet	DA	sandy, open brushwood, pioneer	open water	+
Kentish Plover	BD	sandy, open brushwood, pioneer	sandy, open brushwood, pioneer	
Ringed Plover	D	sandy, open brushwood, pioneer	sandy, open brushwood, pioneer	+
Redshank	C	grasland	grasland	+
Black-tailed Godwit	CA	grasland	grasland	+

B Very threatened
BA Very threatened, important internationally
BD Very threatened, vulnerable
C Threatened
CA Threatened, important internationally
D Vulnerable
DA Vulnerable, important internationally

Fig. 799 *The national responsibility for birds*

Habitat combinations important for birds

Judged by its feathered visitors, the national rarity of the region can be listed as open water, reed vegetation, brushwood, grasslands and sanctuaries (also on the land of South Flevoland). Sanctuaries are important for birds during the vulnerable moulting period, when their flying capacity and food menu is restricted. For this reason, a favourite moulting place is the lonely Houtribdijk, because it is out of reach of predators and it offers sufficient food. If also used for recreational purposes, then good organisation is required. Wide vistas of open water is also a visual rarity, even though the Zeeland waters are not more than 100 km away. Ecologically, however, large expanses of water are not particularly important (what *is* known is that the Scaup duck is moving away from the coast in indeterminable numbers and that only the Cormorant has a flight range of more than 1 km).

Recreation symbiosis

These waters are mostly important for recreation, for those sailing in the 'brown fleet' of old ships from the historically important harbours in the region. For the real sea sailors, the Waddenzee and the North Sea are nearby.Other sailors like to keep in sight of the shores. When the mast route from the Zeeland waters to the Friesian lake region — the 'Blue Arrow' in the national plan — becomes operational, then the IJmeer will become a junction of shipping lanes. It is questionable whether this recreational pressure will be favourable for moulting and breeding birds. There will be great resistance against high-rise buildings along the shores, and certainly on islands off the coast. A minority of the sailors is against the compartmentalisation caused by islands and foreshores. On the other hand, these supply isolated reed vegetation, brushwood and grasslands, the areas of which are too small for non-swimming predators which would otherwise make bird life impossible. For example, the Spoonbill has been forced out of the Naardermeer by the fox. There is little differentiation in the Markermeer, in this respect. Greater differentiation in land/water transitions would create a more complex system with more species of birds and of other creatures too.

5.4.4 Replaceability

Expressing replaceability in years

Just as rarity can be expressed in kilometres, so can replaceability be expressed in years. A combination of both was first suggested by J.H.J. Joosten and B.P.M. Noorden (1992) as a basic way of valuing an ecosystem. This method has been worked out here and applied for the first time in Almere in order to include human artefacts in the comparison. This basis for comparison is important for many urban architectural and political considerations. It is a consideration of basic qualities in space and time. For example, it is an alternative to earlier attempts to express nature in terms of money or functionality for people (Maarel, E., van de and P.L. Dauvellier 1978; Groot, R.S., de 1992). On the other hand, it might offer the possibility of expressing money in more general ecological definitions of scarcity and production opportunities. The replaceability of an ecosystem or artefacts can be expressed as the number of years needed to recreate that object.

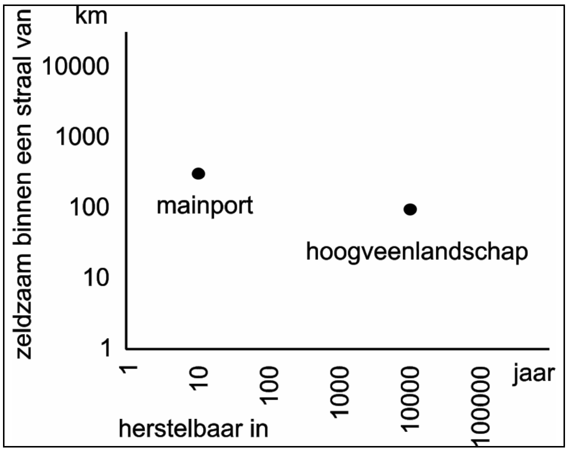


Fig. 800 *Rarity and Replaceability*

Comparing natural and artificial monuments

This figure shows that a main port such as Schiphol and a blanket bog formation such as the Peel (both with an radius of 3km) in a radius of approx. 300 and 100 km, respectively, are rare, but that the time needed to create them is very different. It takes about 10 years to rebuild a main port, but the destruction of blanket bog landscape takes at least thousands of years to reverse. The value of both can be expressed by multiplying both amounts: 3,000 for a main port and 1,000,000 for a blanket bog landscape in our country. The values become more legible by choosing the logarithm (the 'number of noughts'): 3.5 and 6.

Rarity and replaceability

By viewing rarity in combination with replaceability, a host of methodological queries arise, but they have managerial, cultural, economic, technical, ecological and time–spacial departure points which are urban ecologically relevant. Also even if one doubts the possibility of putting this idea into practice, the mental exercise of thinking through from these points of departure can lead to clarification in various scientific, technical and managerial urban ecologically relevant areas.

5.4.5 Comparability Problems, which categories?

What is replaceable?

Both the IJsselmeer and the Oosterschelde are ecosystems that were formed from a salty sea environment by human intervention during the last century. To what extent can they be compared? This is important for determining their rarity. In determining their replaceability, the question of comparability also plays an important role.
The replaceability of both systems can be initially viewed as being less than or equal to their age, say 30 years. However, one could ask what should be understood by 'recovery' in this context.

Supposed expectations on succession

Would their ecosystems experience the same succession if they were now exposed to the sea for a number of years and then shut off from it again? There are a host of examples in which small differences in the initial situation or differences in intermediary situations (e.g., different weather conditions at crucial phases, climatic changes that have started in the meantime, changes in recreational use) can change the direction of the development, to give another result. Are the different outcomes from such possibly different successions comparable and accountable as one group of ecosystems? If one would answer 'no', then one would not be able to give meaning to the concept 'recovery'. In that case, one should, on the grounds of deep ecological insight into succession variants and how to influence them, have access to a sophisticated division of the ecosystem categories that emerge in order to judge exactly whether the outcome of the present succession can be considered to be reconstructable. To have such confidence in ecological predictability is unjustifiable. The far-reaching planning that would be needed to achieve a nature concept exactly is both unnatural and paradoxical, if we want to consider and appreciate 'nature' as being outside human planning.

