5 Life

5.1 Diversity, scale and dispersion

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.

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 rareness.
The concept of rareness and thus responsibility is scale-sensitive.

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.

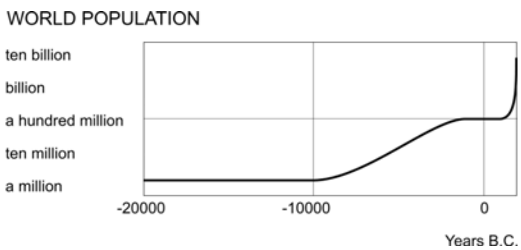


Fig. 502 *Estimated growth of world population*

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 then 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.

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?

5.1.1 The importance of diversity 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.

[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/

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. 503).

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.

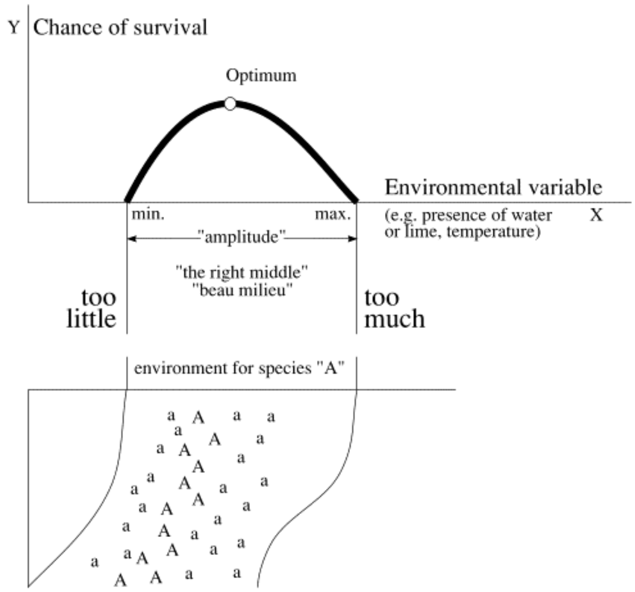


Fig. 503 *Ecological tolerance in theory and reality.*

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.

5.1.2 The importance of diversity for human living

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 economical 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.

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 economical 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.

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 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.

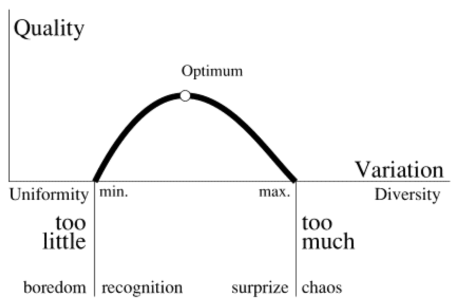


Fig. 504 *Quality = f(Variation)*

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.

5.1.3 Scale-sensitive concepts

As I mentioned in the introduction, rareness, 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.

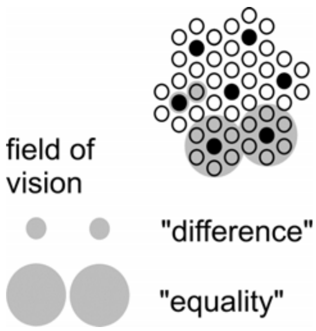


Fig. 505 *The scale paradox*

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*'!

In Fig. 505 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.

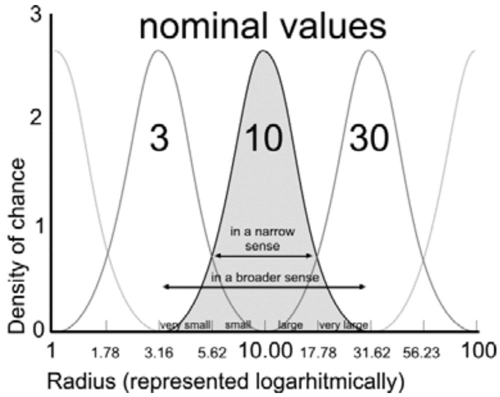


Fig. 506 *Names and boundaries of urban categories*

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.

5.1.4 Spatial state of dispersion as a condition of diversity

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

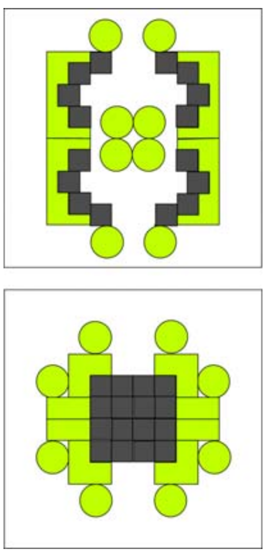
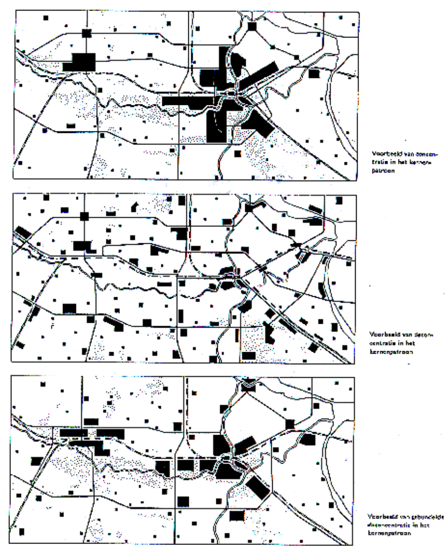


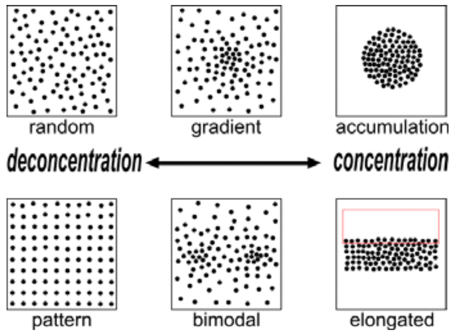
Fig. 507 *States of dispersion r=100m*



RPD (1966)

Fig. 508 *Accumulation, Sprawl, Bundled Deconcentration r=30km*

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. 509) and that is the case on every level of scale again (Fig. 510).



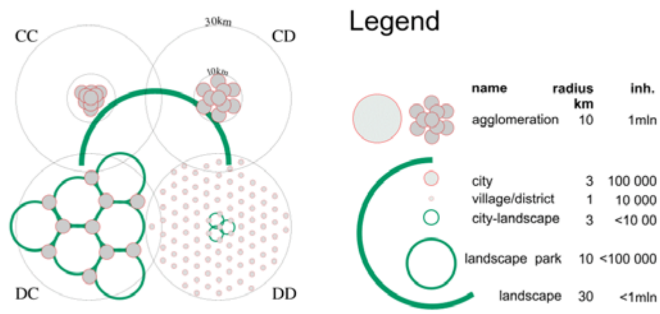


Fig. 509 *States of dispersion in the same density on one level of scale*

Fig. 510 *One million people in two states of distribution on two levels of scale (accords CC, CD, DC and DD).*

Fig. 509 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. 510).

In Fig. 510 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. The *urban density* remains approx. 3000 inh./km^2.

In the case $D_{30km}D_{10km}$ they are dispersed on both levels.

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. 510).

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 RPD (1966)), after 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.

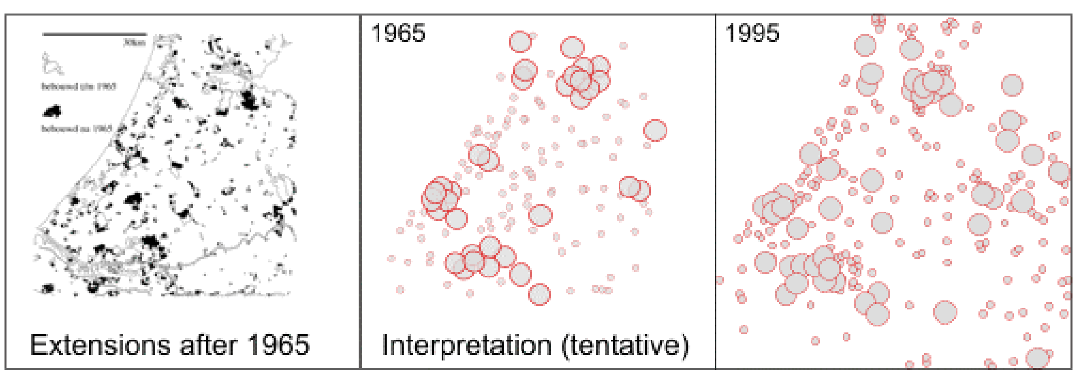


Fig. 511 *Urban sprawl in Randstad, The Netherlands*

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) seems to be the only ecologist fully aware of scale articulation consequences.

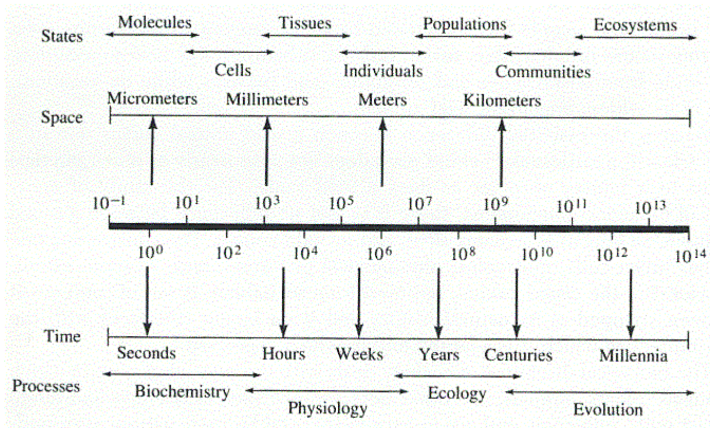


Fig. 512 *Diagrammatic representation of the time-space scaling of various biological phenomena.*

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'.

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5.2 Ecologies

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	biosphere
chaos ecology	opportunities	individual strategies for survival

Fig. 513 *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 and Kwa (2000); Jong (2002) describes in her thesis the strikingly separated Dutch development of the last four categories in Fig. 513 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.

	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

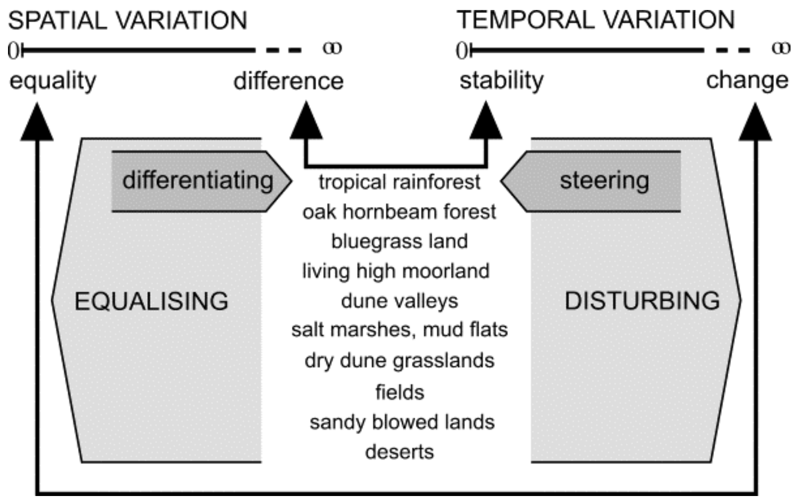
Odum (1971) page 252

Fig. 514 *System dynamic stages*

5.2.1 Cybernetics

The ‘cybernetic ecology’ originated from my teacher and predecessor in Delft Van Leeuwen[a] commuting between East and West of The Netherlands and between holistic and dynamic ecology. In his lectures he stressed variation in space running from equality into difference and from stability into change in time.

[a] Leeuwen, C. G. v. (1953 / 1954) "Het blauwgrasland" Natuur & Landschap jrg. 7/8: 84-93Leeuwen, C. G. v. (1955) "Delfstof winning en natuurgebieden in Nederland" De Levende Natuur 58: 217-220Leeuwen, C. G. v. (1964) The open- and closed theory as a possible contribution to cybernetics (Leersum) Rijksinstituut voor NatuurbeheerLeeuwen, C. G. v. (1965) Over grenzen en grensmilieu's Jaarboek 1964 Kon. Nederlandse Bof. Ver.**:** 53-54Leeuwen, C. G. v. (1965) Het verband tussen natuurlijke en antropogene landschapsvormen, bezien vanuit de betrekkingen in grensmilieu's Gorteria 2-aug**:** 93Leeuwen, C. G. v. (1966) Het botanisch beheer van natuurreservaten op structuur-oecologische grondslag Gorteria 3-feb**:** 93Leeuwen, C. G. v. (1966) A Relation Theoretical Approach to Pattern and Process in Vegetation Wentia 15**:** 25-46Leeuwen, C. G. v. (1967) Tussen observatie en conservatie RIVON-verhandeling nr.4 1967 2-aug**:** 38-58Leeuwen, C. G. (1970) Onderzoek aan structuur en dynamiek van vegetaties in: J. C. v. d. Kamer Het Verstoorde Evenwicht (Utrecht) Oosthoek Uitgeversmaatschappij**:** 125-138Leeuwen, C. G. (1971) Ekologie (Delft) Technische Universiteit Delft, faculteit BouwkundeLeeuwen, C. G. v. (1971) Cursus natuurbehoud en natuurbeheer TH Delft, Afdeling BouwkundeLeeuwen, C. G. v. (1973) Ekologie (Delft) TH-Delft, Afd. BouwkundeLeeuwen, C. G. v. (1973) "Oecologie en Natuurtechniek" Natuur & Landschap 3Leeuwen, C. G. v. (1979-1980) Ekologie I en II. Beknopte syllabusLeeuwen, C. G. (1981) From ecosystem to ecodevice in: S.P., Tjallingii and A. A. d. Veer Perspectives in Landscape Ecology; contributions to research, planning and management of our environment (Wageningen) Pudoc**:** 29-34Leeuwen, C. G. (1983) "Natuurtechnische maatstaven (1-2)" Tijdschrift Koninklijke Nederlandse Heidemaatschappij 94: 20-23; 44-48Leeuwen, C. G. (1984) "Maatstaven voor natuurreservaten (1-3)" Tijdschrift Koninklijke Nederlandse Heidemaatschappij 95: 179-186; 391-395; 419-123Leeuwen, C. G. (1987) "De grootvader van de relatietheorie" De levende Natuur 88e jaargang nr. 1.: dec-15



Leeuwen (1973)

Fig. 515 *Spatial and temporal variation*

The practical implications of his 'relation theory' made him popular amongst architectural and urban designers in Delft and amongst managers of nature reserves. They recognised steering devices, 'selectors' like basin, lid and gutter stressing rather boundaries and conditions we can draw then the surrounded systems developing inside after realisation of a design. According to Leeuwen (1964) selectors determine the openness and closedness of systems, especially when they are bordered vaguely (gradients).