Initial situation

For this reason, one has to harmonise the definition margins of the ecosystem category with the predictability of its, by natural chance directed, existence, and answer 'yes' to the question. In the same initial abiotic situation of a large-scale transition from salt to fresh water, one must include in an ecosystem category all outcomes of possible, and within reasonable margins, spontaneous successions.
What is meant by 'the same initial abiotic situation'? Can this initial situation ever be achieved again? What effects do we have in mind?: total resalination; unexpected overall oil pollution and the resulting death of all life; building to saturation?
For a realistic definition of the replaceability, one has to add the time needed to return to a similar initial situation with the time needed for the succession that follows.

Internal and interdependent comparability

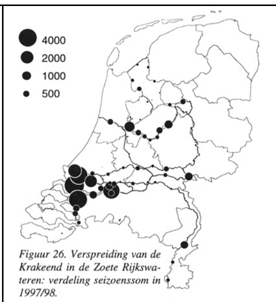
Within one ecosystem, one can talk of an 'internal comparability', as being essential for defining its replaceability. For defining rarity, the 'interdependent comparability' of a number of ecosystems is necessary. In this way, the rarity of the IJsselmeer region can be relativised by the presence of the Oosterschelde. This consideration is clarified by means of an example.

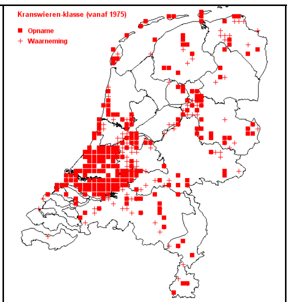
5.4.6 Valuation bases

The death of one is the food of another

Love for an animal or plant species is not always the best stimulus for gaining insight into ecological coherency and perspective. In an ecosystem the death of one is the food of another. Every human intervention in this is a choice, just as building an urban district is a choice. To report on the ecological effects of such a project, a broader insight is required than can be supplied by a few indicator species. Bird, butterfly, plant, toadstool, reptile, mammal and bat work groups are active in almost every town and city. They collect a wealth of information about *their* fascination for the more attractive (caressible) species of the plant or animal kingdom. Full of idealism, thousands of volunteers and hundreds of professional biologists go out and about daily to make inventories. Because of this, atlases are now available showing the distribution not only of categories already named, but also of aquatic plants, molluscs and fish for the Dutch and sometimes European areas or for urban areas, e.g. Amsterdam (Melchers 1991, 1996; Denters 1994), that register their occurrence up to an accuracy of 5 km and sometimes even to 1 km.

Preference for specific species or combinations
From time to time, these distribution maps are amended. There are now already a number of decades that can be compared, so the national or regional presence of animal or plant species can be clearly seen. However, one should realise that there are more and better observers than there were, so that some species might appear to be expanding in numbers, while that might not, in fact, be the case. A recent milestone in Dutch synecology is the overview made of all plant communities, which is also available electronically (Alterra, Synbiosys). Because of this, one can gain a view of succession series and thus the planning for each community. These possibilities will be utilised in the years to come in national and provincial policies on the goal species for the EHS. These atlases have been very useful in writing this book. The example below illustrates how, by referring to different sources, the importance of garland weeds (kranswieren) for the Gadwall duck can be suggested.





IVN Vecht & Plassengebied	Bekhuis, Bijlsma et al. (1988)	W.Kolvoort	Synbiosis, Alterra
Gadwall duck (krakeend)		04 Garland Weed Class (kranswierenklasse)	

Fig. 801 Similarities in distribution situations

Uncertainties
These facts are by far not in a form in which they can be gathered together into a definitive system description. Attempts to do this at national and regional levels by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) and the *RIZA,* among others, are underway. For the time being, the Ministry of LNV is placing an accent on the relationships between vegetation and birds (Schaminée, Joop, and André Jansen 1998, 2001). The presence of certain birds can indeed be an indication of combinations of environmental factors of different scales, because they put different demands on their dynamic fouraging area compared with their peaceful breeding or moulting site. The RIZA has recently produced a more complete description of the IJssel- and Markermeer (Noordhuis, R. 2000), paying attention to the physical and chemical environment, the by many underestimated role of plankton, aquatic plants, fish, water birds, birds that breed in the Netherlands, reptiles, amphibians, mammals, their developments and regional potentials.

An unpredictable young and dynamic ecosystem
From this emerges a dynamic picture of the IJsselmeer region — a young, artificial and unpredictable ecosystem, with the seasonal, annual and decennial coming and going of species, largely in an unclear relationship with each other. Every year, new species are found in the IJsselmeer region, while, at the same time, others disappear. It is difficult to find a reference in the past to make a guess as to where it will go to in the end.
The relation between the large water system outside the dykes and the just as dynamic and increasingly valuable ecosystem on the new land is hardly indicated, because the land, the Oostvaarders- and Lepelaarsplassen, are not included in the area of study of the publication. Nevertheless, it is precisely this relationship that is important when making decisions about whether or not to build outside the dykes.

5.4.7 Valuing urban nature

A continuing debate
There is no concensus about the way in which urban nature should be valued. This emerged from a debate of biologists in the WLO Work Group for Urban Ecology held on 20 June 2001 at the request of Bram Mabelis, following the publication of his article '*Kwaliteitsmeters voor stadsnatuur*' (Quality gauges for urban nature) in *Levende Natuur* (Issue 6, 2000).

Source: Bram Mabelis' article
During that debate, other publications and methodologies were discussed. From that discussion it appears that potential, time and scale are important concepts in valuing nature. The usefulness of a methodology depends on the balance between politics, design and science. Each of these three has its own character and values.
The texts of different reactions are given below:

IJsbrand Zwart:
Said that, as an employee responsible for ecological policy in Almere, he is trying hard to find a basic ecological map with valuations. Because of the fact that Almere is only 25 years old, the present quality is limited and many facts are missing. The soils (clay and building sand) have nothing special to offer. Describing ecotopes fits in with his intentions to map the nature values of Almere. Due to lack of data, however, it is impossible for him to use species as a gauge. In his opinion, the methodology relies too much on existing facts and qualities, because, in particular, the potentials that are present play an important role.

Henk Timmermans:
Thinking about quality sizes and weights for urban nature demands standardisation on the one hand, and that could be done well by the institutes, and on the other, it must fit in with, and be useful in practice. The latter must be done, and is already partly done, by the municiple services. But they are all trying to 're-invent the wheel'. Therefore, cooperation has to be sought between the various municiple services, the exchange between institutes could be brought up to a higher level and the relationship between research and practice needs to be improved. That is possible in a large project, but non of the participating actors is powerful enough in capital or influential enough to initiate such a project. Would not this be a coordinating task, and thereby a *raison d'être,* for the WLO?