Cybernetic ecology studies mutual relations between ecosystems. If system B lies above system A, B influences A more then the reverse. B is in terms of Van Leeuwen dominant (>>) over A. For example, if B is nutricious and wet and C malnutricious and dry, this arrangement causes change, disturbance, sharp transitional stages (limes convergens, by homogeneous adjacent vegetations) and loss of rare species. In a reverse arrangement a wide transitional stage (limes divergens, gradient) develops between A and B causing exceptional states of affairs.

Gradient (limes divergens)	acid, malnutricious	>>	alkaline, nutricious	Humification, weak dynamics, rich pattern, many species, rareness
	organic, humus, peat	>>	mineral	
	dry	>>	wet	
Disturbance (limes convergens)	alkaline, nutricious	>>	acid, malnutricious	Mineralisation, strong dynamics, poor pattern, little ordinary species
	mineral	>>	organic, humus, peat	
	wet	>>	dry	

Fig. 516 *Extreme dominances according to Van Leeuwen (1971)*

Not communities themselves, but their boundaries yield favourable areas. Van Leeuwen shifted the attention of nature conservation in The Netherlands from biotopes into boundaries between biotopes. Where these boundaries were sharp (ecotones, fronts, limes divergentes) he always saw dynamics changing special vegetations by competition into uniform ones. Wave fronts and vague boundaries (gradients) appeared to produce special species not to be found on both sides of the boundary.

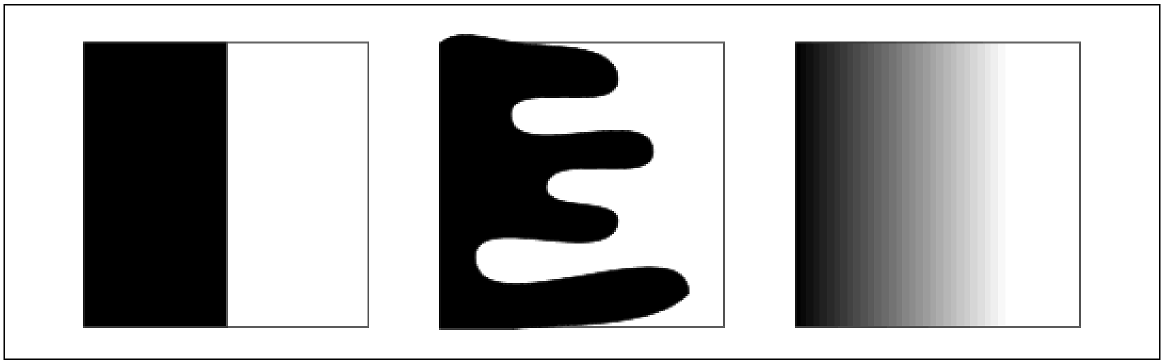
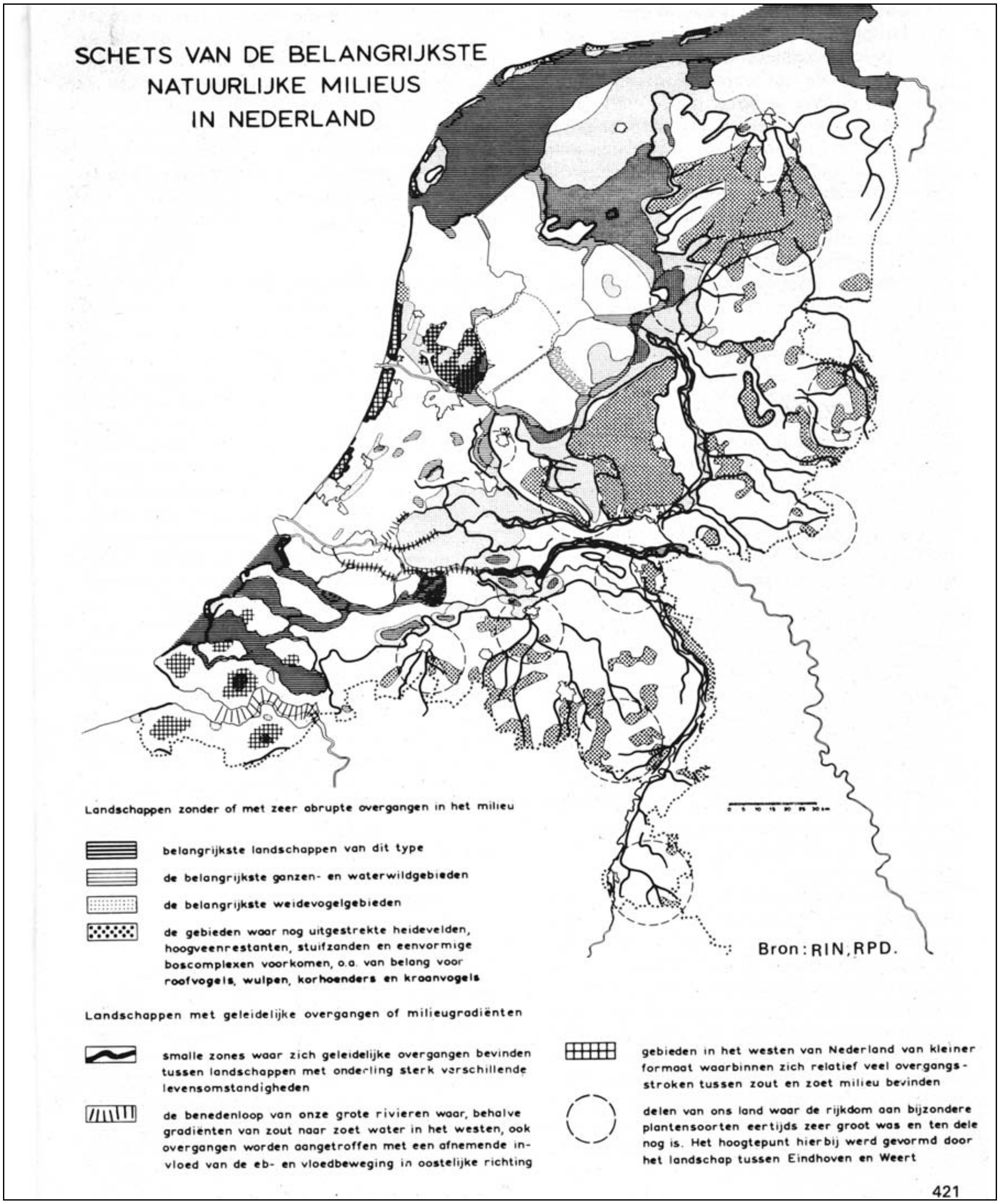


Fig. 517 *Types of boundaries according to Van Leeuwen (1971)*

A wave front not only offers a larger boundary length but also by more orientations to the sun a larger diversity of life possibilities for different species. Van Leeuwen made an inventory of most interesting gradient environments in The Netherlands published as ‘gradiëntenkaart’ in Tweede Nota Ruimtelijke Ordening (RPD (1966) , second bill on national spatial plannning). This map is improved and still used (Fig. 518).[26]



RPD (1966)

Fig. 518 *Gradientenkaart*

Citing RPD (1966) :'Gradients are narrow zones where are gradual intermediate stages between landscapes with mutual strongly different life circumstances. Examples are contact zones between salt and fresh water environments, between reatively 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 gradadion of environmental types in small compass and in connection a large richness of plant and animal species. To this richness belong nearly all rare, i.e. in little specimens present, 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 environment is typical. This assures continued existence of species concerned at location, subject to not distrubing the transitional environment fully by changes caused by modern agricultural methods.’

Van Leeuwen’s botanical field knowledge was generally recognised as ‘phenomenal’. Both theoretical and practical qualities got him a honorary doctorate in the University of Groningen (1974). However, some ten years later in the same University a mathematically oriented thesis of Sloep (1983) showed methodological weaknesses in his theories (to be found in other ecological theories as well). After decades of means directed and *conditional* relation theoretical applications in national planning from RPD (1966) the more aim-directed and *operational* holistic-vitalistic approach with predictable states of synecology became dominant. The general nature policy in The Netherlands now is based on nature target types. The ‘completeness’ of a natural reserve determines its support by government. Nevertheless, Van Leeuwen’s boundary-oriented conditionality rather than operational causality in systems supposed by aim-directed managers keeps the designer fascinated. A house should not cause a household, it should make many households possible, whatever household may come.

I was fascinated by the difference in logical mode between possible and probable futures. Anything that is probable is per definition in the same time possible, but not anything possible is also probable. Designers are asked to study improbable possibilities, probable futures after all can be opened up by classical forecasting research. This controversy between designing and forecasting in Faculties of Architecture meets the difference between conditional and operational thinking Van Leeuwen often mentioned. The city creates conditions (possibilities) for different societies, it should not cause a (probable) community. So, a nature reserve should offer conditions for different kinds of nature. After all we appreciate nature by its own dynamics not influenced or even planned by man. Nature offers an escape from planned space and time. The Dutch word for cinema, ‘bioscoop’ means ‘looking life’ (bios), an escape from our own living. We have to live without loosing life going by itself.

5.2.2 The condition of measure and scale

The methodological problems relation theory can be solved by scale-articulation of concepts like variation in space and time. They become scientifically operational by naming their scale. Perhaps scale-articulation even solves the controversies of Dutch ecology. By that I can live with different ecologies as long as they do not create myths like not comprehended chaos theory sometimes did.

A number of scale classifications summarised by Haccou, Tjallingii et al. (1994), Klijn (1995), Kolasa and Pickett (1991) preceded Fig. 519. Such a classification is required to weigh rareness, 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.

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 then territorial. So, biotic components have a larger scale span then 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 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. 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
kilometres radius			
10000	earth	3000	biomen
1000	continent	300	areas of vegetation
100	geomorphological unit	30	flora-counties
10	formations	3	landscape
metres			
1000	hydrological unit, biotope	300	communities
100	soil complex, ecotope	30	ecological groups
10	soil unit	3	symbiosis and competition
millimetres			
1000	soil structure and ~profile	300	individual survival strategies
100	coarse gravel	30	
10	gravel	3	
1	coarse sand 0,21-2	0.3	
micrometres (μ)			
100	fine sand 50-210	30	multi-celled organisms
10	silt 2-50	3	single-celled organisms
1	clay parts < 2	0.3	bacteria
0,1	molecule	0.30	virus

Fig. 519 *Ecological units*

Fig. 519 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 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

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. 510) - regularly dispersed over the country - 10 open 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.

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 then 1 000 000 inhabitants, The Netherlands still have 10 landscapes (see Fig. 520). 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. 520 meets the average urban density in The Netherlands. So, where they overlap the density is higher than average.

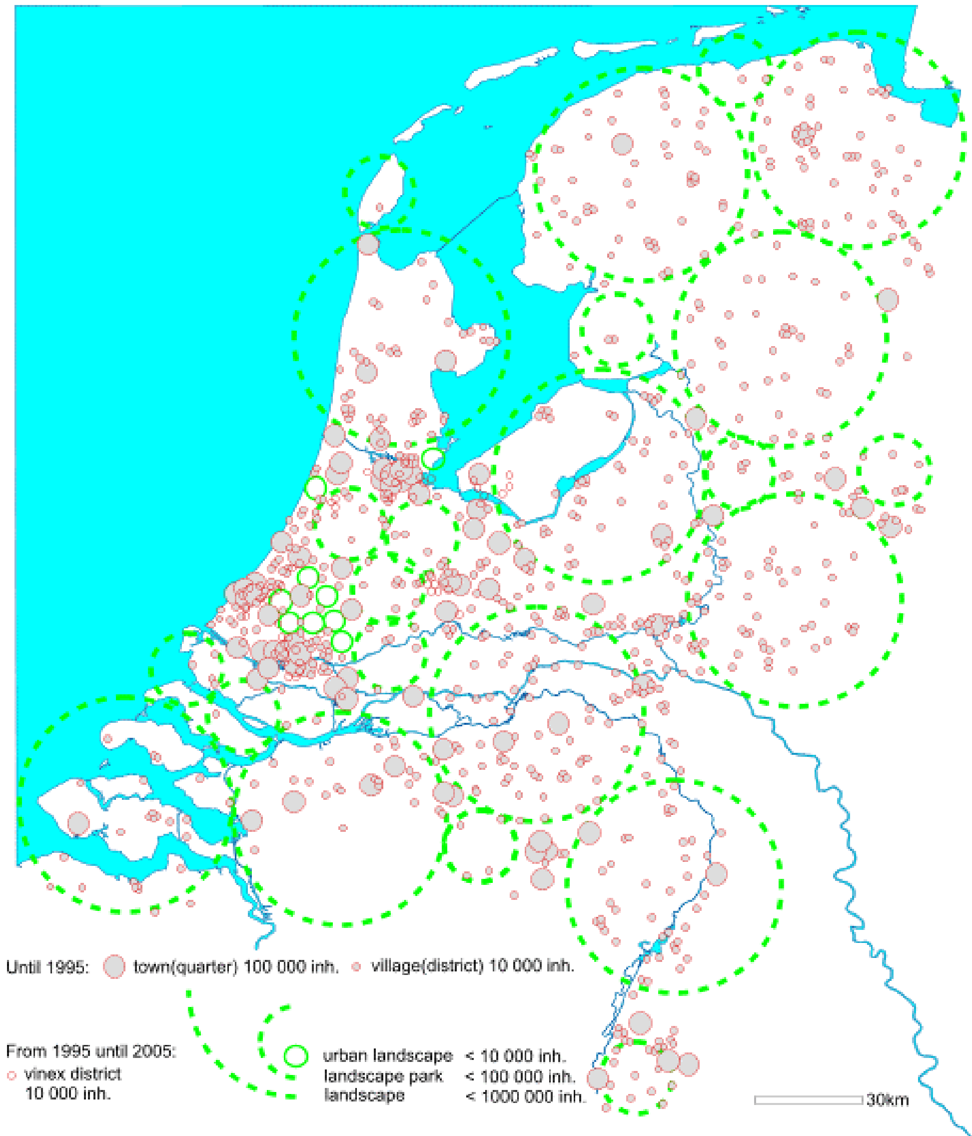


Fig. 520 *Built and open space in The Netherlands*

From Fig. 520 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?