Robbert Snep:
confirms the importance of quality gauges for urban nature. In this, it is important to keep potential and present nature values separate. The present nature value can be determined by making an inventory of nature values and by monitoring target species. The potential nature value is determined by (a)biotic limiting conditions, the spacial positioning (local, regional and national) and the dynamics (management and interference). In working out methods for inventorising and monitoring, as well as determining the potential ecological value, many aspects are not taken into consideration (such as scale level, completeness, trustworthiness, area coverage). A more refined working out of the methods used and (where successful) their standardisation would be desirable.

Taeke de Jong:
Quality gauges for urban nature (Mabelis 2000; Zoest 2001) have managerial, cultural, economic, technical and ecological uses and a function in (time)environmental planning. All the uses earlier listed can be found in this last function. Within environmental planning and urban architecture, each with their own quality criteria (utility, appreciation and durability, in many senses of the word, such as the 'robustness' of the design and the capacity to remain functional in many different situations for many different interested parties), the emphasis does not lie on the actual value of a region, but on its potential value in the future. Essentially, this designer's perspective is essentially of another modality than that of the empiricus. Urban architecture and environmental planning merely create conditions. They cannot bring about or predict utility, appreciation or durability. There is a similar problem in ecology, that of unpredictability due to the lack of many, still unknown and sometimes intangible, causal connections.

The danger of fixing specialists' preferences in valuation maps

For more than 30 years, the urban architectural design profession has been objecting to valuation maps that fix combined values from a particular sector (see, e.g., the debate in the '70s about mapping the environment), because surplus values can only be compiled from partial values. These maps are made using information from different sectors (management, culture, economy, technique, ecology, available capital). A 'sieve analysis' is sometimes applied to all these maps, brought together as layers in a GIS system, to form a stain chart with vetos. Once the vetos have been established, then the role of those sectors in the decision process comes to an end. The urban architectural conceptions that are still allowed to enter this type of 'hinderance chart' or 'limiting condition chart', are often no more than 'left-over options' that produce insufficient or poor living environments. In practice, all these sector charts have their own untraceable assumptions and complicated deliberation systems that are mistrusted in political debate because they cannot be understood in 'simple round words'.

Playing specialists off against one another

In this confusion, the designer takes the opportunity to undermine all these interests with a new concept that offers unforeseen possibilities. In doing this, previous advice is shouted down by reactions from sectors that have kept quiet up to that point and now see a new chance. The agenda is quietly changed in favour of those who are shouting the loudest at the decisive moment. The trick is to be able to play out alternative ecological plans against each other in simple round words or pictures. The valuation chart is used occasionally in this process, but by continually referring to it lessens its power to convince, because the other sectors bring their own valuation chart into the game, whether or not from a hidden agenda. The political game of dice only looks at the side that lies uppermost at the crucial moment.

Improving instead of protecting

Whatever way one measures it, everyone can see that ecological values are going down. It is important to find a method whereby not only registered values are protected and stabilised, but where the value of 'worthless' areas can be increased in the hands of designers so that they are given new chances in changing situations. Ecology can offer vegetative images that stimulate designers' imagination. For me, the aim of urban ecology is to operationalise the design-relevant presuppositions of different ecological valuations in a language that offers a framework for deliberation for designers and politicians, and also for other sectors. My first attempt (Jong 2001) took rarity and replaceability as a point of departure for valuation. These ecologically important variables are compatible with the way of thinking of the urban architectural designer, but they also have an economic meaning. They offer a design-technical and political framework within which other sectors can also be considered.
As urban architectural work and the political trade are both differentiated on the basis of scale (European, national, provincial, regional, municipal), it is a good idea, also in ecology, to differentiate by scale. Each scale range between a given grain (unit) and framework of decision-making has its own style of deliberation.

A grain of valuation

In Mabelis' systematics, two differences can be identified that have many interesting theoretical implications. Mabelis' grain is species-level, and the framework is a referential area such as a park, neighbourhood, district or town. After long hesitation, the grain taken in a variable framework when planning Almere Pampus was the neighbourhood level (radius 300 metres). By including 'species-similar' references in the wider surroundings within the concept of rarity, many problems in establishing an historical place-bound reference can be avoided. Therefore, unlike Mabelis' system, the reference is not internal, but external: Are there similar systems in the (wide) vicinity? These references would change simultaneously and detectably if, for example, climatic change made the historical reference irrelevant. In addition to that, the urban environment is already incomparable with historical references, due to raising (using sand to prepare land for building), draining and a higher average temperature, unless one restricts oneself to those district parks which have a similar water management system as before urbanisation.

Indicator species

I agree with Mabelis' choice to use a number of indicator species, irrespective of their rarity and relationship to each other. If the rarity can be valued at system-level, then valuing it at species-level would lead to double valuation. Mabelis only measures the diversity of indicator species. In itself, it is a valuation choice that can become opaque and evoke discussion when the choice of indicator is made complicated by professional ecologists. My question in Almere was: 'From what scale and categories does one choose the limits to a system, in order to be able to identify surrounding systems as being comparable?' I have not found an answer yet. Perhaps it is completely unnecessary to make a systematic choice of category. On the one hand, I am impressed by the enormous number of inventorial data that, due to Schamineé's efforts, have now been released by Westhoff's plant community School and built into the nature-target types of the LNV (Schamineé and Jansen 1998, 2001). On the other hand, I am also sensitive to the criticism directed against such preconceived category formation. I am more inclined towards abiotically orientated types of ecotope, because they can be directly influenced by urban architecture, and indicate potentials. However, data and prognoses based on them are less accessible.

Categories and types to compare

New categories are constantly emerging, especially in urban districts, or new spacial constellations are recognised that do not fit into an existing typology. A similar sort of problem already exists within the designers' profession when you try to set up a building typology, not to mention an urban architectural typology. Every final year student will try to prove that their design does not fit in there, and that it is thus a 'new type'. In the 1950's, CBS's Standard Company Categorisation (SBI) divided companies into the wood industry, steel industry, textile industry, and so forth, but it collapsed as more industries came into being that began to use a combination of all these materials. The statistics from the old company categorisation became incomparable with those of the new one, so that it was no longer possible to make long-term prognoses from this material. The same thing happened with the land-use statistics. Each categorisation is thus a child of its time and carries along with it hidden assumptions. The only aspect that remains is the level of the species. I have to agree with Mabelis there, although taxonomy also turns out to be a dynamic process.