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. 521 .

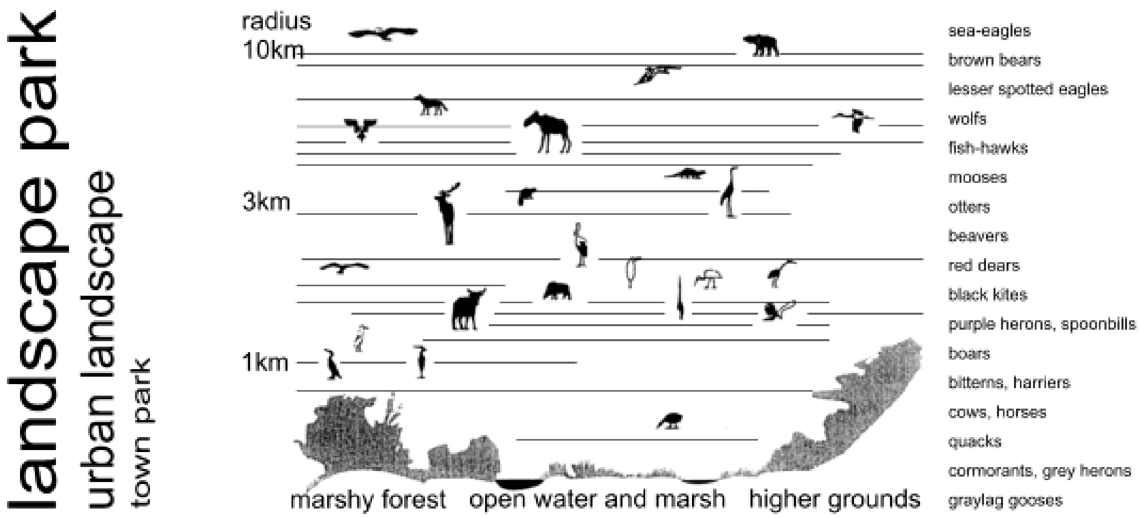


Fig. 521 Possibilities for nature by size and altitude

In Fig. 522 they summarised possibilities of human recreation as well.

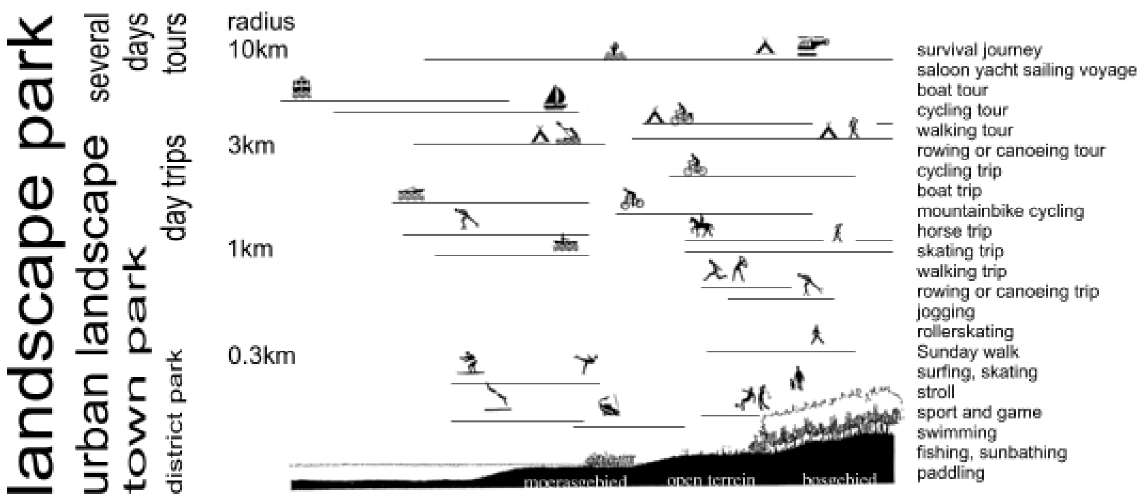


Fig. 522 *Possibilities for recreation by size and altitude*

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.

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

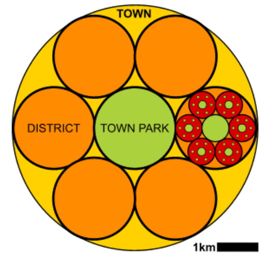


Fig. 523 *25% Central green area equally dispersed on 7 levels of scale*

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 and a small profit of species.
If on 7 levels of scale from r=30m until r=30km any built area should be adjacent to at least one central open area of the same size (see Fig. 523), approximately 75% of total surface would be occupied by built space and 25% by open space. The largest open space would occupy 10 of that 25%, the 6 next smaller ones together 6 of the 25%, the 36 even smaller ones 3% and so on. The relatively large amount of space token by the largest one is an economic argument for more small ones near by home. However this strategy would stress botanical rather then zoological biodiversity. Moreover, a priority for smaller green spaces nearby home with a smaller emphasis on animals brings nature closer to the inhabitants, especially the young ones.

Ecological infrastructure could be important for distribution of animals with a larger feeding ground or reproduction area then 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 connecting but deconcentrated

Fig. 524 *The surface dilemma of concentrating or connecting*

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

5.2.3 Urban ecology

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.

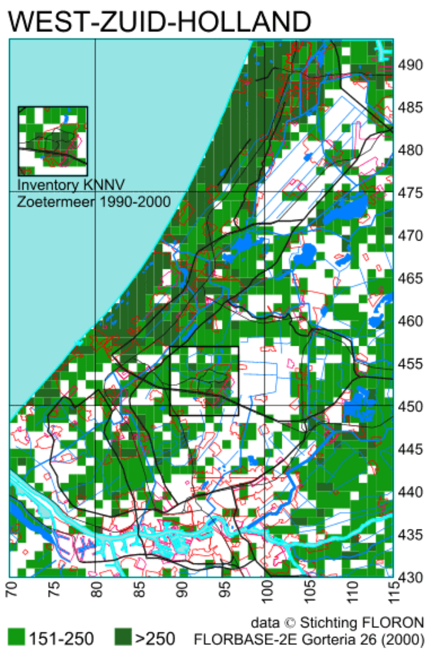
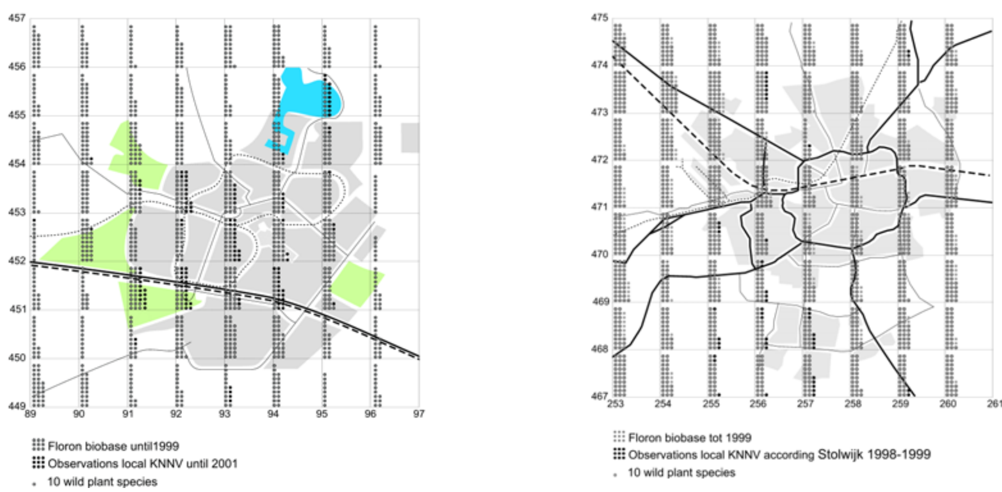


Fig. 525 *Number of wild plant species per km2 in the lower and higher part of The Netherlands*

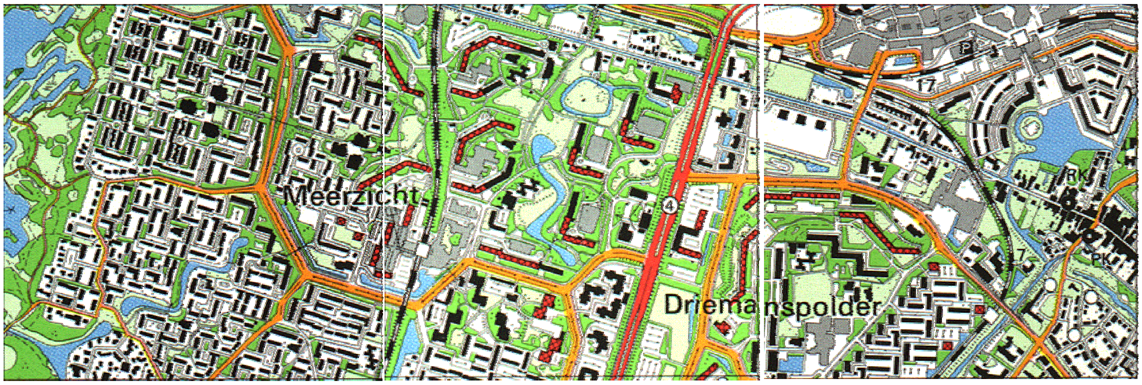
Fig. 525 shows that some square kilometres in the urban area of Zoetermeer indicated in the left picture have more that 250 wild plant species per km^2. Local observers (like KNNV Zoetermeer, reported by Jong and Vos (1995); Jong and Vos (1998); Jong and Vos (2000); Jong and Vos (2003)) counted even more then national ones (counted by FLORON, reported by Groen, Gorree et al. (1995)). The urban area of Zoetermeer is more in contrast with the rural environment characterised by cattle breeding then Enschede (indicated in the right picture) surrounded by more natural equally rich areas. Fig. 526 shows both in more detail. Here we can see that infrastructure and industrial areas contribute more then we would expect by intuition. Their verges, slopes and rough grounds are less visited and disturbed by man and pet.



Jong (2000)

Fig. 526 *Number of plant species per km2 in Zoetermeer and Enschede*

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 then other ones, for example the outskirts.



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

Fig. 527 *Number of wild plant species in 3 km^2 of Zoetermeer*

Even when in the centre the plant observations were better then in the outskirts, Fig. 527 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.

Effective variation for botanical biodiversity	**in a radius of approx.**
altitude, ground	30km
soil, water management	10km
seepage, drainage, water level, urban opening up	3km
The next levels are still hidden for botanical observation usually sampled per square km.	
urban lay-out	1km
parcelling (distribution of greenery)	300m
pavement, tread, pet manuring, minerals	100m
altitude differences, mow management, disturbance	30m
sun lighting	10m

Fig. 528 *Scale-articulated hypotheses of effective abiotic variation producing botanical biodiversity*

Fig. 528 shows possible working factors in urban design per level of scale. These hypotheses should be examined and evaluated yet. Accepting that the character of botanical diversity can not be predicted, one could question whether urban biotopes are valuable at all compared with rural nature. Fig. 529 arranges some 500 urban plant species from the 1500 known in The Netherlands in a sequence of national rareness, 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.

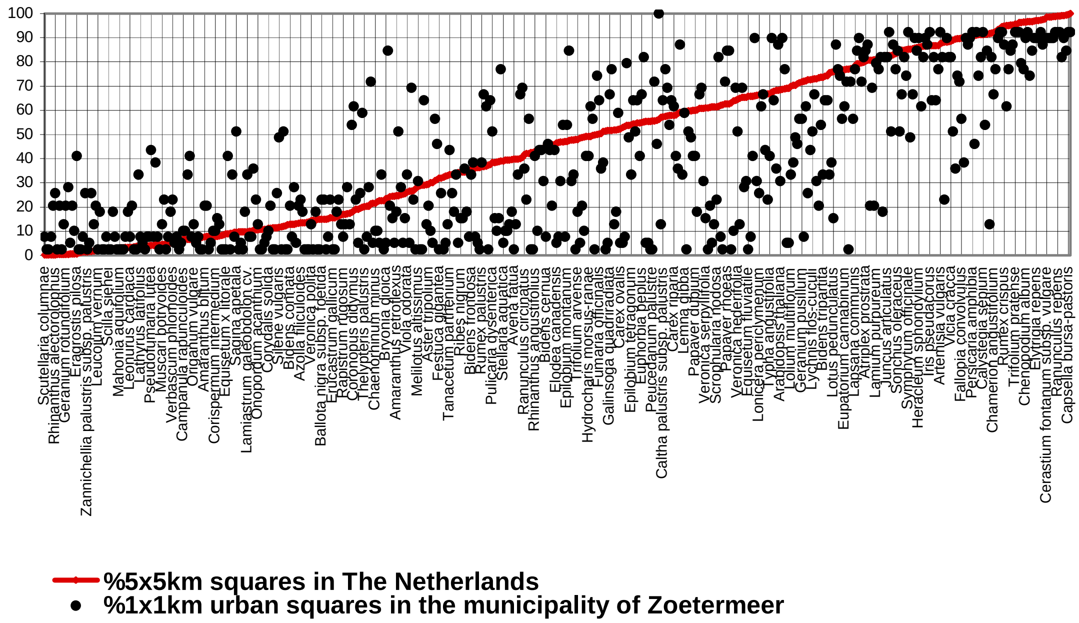
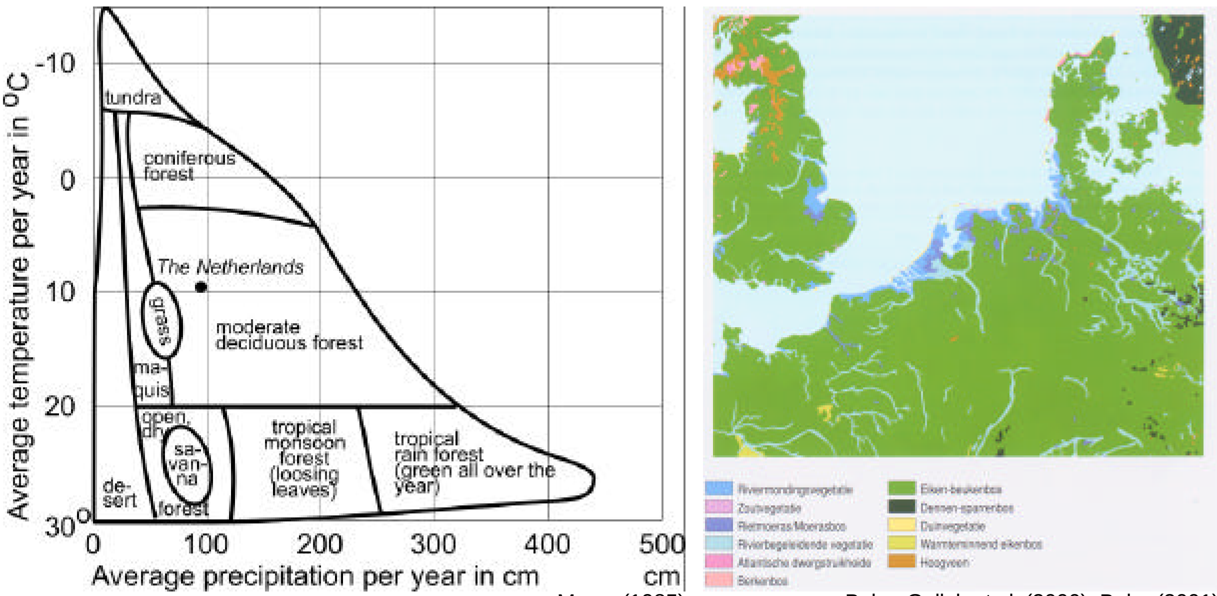


Fig. 529 *Local rareness (100% is very common) of approximately 500 plant species (only partly named) in a sequence of national rareness*

A number of nationally rare plant species in the left side of Fig. 529 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.