Valuating potentials

I do not know how the ecological valuation charts that van Zoest showed of Amsterdam were made. I am curious to find out, and hope that their valuation systematology is simple enough for designers to have access to their presuppositions. In that case, an interest will also emerge in the ecological potentials of less valuable areas and that is more challenging and more productive than a veto chart of valuable areas. For the time being, in Almere, there is only talk of less valuable areas. Therefore what it comes to here is extending the abiotic potentials. That demands design, ecological design, and the creation of living conditions. When considering nature development, one should perhaps have no other aims in mind than diversity. After all, we value nature mainly in that it *does* lack human influence. In that light, nature-target types are paradoxical. We do not design a house to instigate a certain type of household. We design an *oikos* merely to make different households possible.

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5.5 Managing Nature

Many kinds of context

There are many managerial, cultural, economic, technical, ecological and spatial situations (spacial contexts and perspectives in time) that influence ecological success, whatever the plan. They can be incompatible on different scale levels, without interfering with a rich natural habitat. It is thus possible for the aims for nature at the provincial level to be mainly directed towards clay morasses, while at the municipal level, local differences in soil and land use are utilised for much more promising nature development on such tiny local areas that they do not hinder the larger targets. In this way, national societies such as the *Natuurmonumenten* and the ANWB can place the emphasis on recreational values and national infrastructure, while the municipality can prioritise its responsibility for housing.

Contradictions and conflicts solved by scale

Such contradictions are often a question of differences in scale and are therefore not true contradictions. Management may direct on a national level, follow on a regional level and direct again on a local level. Nationally, culture may be focused on tradition, regionally on experimentation and locally on tradition again, or vice versa. The national economy can flourish, be retarded regionally, but within them, there may be successful locations again. In a more physical–technical way one can direct one's attention nationally to specialising on European nature or economy, while striving locally for function combinations that produce a better overall fulfillment of life. Ecological diversity on a European level can produce homogeneity on a national level and within the NW European building concentration there is enough space left over for national distribution, and, within that, for concentration again, regionally.

Effect analysis supposes expectations about the future context

The number of plausible perspectives on all these levels is so large that, unless founded on a broad scenario, there is no possibility of carrying out an effect analysis that will have any predictive value. National, regional and local nature goals and presuppositions about managerial power, cultural developments, economy, techniques, ecology and space are thereby essential. To arrange these presuppositions scalewise, the following scheme can be applied:

	radius	managerial	cultural	economic	technical	ecological	spacial
global	10000 km	directing	experimental	growth	integration	diversity	distribution
continental	1000 km	following	tranditional	shrink	specialisation	homogneity	accumulation
national	100 km	directing	experimental	growth	integration	diversity	accumulation
regional	30 km	following	traditional	shrink	specialisation	homogoneity	distribution
local	10 km	directing	experimental	growth	integration	diversity	accumulation
urban	3km	directing	experimental	growth	integration	diversity	accumulation
in the district	TKA	directing	traditional	growth	specialisation	diversity	distribution
	Hosper	directing	experimental	growth	integration	diversity	accumulation
	H+N+S	following	experimental	growth	specialisation	diversity	accumulation

Fig. 802 *Presumed perspective*

Hidden suppositions about the future in plans

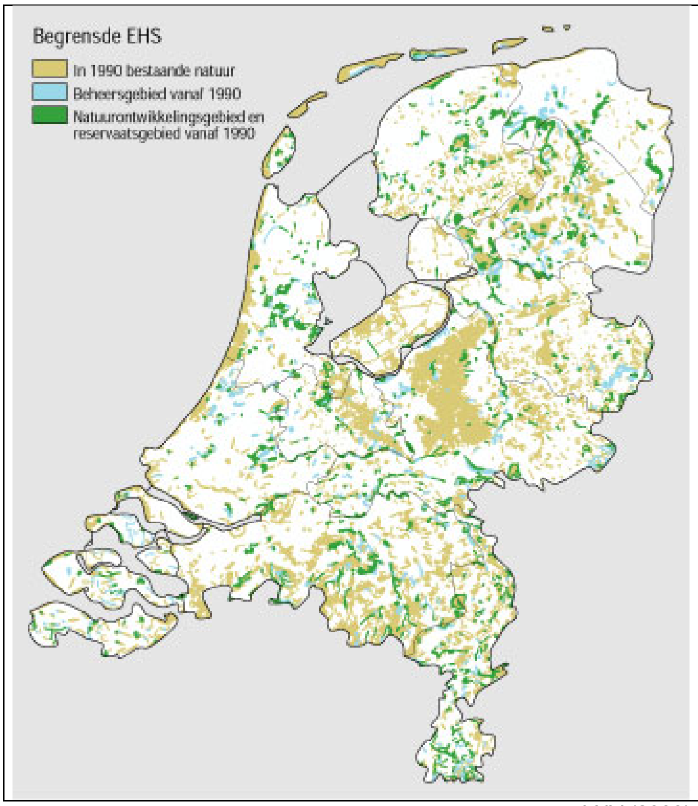
Urban architectural plans for the same region can differ in perspective. The perspectives of the urban architectural plans of TKA, Hosper and H+N+S differ as to whether the authorities will be directing or following at the district level, whether one would like to live more traditionally or experimentally, or whether there is talk of (de)concentrated specialisation or concentrated integration of functions.
The interpretation given here is arbitrary and on higher scale levels it is uniform for the designs, but the scheme makes one aware of suppressed presuppositions that designers and valuators have with

respect to different levels. These presuppositions differ among the participants in the decision-making process. We can, however, realise them in part, especially at the local level. If these presuppositions are explicit, a guess can also be made of the effects of different plans after further research at the neighbourhood level.

5.5.1 Main Ecological Structure (EHS) and nature-target types

EHS

A main ecological structure (EHS) is established in nature policy that is worked out further for each province.