5.2.4 Typing biotopes or ecotopes

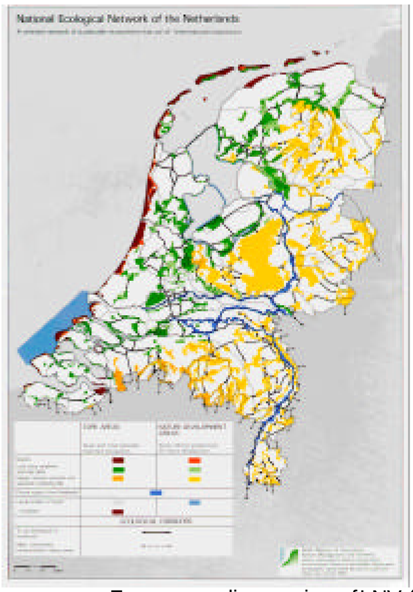
Ecological typology is scale-sensitive. On a global level (r=10 000km) year average temperature and precipitation determine so-called 'biomen'. On a continental level (r=3 000km) areas of vegetation like estuaries, salt vegetations, reed marsh, river accompanying, Atlantic heather, birch forest, oak-beach 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. 530).



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

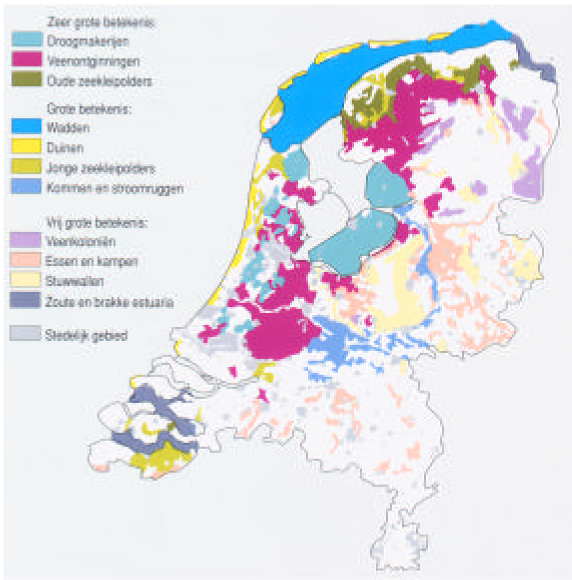
Fig. 530 *Global and continental ecological typology*

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. 531 *Planning Ecological Infrastructure*



RIVM (2001)

Fig. 532 *International rareness 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.

Regional ecological units in the Holocene are based on soil characteristics, highly influenced by altitude in 'formations', causing dynamic local communities.

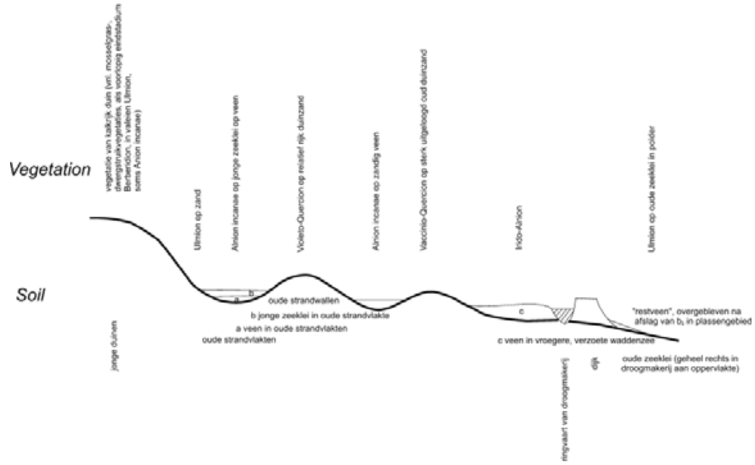
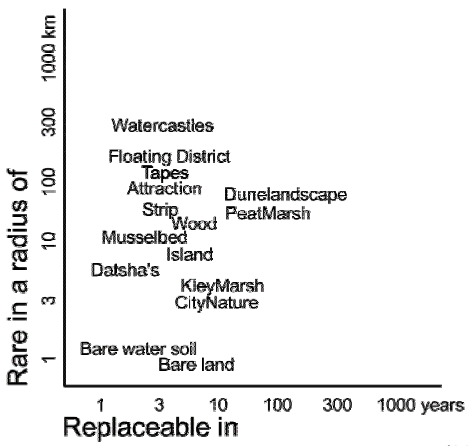


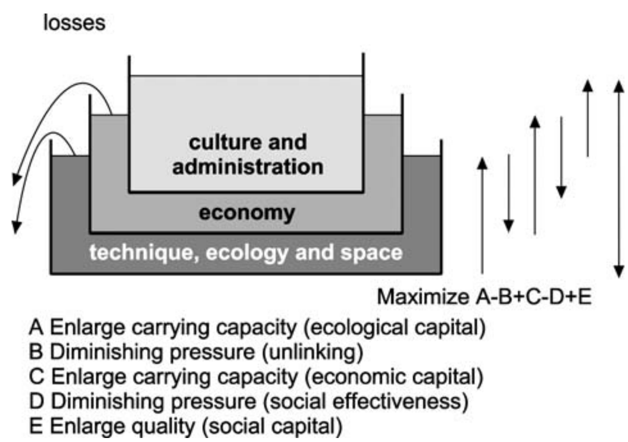
Fig. 533 *Formations mid-west of The Netherlands (see* Fig. 552 *for enlargement)*

Within these ecological contexts the urban area has to find its own ecological typology. Its unpredictable ecological riches and potential urges to a more conditional approach like ecotopes and ecological groups of Runhaar, Groen et al. (1987), summarised by Meijden (1996) rather then a causal one by biotopes and communities being 'complete' or not.
A more conditional typology (see Fig. 559) based on moist, sun lighting by vegetation height and nutritional value of the soil does not predict target communities but rareness. It stresses conditions to be influenced by urban design. Rareness is also culturally useful because it makes cultural values comparable with ecological ones (Fig. 534). Conditionality represented by tanks filled with liquids of different specific gravity clarifies a possibility evaluating categories of nature and culture (Fig. 535).



Jong (2001)

Fig. 534 *Comparing ecological and urban objects*



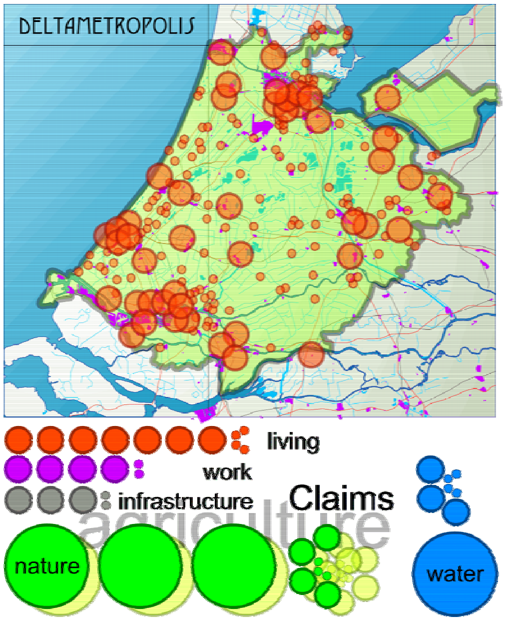
Jong and Priemus (2002)

Fig. 535 *Evaluating the incomparable*

They could be named as conditional evaluation.

5.2.5 Urban perspectives

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 then ever and the idea of an open Green Heart fades away by urban sprawl.



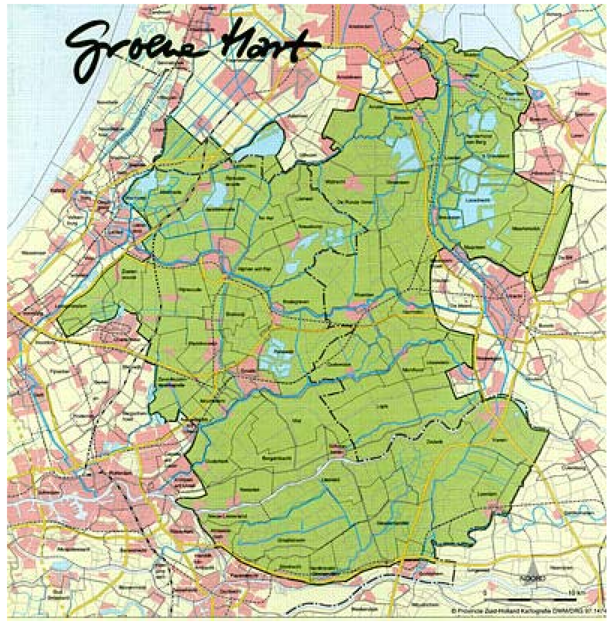


Fig. 536 *Claims on Detametropolis area*

Fig. 537 *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. 510) in saving surrounding landscape. 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.

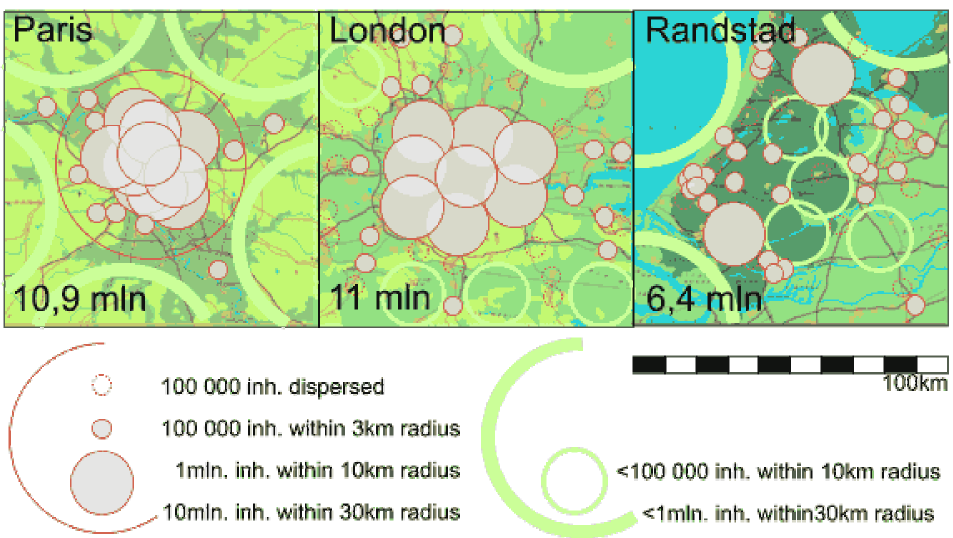


Fig. 538 *The capacity of metropoles*

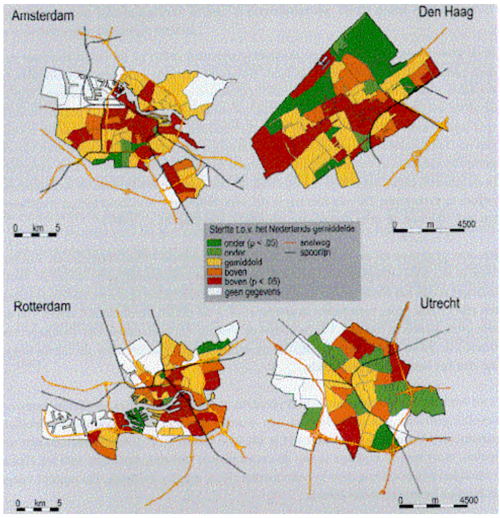
From an ecological point of view the condition of measure (see paragraph 5.2.2 on page 330) is less important when we concentrate on vegetation rather than on big animals. From a human point of view we should bring nature closer to home (see page 334). That pleads for openness within the agglomeration and not for accumulation on every level of scale.

5.2.6 Human health in the urban environment

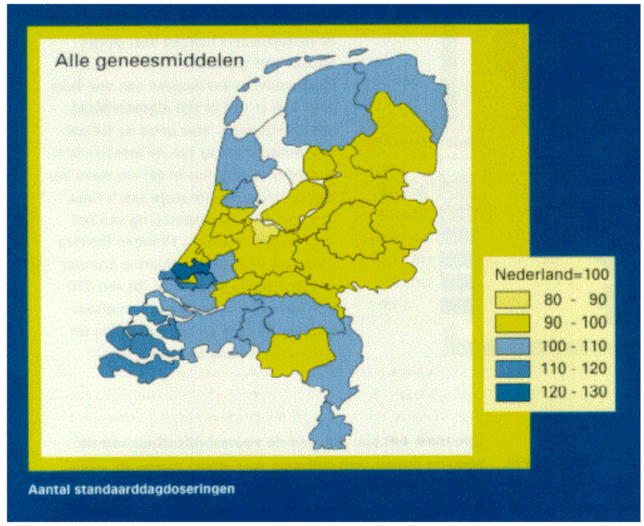
Being no expert on human health the most extensive overview I know in the joint field of medicine and urbanism is edited by Vogler and Kuhn (1957) some 50 years ago. They discuss many kinds of 'civilisation damage' in the urban environment from different medical specialist's points of view. I never found 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. Freedman (1975); Freedman (1977) 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.

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.

Epidemiological research seldom succeeds in convincingly separating causal physical context factors like the urban environment from other coinciding influences affecting 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. 539). 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. 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. 540). 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. 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 then sharing them in collective fear.



Garretsen and Raat (1989)
Fig. 539 *Differences in death rates*



Batenburg-Eddes and Berg-Jeths (2002)
Fig. 540 *Use of medicines*

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. 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.

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.

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 then 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.

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.
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 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.

5.2.7 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.

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5.3 Legends by scale

5.3.1 300km continental vegetation areas

The subdivision of global life in Fig. 530 distinguishes biomen by temperature and precipitation[27]. This variation is on a smaller level of scale recognisable vertically in mountains.
On a European level of scale different distinctions were made. Fig. 530 gave the most recent one based mainly on forest types and Fig. 541 an earlier one based on species[28]. In The Netherlands the distiction of Fig. 530 corresponds highly with geological categories like Pleistocene (until 1 000 000 years old) and Holocene (until 10 000 years old). Fig. 541 distinguishes grounds mainly older then 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.

Pleistocene and Holocene in The Netherlands are roughly divided by the altitude of 5m above sea level (N.A.P.). 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.[29]

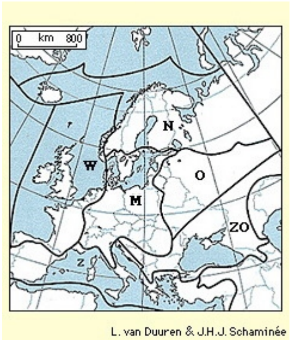
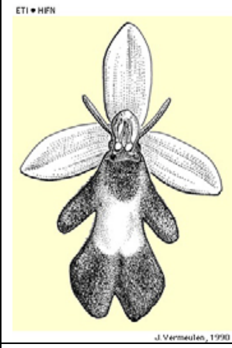
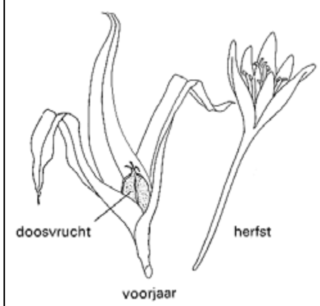
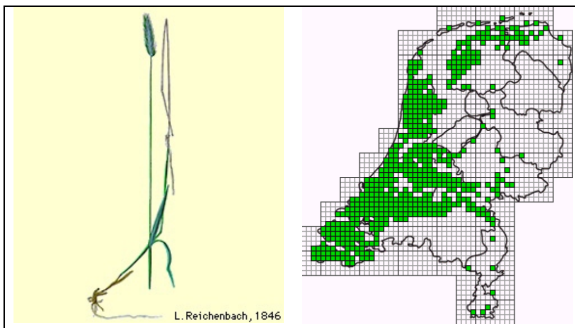
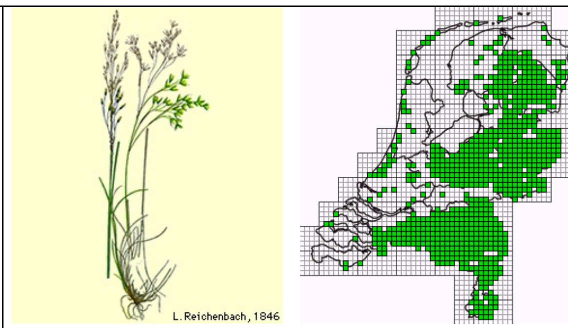
			
Mennema, Quene-Boterenbrood et al. (1980) , p. 16	Meijden (1999)	Kelle and Sturm (1980)	Meijden (1999)
Continental vegetation areas,	*Vliegenorchis H43*	Herfsttijloos	*Kleine Kaardebol*

Fig. 541 *Plants, characteristic for Middle-European vegetation areas (M)*

5.3.2 30km national counties

The ecological difference between low Holocene and high Pleistocene is clearly illustrated by dispersion of two species: meadow barley (veldgerst, Fig. 542) and wavy hair-grass (bochtige smele, Fig. 543).



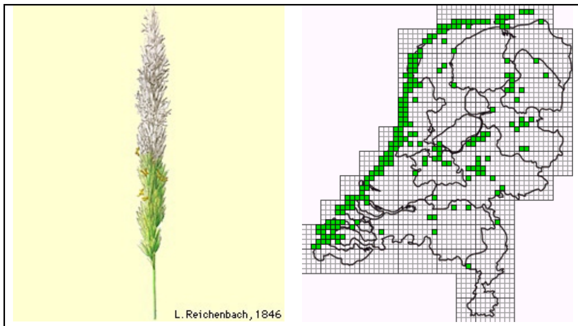


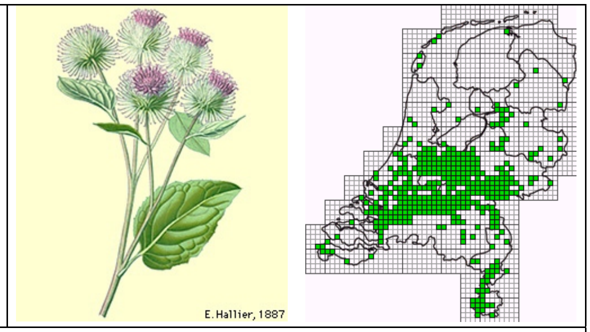
Meijden (1999) and Meijden, Plate et al. (1989) page 84 en 58

Fig. 542 *Dispersion of meadow barley (veldgerst)*

Fig. 543 *Dispersion of wavy hair-grass (bochtige smele)*

Holocene is subdivided in dune and river county, illustrated by the dispersion of two other species, marram (helm, Fig. 544) and greater burdock (grote klis, Fig. 545). The remainder is called Haf county with sea clay and peat.

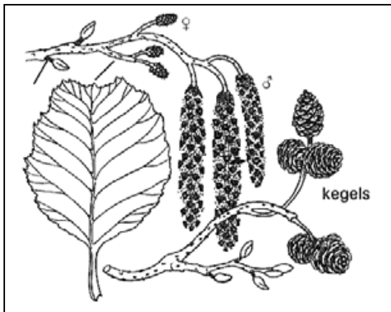
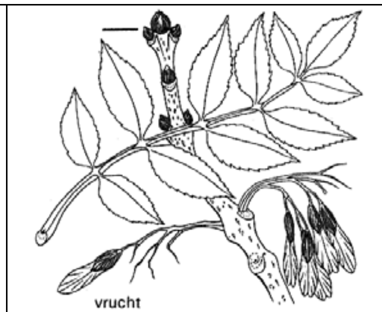
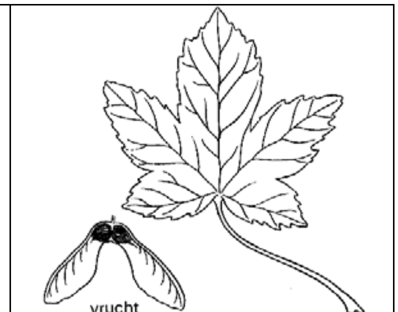
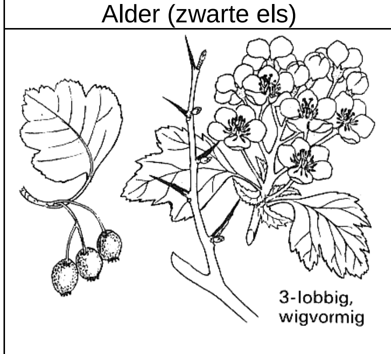
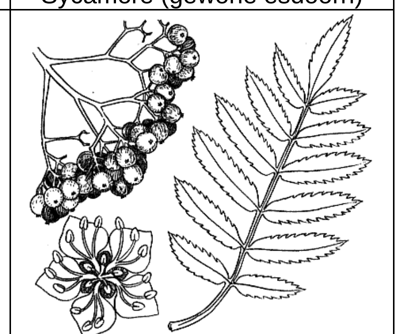




Meijden (1999) and Meijden, Plate et al. (1989) page 44 en 28

Fig. 544 *Dispersion of marram (helm)* Fig. 545 *Dispersion of greater burdock (grote klis)*

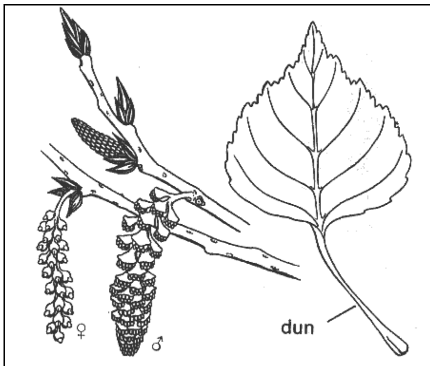
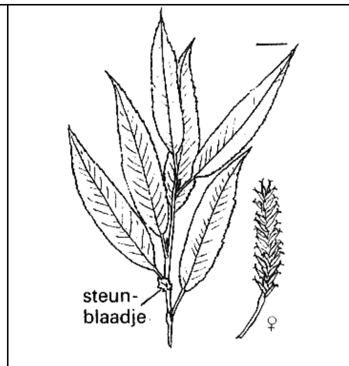
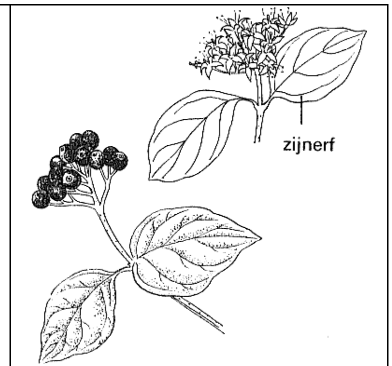
General trees in The Netherlands are alder (els), ash (es), sycamore (esdoorn), hawthorn (meidoorn), birch (berk), rowan or whitebeam (lijsterbes).

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

Kelle and Sturm (1980)

Fig. 546 *General trees in The Netherlands*

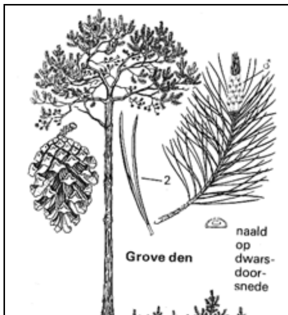
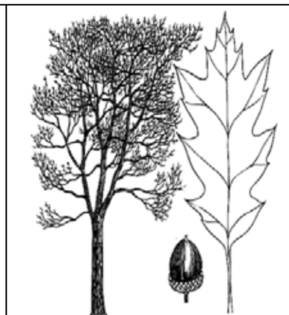
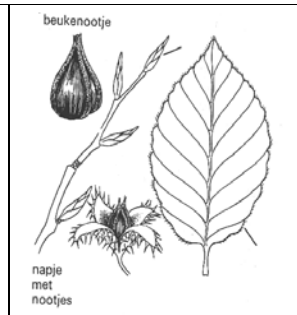
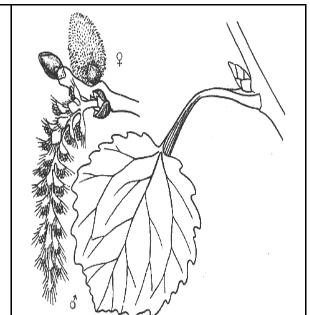
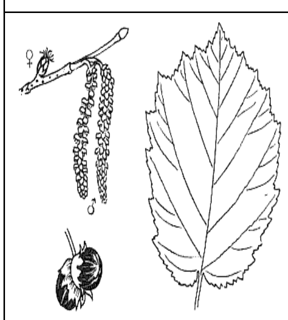
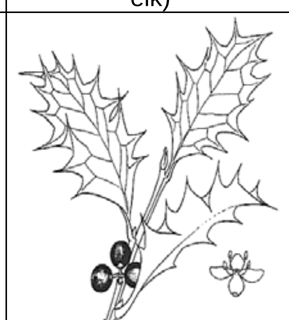
Holocene and rivers are characterised by black poplar (zwarte populier), willow (wilg), dogwood (rode kornoelje) (Fig. 547).

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

Kelle and Sturm (1980)

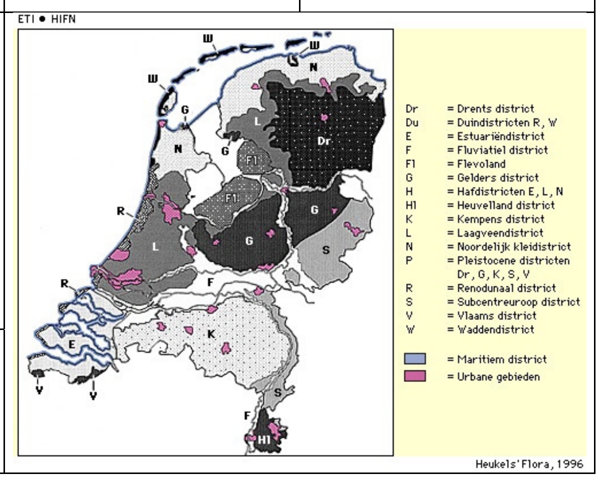
Fig. 547 *Trees of Holocene and rivers in The Netherlands*

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. 548 *Trees of Pleistocene and dunes in The Netherlands*



Meijden (1999)

Fig. 549 Flora districts according to Van Soest

Further elaboration of ecological counties (districten) (Fig. 549) is given by Van Soest (1929/32)[30]

5.3.3 3km (regional or urban) landscapes

Obviously any region in The Netherlands that has got the time for succession of vegetation types a characteristic 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 regional soil 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.