LNV (2000)

Fig. 803 *The EHS for the Netherlands*

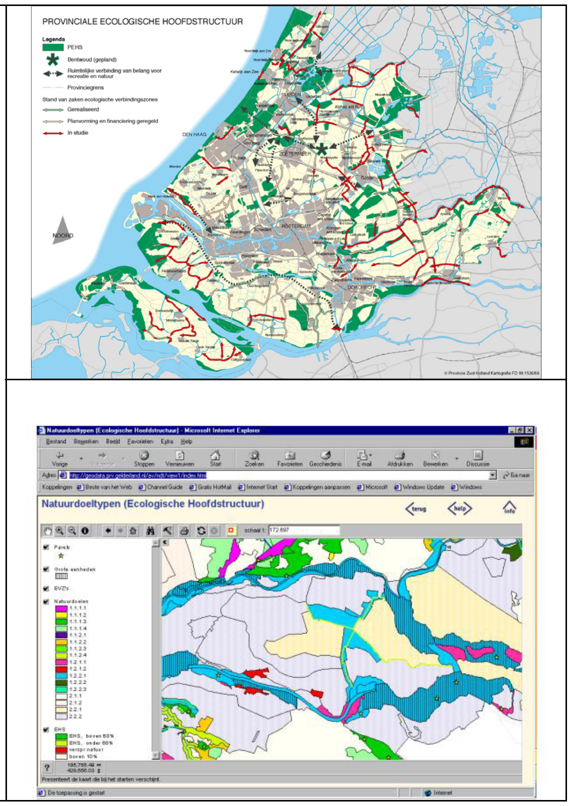


Fig. 804 *The EHS worked out on Internet for the province of South Holland and the Gelderse poort*

Nature target types

Nature conservancy sets certain types of nature as a target for itself, in order to shape the main ecological structure in the Netherlands. In Fig. 31 these nature-target types of the IKC/Ministry of *LAVIN* by Bal, Beije et al. (1995); Bal, Beije et al. (1995); Bal, Beije et al. (2001) are linked to an urban architectural scale.

	Main group 1	Main group 2	Main group 3	Main group **4**[1]**)**
Name	almost-naturally	supervised-naturally	half-naturally	multifunctional
Radius	**3km**	**>1km**	**300m**	**100m**
Future picture	global	global	fixed	fixed
1. STRATEGY				
spacial scale	Landscape > thousands of ha.	Landscape > 500 ha.	ecotope/mosaic to approx. 100 ha.	ecotope mostly a few ha.
location	mostly process-determined	process and pattern-determined	process-, pattern- and species-determined	pattern- and species-determined
processes	not directed	directed integrally	directed in detail	directed in detail
patterns	not established	not established	established, perhaps a cyclical succession	established
directing variables	non	process-focused on landscape level	process- and pattern-focused up to ecotope level	process- and especially pattern-focused up to ecotope level
2. LAY-OUT				
nature–technical	only in the beginning phase	only in the beginning phase	perhaps repeated	perhaps repeated
environmentally specialistic	only in the beginning phase	only in the beginning phase	permanent, if necessary	non
Conservancy				
Internal nature conservancy	non	non	partly necessary	necessary
compartmentalising	non	non	possibly in mosaic	possible
shared use	(very) extensive	(very) extensive	(fairly) extensive	characteristic
3. DEVELOPMENT				
succession-stage	mostly diverse stages	diverse stages	a stage/mosaic	a stage
extent of development	on average long	on average long	rather short	short
predictability	on average, limited in the long run	on average, rather limited in the long term	quite large	large

[1]) The characteristics of the types in subgroup 4B (derived multifunctional types), apart from the characteristics associated with shared use, they are the same as those of the types from which they are derived.

Bal, Beije et al. (1995)

Fig. 805 *Overview of nature-target types*

Nature-target types specified by physical-geographical region

The nature-target types are specified according to physical-geographical region (Fig. 806).

Physical-geographical region		Main group				total
		Landscape scale		ecotope level		
		1	2	3	4	
		3km	>1km	300m	100m	
hl	Hilly land	1	2	12	2	17
hz	Higher sandy soils	2	3	19	2	26
ri	Fluvial area	0	2	12	2	16
lv	Laagveen area	1	3	10	2	16
zk	Marine clay area	0	3	13	2	18
du	Dunes	1	1	16	2	20
az	Estuaries	0	3	8	1	12
gg	Tidal zone	2	2	2	0	6
nz	North Sea	1	0	0	0	1
	Total	8	19	92	13	132

Bal, Beije et al. (1995)

Fig. 806 *Nature-target types per* ***physical–geographical region***

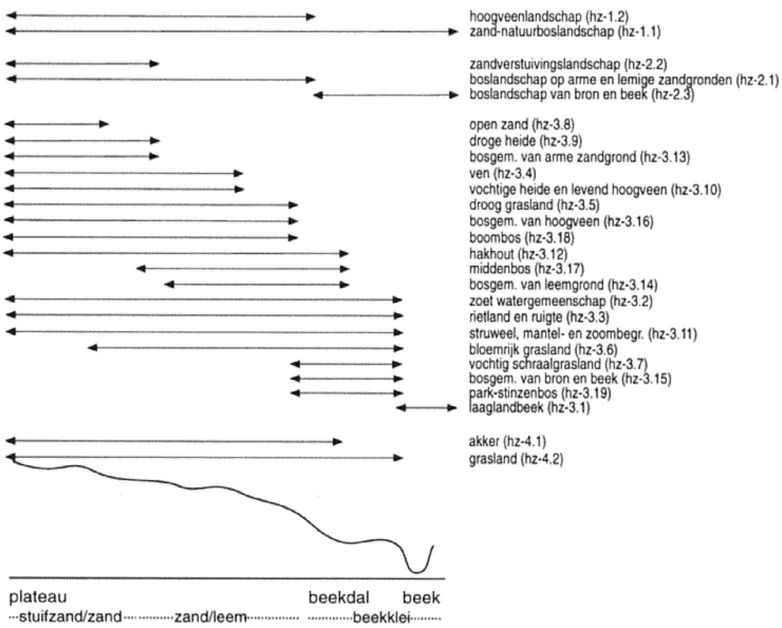
5.5.2 Nature-target types for the higher sandy soils

The following nature types have been established as targets for the physical-geographical region 'higher sandy soils' (e.g. the Veluwe) (Fig. 807).

Fysisch-geografische regio ***Hogere zandgronden***			
3km	>1km	300m	100m
hz-1.1: zand-natuurbos-landschap	hz-2.2: zandverstuivingslandschap 	hz-3.1: laaglandbeek	hz-4.1: akker 
hz-1.2: hoogveenlandschap 		hz-3.2: zoetwatergemeenschap	
		hz-3.3: rietland en ruigte	
	hz-2.3: boslandschap van bron en beek 	hz-3.4: ven	hz-4.2: grasland 
		hz-3.5: droog grasland	
		hz-3.6: bloemrijk grasland	
		hz-3.7: vochtig schraalgrasland	
		hz-3.8: open zand	
		hz-3.9: droge heide	
		hz-3.10: vochtige heide en levend hoogveen	
hz-2.1: boslandschap op arme en lemige zandgronden 		hz-3.11: struweel, mantel- en zoombegroeiing	hz-48: afgeleide doeltypen uit hoofdgroepen 1-4
		hz-3.12: hakhout	hz-48.3: inheemse bos cultuur
		hz-3.13: bosgemeenschappen van arme zandgrond	hz-48.4: bos cultuur met uitheemse soorten
		hz-3.14: bosgemeenschappen van leemgrond	
		hz-3.15: bosgemeenschappen van bron en beek	
		hz-3.16: bosgemeenschappen van hoogveen	
		hz-3.17: middenbos	
		hz-3.18: boombos	
		hz-3.19: park-stinzenbos	

Bal, Beije et al. (1995)

Fig. 807 Nature-target types for the **higher sandy soils**

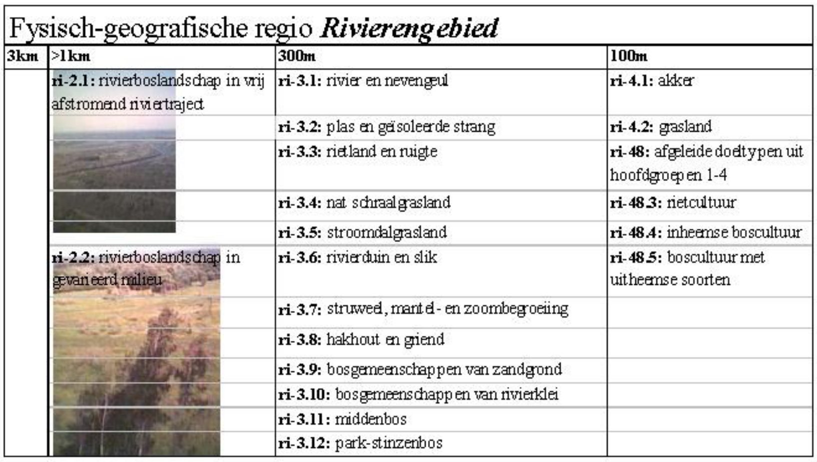


Bal, Beije et al. (1995)

Fig. 808 *Nature-target types for **higher sandy soils in local profile***

5.5.3 Nature-target types in fluvial areas

For The Fluvial Area, the following nature types have been established as targets (Fig. 809).



Fysisch-geografische regio ***Rivierengebied***

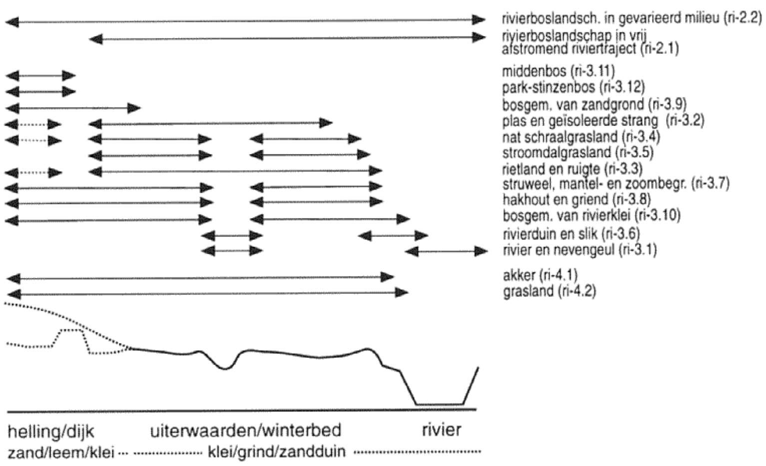
3km	>1km	300m	100m
	ri-2.1: rivierboslandschap in vrij afstromend riviertraject	**ri-3.1:** rivier en nevengeul	**ri-4.1:** akker
		ri-3.2: plas en geïsoleerde strang	**ri-4.2:** grasland
		ri-3.3: rietland en ruigte	**ri-48:** afgeleide doeltypen uit hoofdgroepen 1-4
		ri-3.4: nat schraalgrasland	**ri-48.3:** rietcultuur
		ri-3.5: stroomdalgrasland	**ri-48.4:** inheemse boscultuur
	ri-2.2: rivierboslandschap in gevarieerd milieu	**ri-3.6:** rivierduin en slik	**ri-48.5:** boscultuur met uitheemse soorten
		ri-3.7: struweel, mantel- en zoombegroeiing	
		ri-3.8: hakhout en griend	
		ri-3.9: bosgemeenschappen van zandgrond	
		ri-3.10: bosgemeenschappen van rivierklei	
		ri-3.11: middenbos	
		ri-3.12: park-stinzenbos	

Bal, Beije et al. (1995)

Fig. 809 *Nature-target types for* ***The Fluvial Area***

Bal, Beije et al. (1995)

Fig. 810 *Nature-target types for* ***The Fluvial Area — 300m***.



Bal, Beije et al. (1995)

Fig. 811 *Nature-target types for* ***The Fluvial Area in local profile***

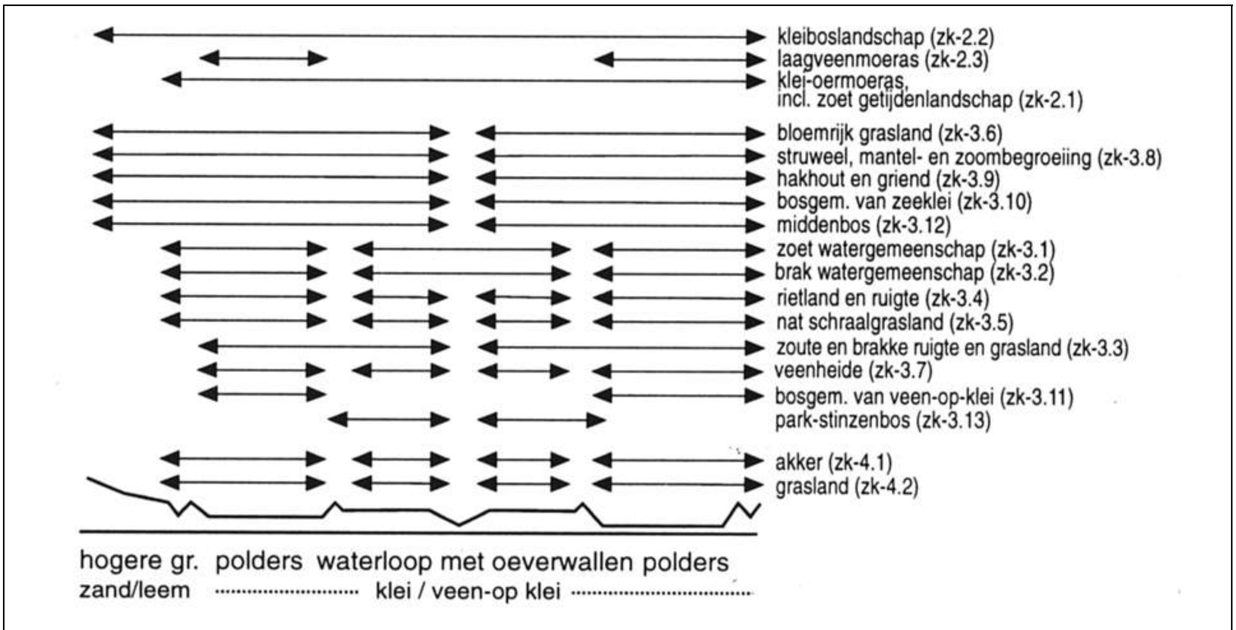
5.5.4 Nature-target types for the Marine-clay areas

For the Marine-clay areas, the following nature types have been established as targets (Fig. 812).