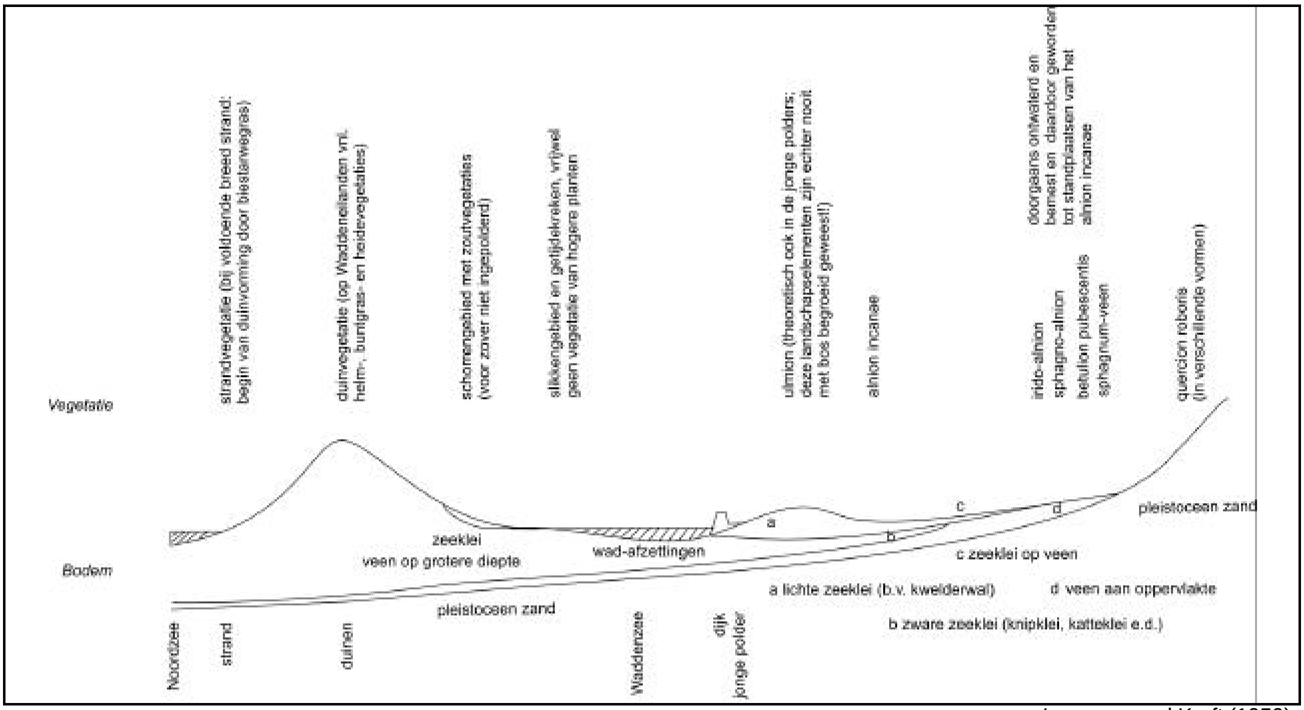
Following descriptions are derived from Leeuwen and Kraft (1959). With regard to these elaborations Van Leeuwen's nomenclature is obsolete but simple, useful and clarifying for urbanists and not yet exceeded in that respect.

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)

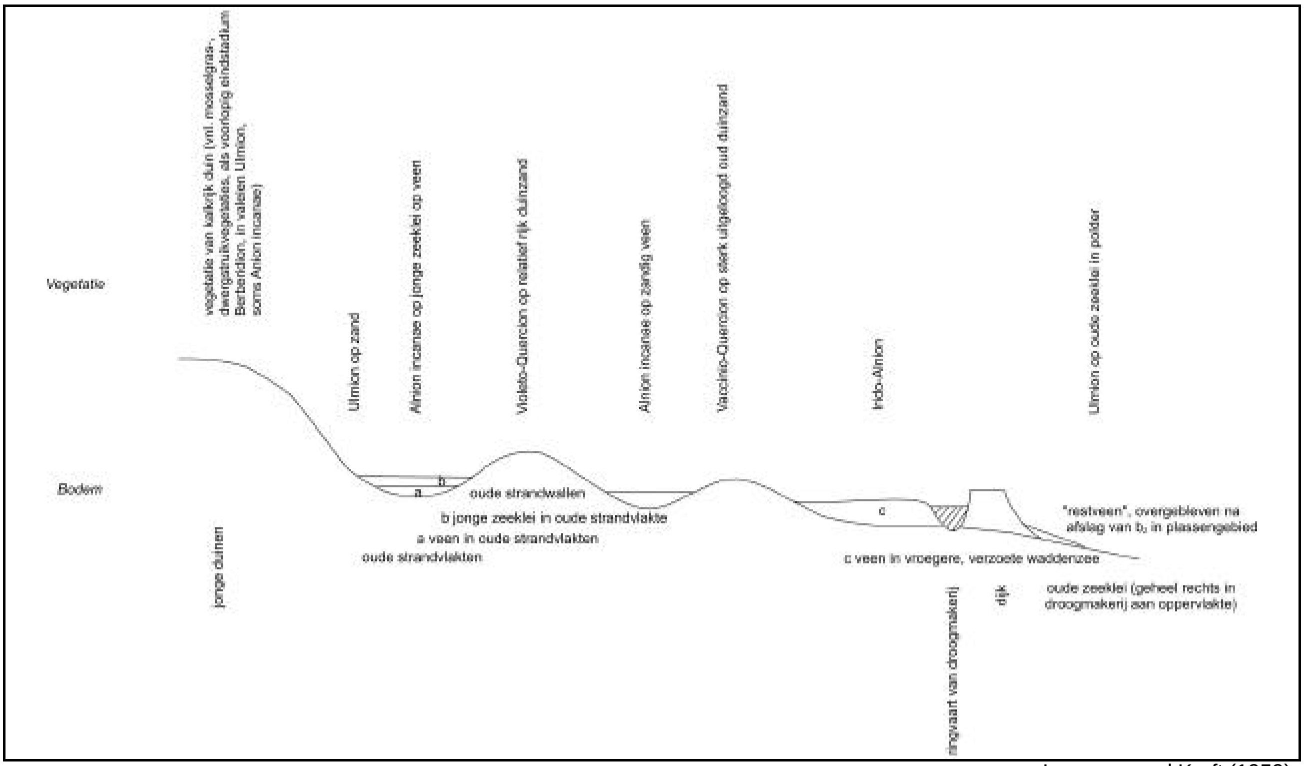
Fig. 550 *Relation between original natural forest type and reclamated landscape.*

The situation of most important soils and corresponding vegetation is represented in ideal typical profiles Fig. 551 to Fig. 556 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.
‘Original landscape’ is not the same as the ‘natural landscape’ appearing when human impact would stop, especially when agricultural measures were very radical.



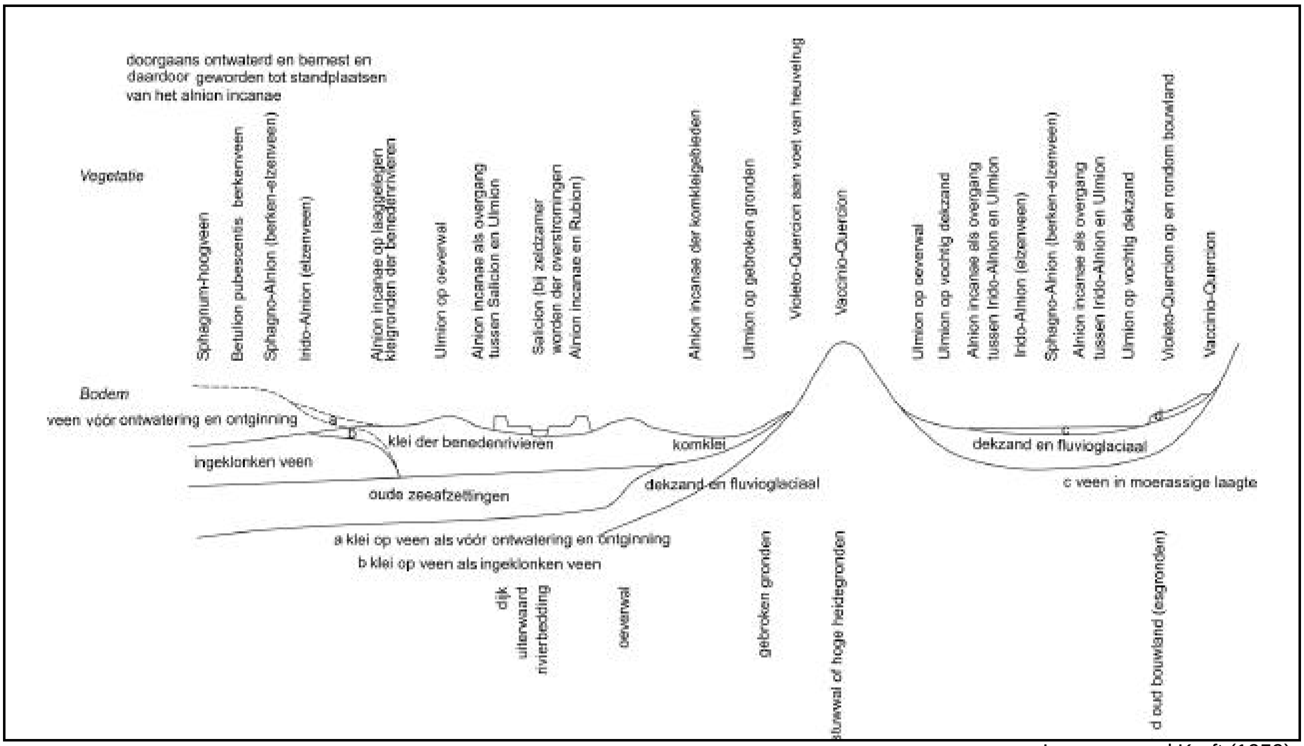
Leeuwen and Kraft (1959)

Fig. 551 *Ideal typical coast formation in Northern part of The Netherlands*



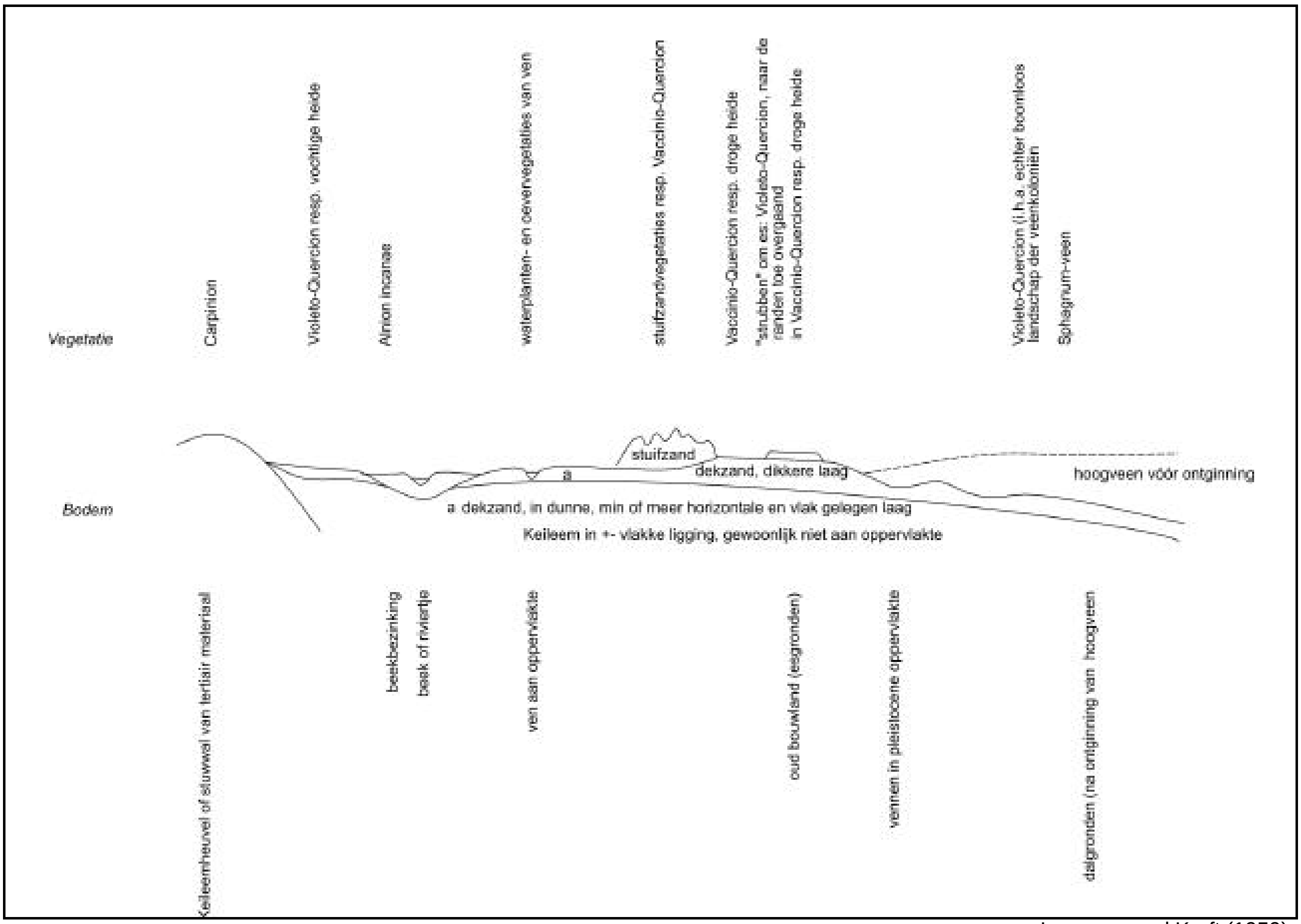
Leeuwen and Kraft (1959)

Fig. 552 *Ideal typical coast formation in mid-West of The Netherlands*



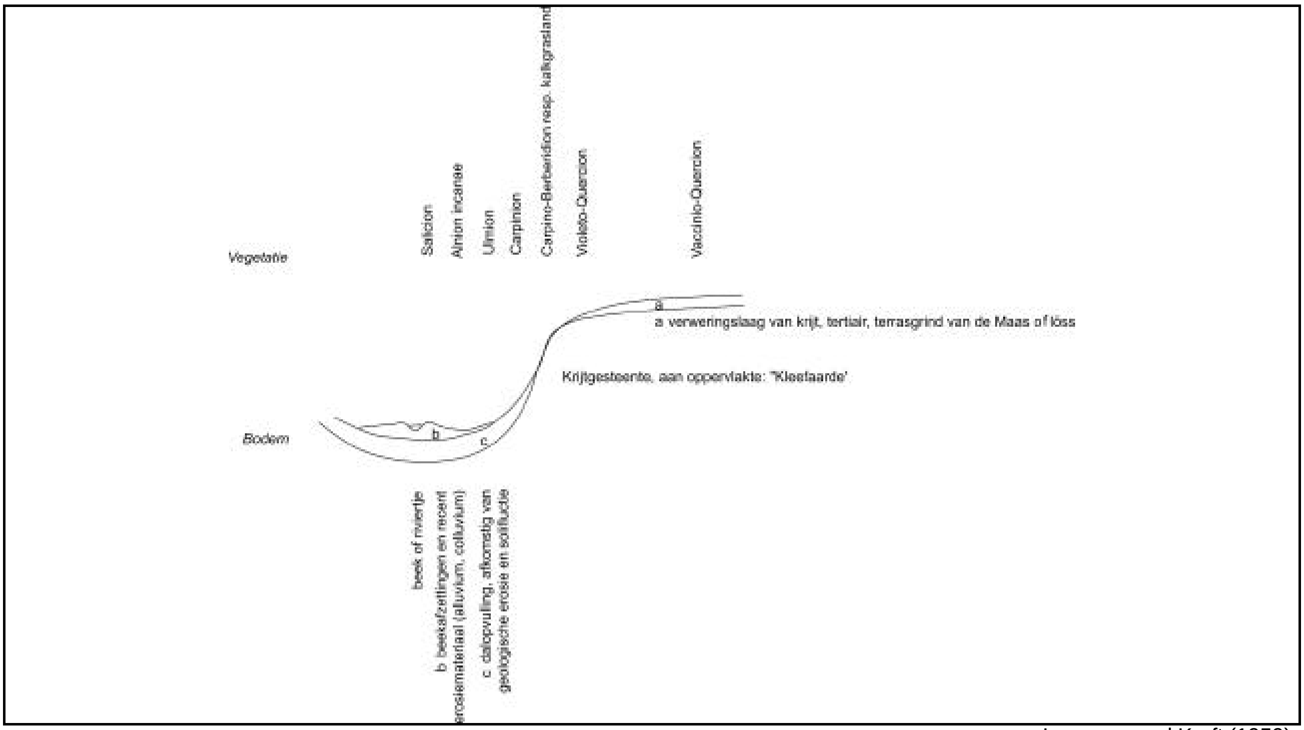
Leeuwen and Kraft (1959)

Fig. 553 *Ideal typical peat, river and pleistocene sandy formations*



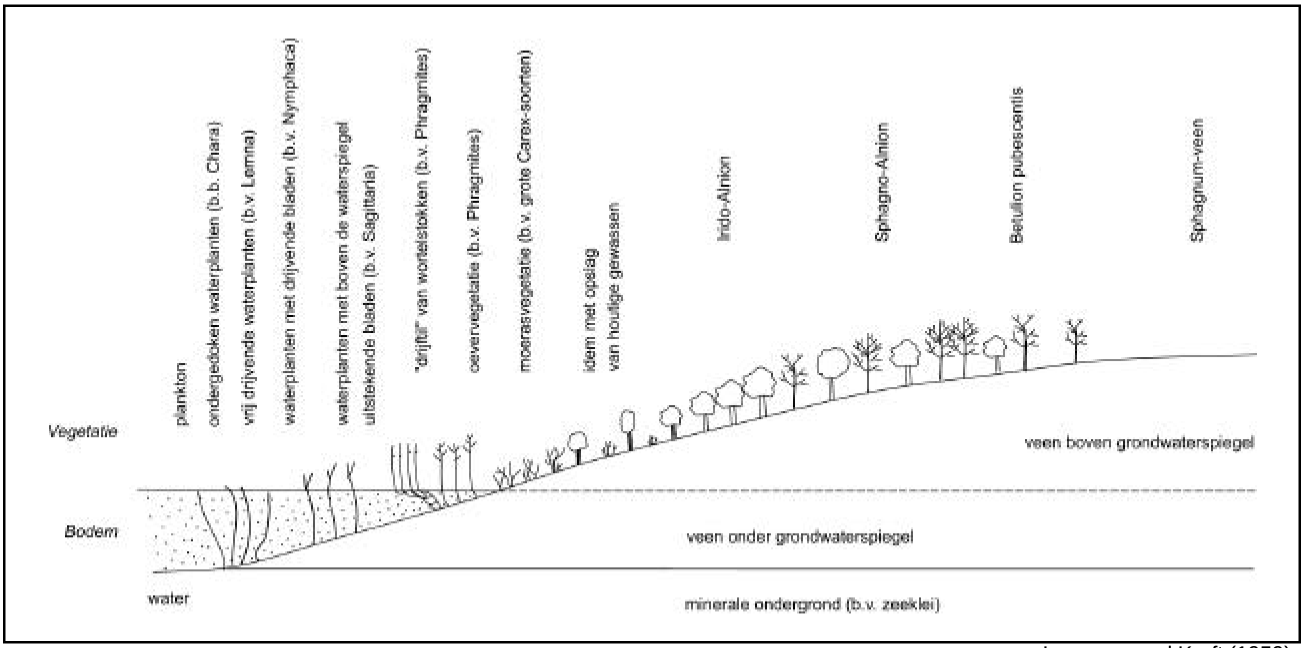
Leeuwen and Kraft (1959)

Fig. 554 *Ideal typical boulder clay formation*



Leeuwen and Kraft (1959)

Fig. 555 *Ideal typical formation of South Limburg*



Leeuwen and Kraft (1959)

Fig. 556 *Ideal typical 'verlanding' in nutricious environments*

5.3.4 300m local life communities

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 then 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. 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. 514) requires coordination in space and sychronisation in time. In general it takes time.

In the same type of biotope different life communities can develop, according to the histroy 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.

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.

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. 557)[31]. Classes 32 to 38 elaborate forests more in detail then

Fig. 550 did obsoletely but simply. Some scientific names like Salicion (32Aa and 33Aa), Alnion (35Aa) remain the same, other forest types named in paragraph 5.3.3 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
06	Littorelletea				Oeverkruid-klasse
07	Asplenietea rupestris				Muurvaren-klasse
08	Thero-Salicornietea				Zeekraal-klasse
09	Cakiletea maritimae				Klasse der vloedmerkgemeenschappen
10	Isoeto-Nanojuncetea				Dwergbiezen-klasse
11	Bidentetea tripartiti				Tandzaad-klasse
12	Chenopodietea				Ganzevoet-klasse
13	Secalietea				Klasse der graanvrucht-akkers
14	Spartinetea				Slijkgras-klasse
15	Ammophilitea				Helm-klasse
16	Plantaginetea majoris				Weegbree-klasse
17	Artimisietea vulgaris				Bijvoet-klasse
18	Epilobietea angustifolii				Wigeroosjes-klasse
19	Phragmitetea				Riet-klasse
20	Koelerio-Corynephoretea				Klasse der zandige droge graslanden
21	Festuco-Brometea				Klasse der droge kalkgraslanden
22	Violetea calaminariae				Zinkviooltjes-klasse
23	Saginetea maritimae				Zeevetmuur-klasse
24	Asteretea tripolii				Zeeaster-klasse
25	Molinio-Arrhenatheretea				Klasse der vochtige grasanden
26	Montio-Cardaminetea				Klasse der brongemeenschappen
27	Parvocaricetea				Klasse der kleine zeggen
28	Scheuchzerietea				Scheuzeria-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		
32Aa*1*				*Myricetum gale*	
32Aa*2*				*Frangulo-Salicetum auritae*	
32Aa*3*				*Alno-Salicetum cinereae*	
32Aa*4*				*Salicetum pentandro-cinereae*	
32Aa*5*				*Salicetum pentandro- arenariae*	
33	Salicetea purpureae				Klasse der wilgen-vloedstruwelen en bossen
33A		Salicetalia purpureae			
33Aa			Salicion albae		
33Aa*1*				*Salicetum triandro-viminalis*	
33Aa*2*				*Salicetum arenario-purpureae*	
33Aa*3*				*Salicetum albo-fragilis*	
34	Rhamno-Prunetea				Klasse der eurosiberische doornstruwelen
35	Alnetea glutinosae				Klasse der elzenbroekbossen
35A		Alnetalia glutinosae			
35Aa			Alnion glutinosae		
35Aa*1*				*Carici elongatae-Alnetum*	
35Aa*2*				*Carici laevigatae-Alnetum*	
36	Vaccinio-Piceetea				Klasse der naaldbossen
36A		Vaccinio-Piceetalia			
36Aa			Dicrano-Pinion		
36Aa*1*				*Leucobryo-Pinetum*	
36Aa*2*				*Dicrano-Juniperetum*	
36Ab			Betulion pubescentis		
36Ab*1*				*Betuletum pubescentis*	
37	Quercetea robori-petraeae				Eiken-klasse
37A		Quercetalia robori-petreae			
37Aa			Quercion robori-petreae		
37Aa*1*				*Querco roboris-Betuletum*	
37Aa*2*				*Fago-Quercetum*	
37Aa*3*				*Convallario-Quercetum dunense*	
38	Querco-Fagetea				Eiken-beuken-klasse
38A		Fagetalia sylvaticae			
38Aa			Alno-Padion		
38Aa*1*				*arici remotae-Fraxinetum*	
38Aa*2*				*onsortium van Carex remota & Populus nigra*	
38Aa*3*				*runo-Fraxinetum*	
38Aa*4*				*acrophorbio-Alnetum*	
38Aa*5*				*iolo odoratae-Ulmetum*	
38Aa*6*				*raxino-Ulmetum*	
38Aa*7*				*nthrisco-Fraxinetum*	
38Aa*8*				*rataego-Betuletum*	
38Aa*98*				*lmion carpinifoliae*	
38Aa*99*				*ircaeo-Alnion*	
38Ab			Carpinion betuli		
38Ab*1*				*Stellario-Carpinetum*	

code	klasse 01-38 ~ea	orde A-C ~alia	verbond a-d ~ion	*associatie 1-99 ~tum*	Nederandse naam klasse

Fig. 557 *Taxonomy of life communities according to Westhoff and Den Held.*

However, 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. 558 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*

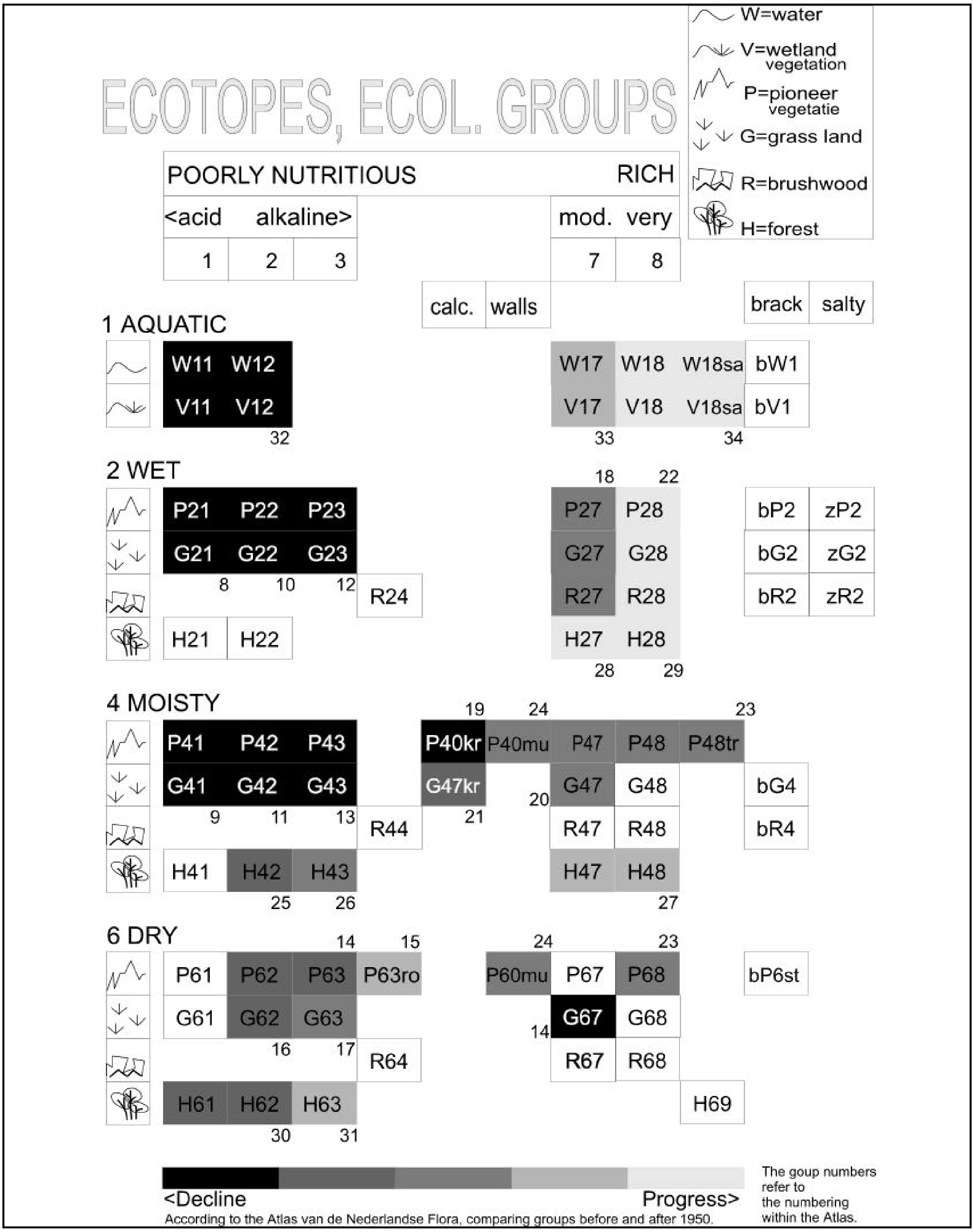
Fig. 558 *Taxonomy of life communities according to Schaminee.*

This taxonomy at last was used in nature conservation, simplified in nature target types we will discuss in 5.6.1 more in detail.

5.3.5 30m ecological groups

Based on ideas of Van der Maarel (1971), Runhaar, Groen et al. (1987) divided Dutch plant species in ecological groups (Fig. 559), suitable for estimating impacts of technical measures and ecological potencies. 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 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.[32] 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.



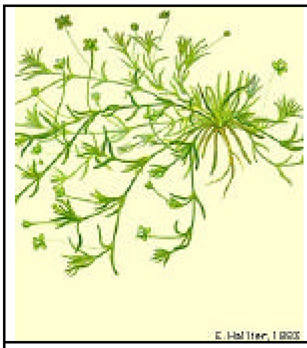
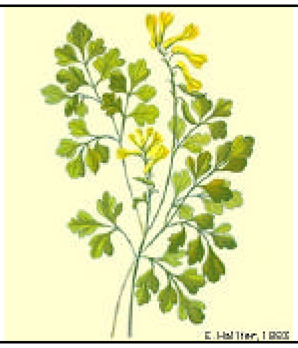
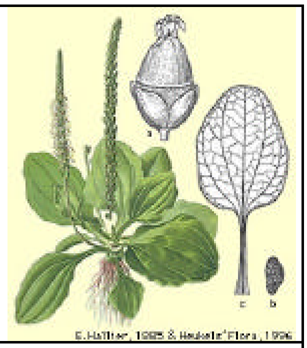
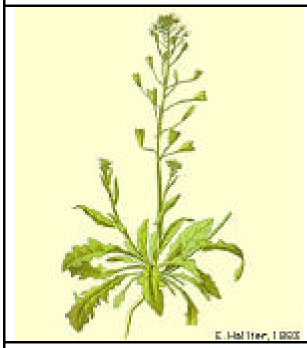
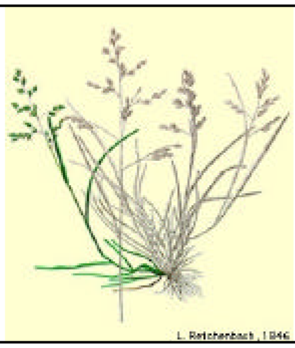
Runhaar, Groen et al. (1987)

Fig. 559 *Ecological groups*

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[33].