3km	>1km	300m	100m
	zk-2.1: clay–primeval morass (including freshwater tidal landscape) **zk-2.2:** wooded landscape on clay **zk-2.3:** low fen morass	**zk-3.1:** freshwater community **zk-3.2:** brackish water community **zk-3.3:** salt and brackish brushwood and landscape **zk-3.4:** reedland and brushwood **zk-3.5** wet infertile grassland	**zk-4.1:** food-crop field **zk-4.2:** grassland **zk-4B:** target types from the main groups 1-4 **zk-4B.3** reed culture **zk-4B.4:** indigenous woodland culture **zk-4B.5:** woodland culture with foreign species
		zk-3.6: grassland rich in flowering plants **zk-3.7:** peat heath **zk-3.8** thicket, mantle and seam growth **zk-3.9:** felling wood and osiers	**zk-3.10:** woodland communities on Marine clay **zk-3.11:** woodland communities on peat-on-clay **zk-3.12** middle woodland **zk-3.13:** park-*stinzen* woodland

Bal, Beije et al. (1995)

Fig. 812 *Nature-target types in **Marine-clay areas***



Bal, Beije et al. (1995)

Fig. 813 *Profile of nature-target types in Marine-clay areas*

5.5.5 Urban nature

The relation between abiotic factors in urban areas and diversity of plant species is examined on 8 levels of scale. Hypotheses on the abiotic origin of this diversity, especially within cities, are listed on each level of scale. They are supported by examples from the cities of Zoetermeer and partially Enschede.

Regions
If one compares regions (of a 30 km. radius) with each other, other differences come to light than when, for example, one compares groups of buildings (‘ensembles’ with a radius of 30 m). Travelling through an urbanised landscape, on average, one sees, for example, that within 30 m. the extent to which land is being trodden on and exposed to sunlight varies, but variations in ground and water management are often only evident at distances greater than 30 km. Which differences in abiotic situations can, for each scale level anew, explain the differences in richness of species? This question is largely unanswerable, but for urban architects and civil technicians it is crucially important, because these disciplines, certainly in new situations, literally set the conditions of these variables. In the case of high-lying wet and dry areas, should one bring about change every 100 km. or every 10 m? Should one open up or drain water every 100m or every 1000m? This produces — depending on the existing context — an entirely different diversity in the initial abiotic situations. In addition, when one realises that one can do that differently in one direction or another, that results in an infinite number of design alternatives. Which of these alternatives produces the most extensive ecological richness?

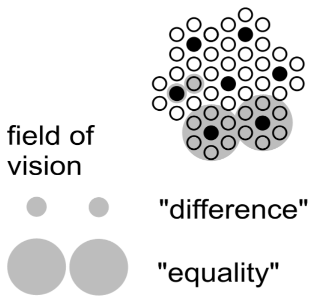
Towns
Towns are stonier, 1 to 3°C warmer, and are nowadays cleaner, than their agrarian surroundings. They are, thanks to the 19th century hygienists (see Houwaart, E.S. 1991), cleaner and more spacious than a century ago. Urban environments are dynamic (there are few places that have not been turned upside down at least once during the last 25 years), but, viewed abiotically, they are also varied. For botanical diversity, the important abiotic differences (in combinations of minerals, moisture, exposure to sunlight, mowing management, disruption, treading on (extent of), (surface) hardening (by constructing roads, heat capacity) are greater per square km. than in agrarian areas and are often also greater than in nature reserves. On what scale level should these variations be explained and utilised?

Hypotheses for design on different levels of scaele
For the time being, we will choose the following points of departure (hypotheses):

Variation effective for the vegetation	R =
the height, ground	30km
ground (‘floor’ or ‘bottom’ if you’re talking about a lake, canal, valley, etc, i.e. a surface), water management	10km
seepage, drainage, water level, opening up waterways in towns and cities	3km
urban architectural planning	1km
dividing land into lots (distributing green areas)	300m
(surface) hardening (by constructing roads), treading on (the extent of), manuring by pets, minerals	100m
difference in height, mowing management, disruption	30m
exposure to sunlight	10m
One must interpret the radius between adjoining radii, flexibly. The last four scale-levels cannot, as yet, be observed in grid squares of one kilometre.	

Jong (2000)

Fig. 814 *Hypothetical working variations per scale-level in urban-nature subsoils*



Jong (1995)

Fig. 815 Scale paradox

Scale paradox
The scale paradox in urban architecture (see *Fig. 815* and Jong, T.M., de 1995) teaches us that conclusions must be drawn from the same scale-level (the smallest grain considered and the largest frame) as that on which the premises were based. For example, in the above figure, if every time one takes into consideration one small circle and its surroundings, then one notices differences, while, on the contrary, when repeatedly comparing small groups of seven with their surroundings (see also Kolasa, J. and Pickett, S.A. 1991) one should conclude that they are alike. The paradoxical notion ‘homogenous mixture’ indicates this dilemma exactly: at a certain scale level it is homogenous and at a lower abstraction level it is heterogeneous. The notion ‘bundled deconcentration’ is another example. For such notions, an immediate question can be raised: ‘On which scale is the one and on which scale the other?’. In addition, this figure shows that confusing concepts like these are already

possible where there is a factor 3 linear difference in scale level. There is a 7-decimal linear difference between a grain of sand and the earth, and so there are more than 14 confusing concepts lurking in the background.

Scale articulated view on image and ecology

With this in mind, in Amsterdam, we have made an image quality plan that attempts to find an optimum in tolerance between surprise and recognition at each scale level (in their extreme form, between chaos and order) as the sensory working of variation (Jong, T.M. de, and Ravesloot, C.M. 1995). Diversity in ecology is also sensitive at scale-level as both cause and effect, or rather as abiotic condition and biotic effect. The crucial rarity of species, biotopes, plant communities, ecosystems, landscapes, plant–geographical districts is just as dependent on scale (globally, continentally and nationally, etc. rare). For example, in Zoetermeer, a policy line was established at some point that one should concentrate on globally (within a radius of 10,000 km) and regionally (within a radius of 30 km) rare species (and thus not on nationally rare species). Insight into this demands a (as yet not available) differentiated and long-term overview of combinations of species and their ability to recover within 1, 10, 100 years, etc. (rarity in time). It thereby becomes possible to deliberate rationally between different urban functions (a main port is rare within 300 km and can recover within 10 years; a peat landscape is rare within 300 km and can recover within a 1000 years). As there are too few facts available, we do not deal with rarity and recoverability any further in this article. A scale-based view of diversity is a condition, and a good first step in the direction of, such a scale-based view of rarity.

5.5.6 Differences in diversity between and within regions

Zoetermeer and Enschede (approx. the same size) are situated in areas that differ greatly in richness of species. The urban areas of Zoetermeer and Enschede differ little in diversity (not counting combinations of species). This complies with Denters's (1999) references that indicate that urban flora differ very much ... from those in the immediate neighbourhood, whereas striking similarities can be found between the flora of various towns ...'. When one views these towns as a whole, at regional level, the age of the town does not have much influence on the diversity. The influence of soils (clay and sand, respectively) should also not be exaggerated because in preparing low-lying land for building, sand is used as a material to raise the level of the ground. In fact, in Zoetermeer, that has not happened very much. Except for relief that is related to infrastructure, in principal, the clay bottom has here only been partially raised to approx. 40 cm using soil from within the urban, excavated from new water features and building pits, thus creating a closed soil balance. Waterways can be encountered approx. every 400 m. The entire urban area here will be drained more or less to the same extent, to 1m. below ground level.

Differences in diversity at urban level

In both Enschede and Zoetermeer there are large differences within the town in richness of species (see Fig. 766). In both towns, the number of wild plant species per square kilometre are shown in dots representing 10 species, such as is more precisely inventorised by Floron and by local observers (municipality and KNNV). Fig. 766 shows three widely differing one-kilometre grid squares in urban architecture, extending from the district Meerzicht (left) to the old village (right) in Zoetermeer. The numbers of species found also differ significantly. In the 1970's, Meerzicht was the third newly built district, following the high-rise districts Palenstein and Driemanspolder that dominate the view from the motorway. From there onwards, high-rise buildings were renounced in the newer, more northerly districts.

Centre and periphery

New perifery districts in Enschede score relatively high; old central districts, just as, for example in The Hague, score relatively low. In Zoetermeer almost everything is new. What is noticably different in Zoetermeer compared with Enschede is that the richness in species decreases from the middle to the edge in many cross-sections. The largest number of species is to be found in the middle of the town, in the old village. During the last 30 years, the town has grown round this centre, first westwards and then in a clockwise direction. The edges of town are sometimes less accessible and admissible for observers. Eutrophication from the rural surroundings can play a role. There have been fewer disturbances in the old village in recent years than elsewhere in the town.

Infrastructure

Apart from this, the centre is a concentration of old high water courses and new, relief-rich infrastructure such as the fast train and the urban motorways, with scarcely trodden-on verges. Both contribute to the richness of the local species. Unexpectedly, in both towns, a concentration of infrastructure appears to foster more species. Industrial premises also score well.
The high, dry, chalk-rich railway line, along which vegetation is regularly removed, produces, in between the maintenence clearances, and for some one-kilometre grid squares, an extraordinary pioneer environment that thereby contributes to the local richness of species. The banks of this looped-shaped fast train line have the largest range of variations of exposure to sunlight imaginable. The only documented example of ecological infrastructure at work along the fast train line, following its opening in 1977, is the advance, in 1984, of the Cinnabar moth via a long yellow ribbon of Ragwort from the dunes near The Hague (van Wely,1993).

Waterways

Waterways in the northern part of Zoetermeer are suffering more and more from seepage containing phosphate and iron, made turbid by algae. They were originally maintained by vegetation-unfriendly dredgers, but this activity has been restricted in recent years to that of keeping the flow of water open at essential bottlenecks in the water system. Old water courses, sometimes with water levels raised as much as 4m, that have been left undisturbed by the urban architect, have clearer water, without any seepage and their banks are rich in species, sometimes with rare flora. At the water's edge, the rough banks of ponds encircled with reeds, although picturesque, are influenced by seepage, and so contribute relatively little to the richness of species.

Mowing habits

Whether removing mown vegetation from the sides of motorways has contributed to the increase in species from 200 to 222 over the entire motorway network between 1982 and 1988 (Vos, 1990) is difficult to prove. It is possible that increases in shade and leaf-fall from planted vegetation and manuring by pets from raised paths has worked against the desired empoverishment of these areas. Moist grasslands that are rich in food are mown twice a year, and drier or wetter grasslands only once.

Smaller scale differences in initial abiotic situations

The urban architectural variation at district level (within a radius of 1 km) appears to influence the richness of species, but can be disrupted by local elements such as the fast train line. The variation in richness of minerals, moisture, sunlight, hardening of soil surfaces and disruption is effective at this scale level, but, for urban architectural ends, can only be evaluated by means of inventories which have a smaller resolution than the usual square kilometre. The 'mean-field assumption' (Dieckmann, C.S. 2000) used in current statistical ecological research is insufficient for that. For example, due to detailed planning, mowing management can vary within a radius of 30 m. Schools could be brought in for such labour-intensive inventories. For the urban nature type 'nature in the living environment', a start has been made to inventorise abiotic factors within a radius of 100m (Breems, S.C. 2000).

Conclusions

For a truly ecological urban architectural design, it is necessary to conduct scale-based ecological research in towns, in which differences in species richness and rarity within a radius of 1 km and 300, 100, 30 and 10 m are explained separately. To help balance a solution against other functions, it is desirable to establish a measure of recoverability (e.g. within 1, 10, 100 ...years). In opposition to current urban ecological opinions, arguments can be put forward about the observed, sometimes negative, influences of seepage, the unexpected positive influence of business zoning and traffic infrastructure, and the limited influence of the subsoil, pond verges and the age of buildings on botanical diversity. Herewith, is also, for example, the much defended strategy of the two networks (traffic infrastructure and water) refuted in its scaleless form.

5.5.7 References to Managing nature

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