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).

Other subdivisions are indicated by indexes. Wall vegetations (Fig. 560) 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. 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. 560) 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)[34].

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

Fig. 559 below shows which ecological groups made progress in the last century (++) and which declined (--). It is clear that oligotrophe groups declined substantially[35].

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[36]. 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.

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.

5.3.6 3m symbiosis and competition

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.

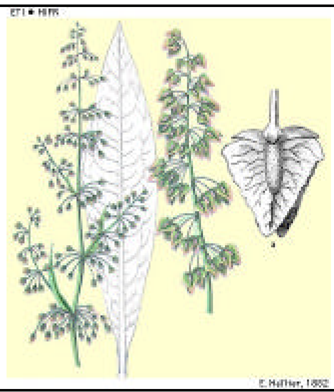
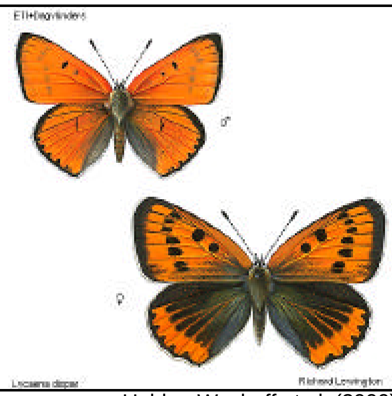
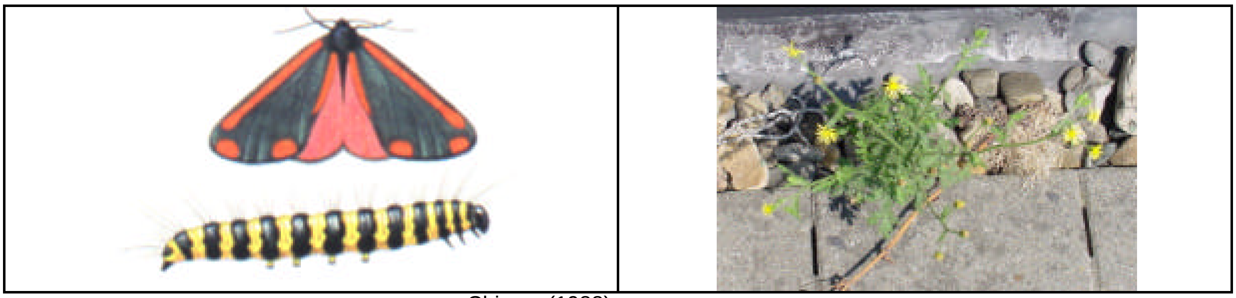
		
Meijden (1999)	Halder, Wynhoff et al. (2000)	Meijden (1999)
water dock (waterzuring) V18,V19	*large copper butterfly (grote vuurvlinder)*	*loosestrife (kattestaart) R27,R28, H27,H28,V17*

Fig. 561 *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. 562) laying its eggs on common ragwort (senecio jacobaea, jakobskruiskruid).



Chinery (1988)

Fig. 562 *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.

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.[37] 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].

The relation of every Dutch plant species with animals - particuarly 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. 564) refers to this publication naming volume and page.
The question how animals recognise 'their' plants depends on perception of smell, colour and form. The recogisability 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. 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.

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 5.6.1) to connect important natural areas by corridors for genetic exchange. This is more important for mammals and reptiles then 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[38]. For vegetation local diversity is a better investment then connections.

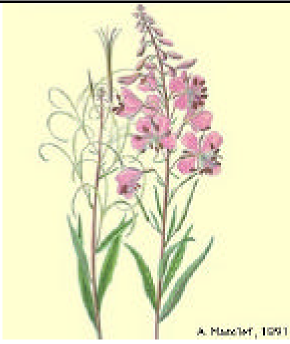
5.3.7 30cm individual strategies for survival

According to Grime, Hodgson et al. (1988) plants have three differerent strategies for survival:[39]

1 growing fast, reproduce and evacuate ("ruderals" like chickweed, stellaria media, vogelmuur);

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

2 develop competition power, then reproduce ("competitors" like rosebay willowherb, chamerion angustifolium, wilgeroosje);
3 endure difficult circumstances other species avoid and reproduce when possible ("stress-tolerators" like cowslip, primula veris, gulden sleutelbloem)

		
Vogelmuur P48,P68 ("ruderal")	*Wilgenroosje R47,R67, H47,H62 ("competitor")*	*Grote sleutelbloem G43,G47kr, H43,H47 ("stress-tolerator")*

Meijden (1999)

Fig. 563 Drie overlevingsstrategieen volgens Grime (1988)

Vogelmuur kan 14 dagen na ontkieming weer zaad zetten en is wat dat betreft recordhouder onder de Nederlandse planten. Het Wilgeroosje zoekt het snel in de hoogte om andere planten af te troeven, maar kan door gebrek aan mineralen bij zo'n groeisnelheid verzwakken en omvallen. De Gulden sleutelbloem is een specialist die alleen in voor ons land bijzondere omstandigheden voorkomt en daarom beschermd is.[a]

Ruderals en competitors komen naast enkele soorten stress-tolerators vooral massaal voor in een zich nieuw vestigend plantendek (pioniersstadium), in een ver ontwikkelde, stabiele vegetatie (climax-stadium, zie Fig. 514 [40]) komen naast enkele soorten ruderals en competitors vele soorten stress-tolerators voor. Daar de agrarische bedrijvigheid een systeem steeds in het pioniersstadium wil houden omdat hoge netto-produktie een kenmerk is van dit stadium, worden hogere stadia door menselijk ingrijpen zeldzaam.[41]

5.3.8 References to Legends by scale

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[a] Specialisten zijn vaak 'wettelijk beschermd', een term die nog steeds geen biotoop-bescherming inhoudt, maar slechts een plukverbod. Bijzondere biotopen dienen beschermd te worden on basis van maatregelen, voortvloeiend uit het Natuurbeleidsplan middels de Wet op de Ruimtelijke Ordening.

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5.4 Natural History

There 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.

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) .

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.

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. 564 *Heukels' flora*

To find one's way in this flora, some insight is needed into the genesis of life (see para. 5.4.1). 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). 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

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

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.

5.4.1 Identifying plants species

Identifying plants to find out biological genius loci of the location and its rareness is a difficult job for laymen. However, on www.bk.tudelft.nl/urbanism/team 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. 565 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. 565 *First columns of Biobase extract on Excel sheet*

By next 17 (yellow headed) columns (Fig. 566) 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. 566 *First identifying characteristics of Biobase extract on Excel sheet with rows of* Fig. 565

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).
If your selection is still too large you can select further on leaf form and flower colour (Fig. 567).

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. 567 Second identifying characteristics *of Biobase extract on Excel sheet with rows of* Fig. 565

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. 568 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. 568 *Codes used in second identifying characteristics from Fig. 567*

The orange heads of columns are not very useful for identification, they give characteristics to check your selection.

After identifying plant species next 16 columns give interesting information about the environment (Fig. 569).

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. 569 *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. 570 *Codes used for environmental information in columns of Fig. 569*

The last row of Fig. 569 shows community type according to Westhoff and Den Held from Fig. 557.
The ecotope columns show the code from Fig. 559 *Ecological groups*. Inbetween these columns their classes of tolerance discussed in paragraph 5.3.5 are shown.
The last columns show additional characteristics summed up in Fig. 571.

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 Heukel's flora	page number in authoritative Dutch flora of Fig. 564 and Fig. 577
Genus Heukel's flora	subdivision of preceding family
Species / soort Heukel's 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 5.6.1)
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. 571 *Additional characteristics per plant species*

For example Fig. 529 used columns Abundance per 25km2 1980 and Abundance per km2 Zoetermeer to compare national and local rareness in a graph.

5.4.2 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.

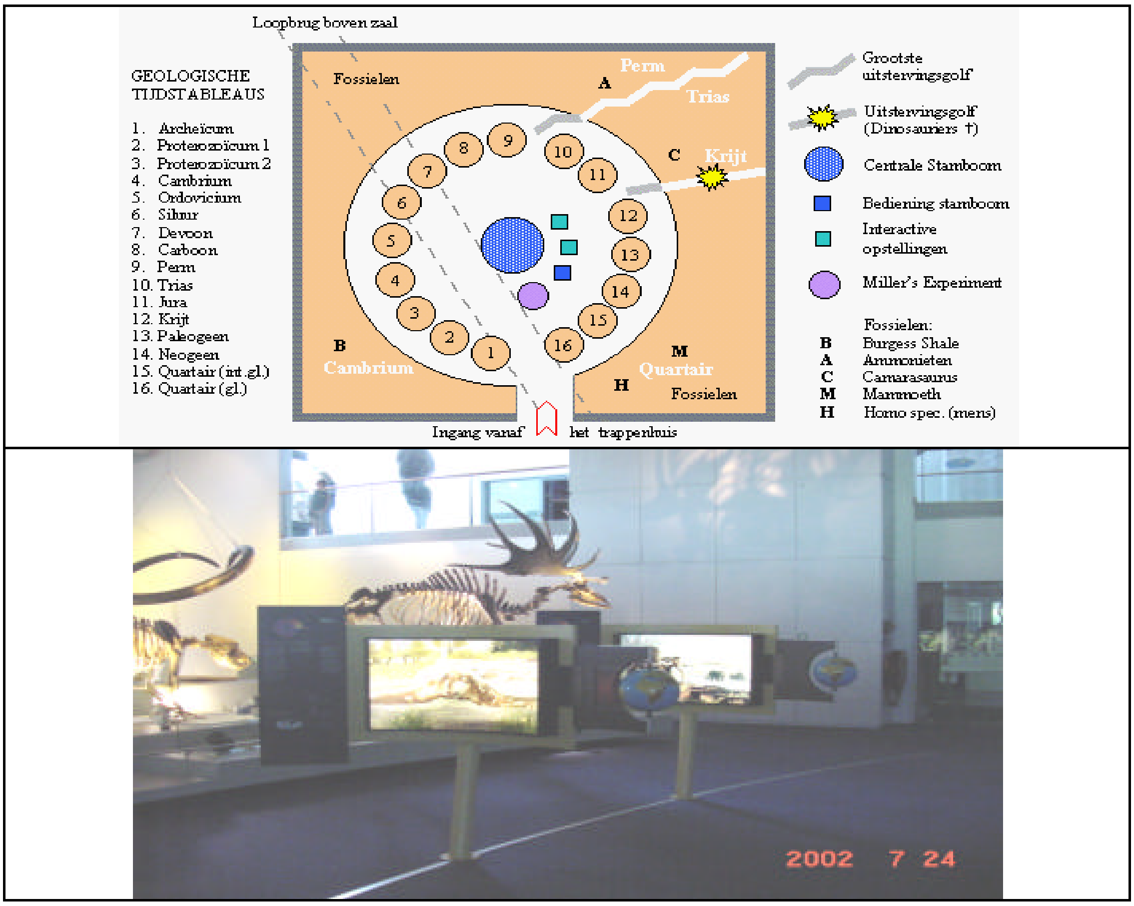


Fig. 572 *Eras at Naturalis*

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.

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

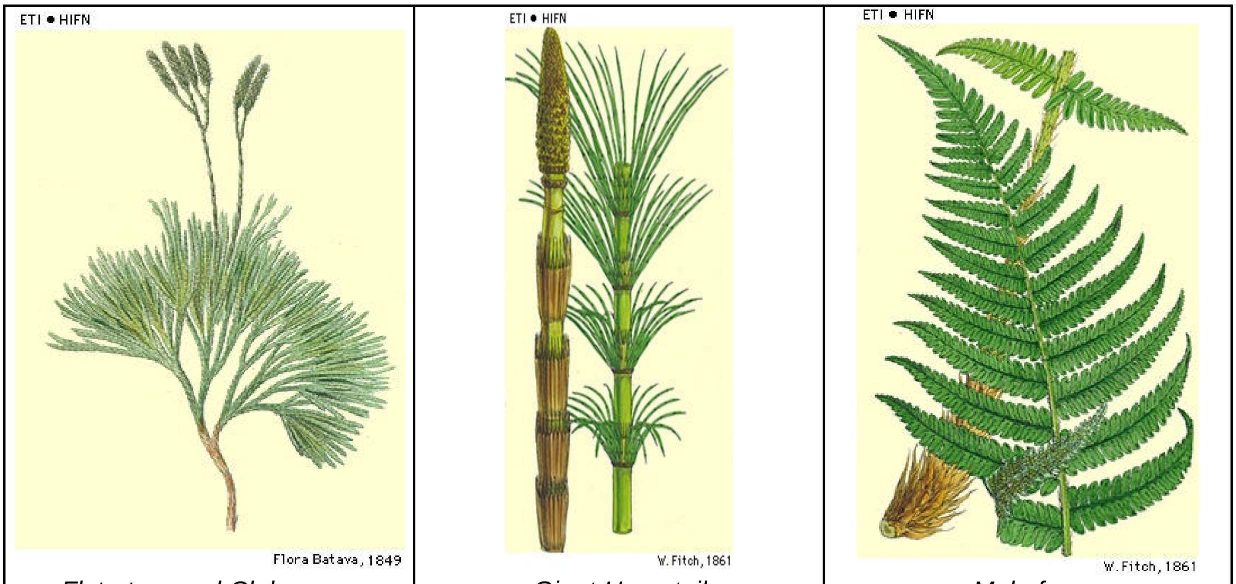
[a] See http://website.leidenuniv.nl/~siebersam/

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 (5.4.3).
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 (5.4.4).
65 million years ago:	The Cenozoic began with the extinction of the saurians and the advance of mammals (5.4.5).

5.4.3 Four-hundred million 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 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)

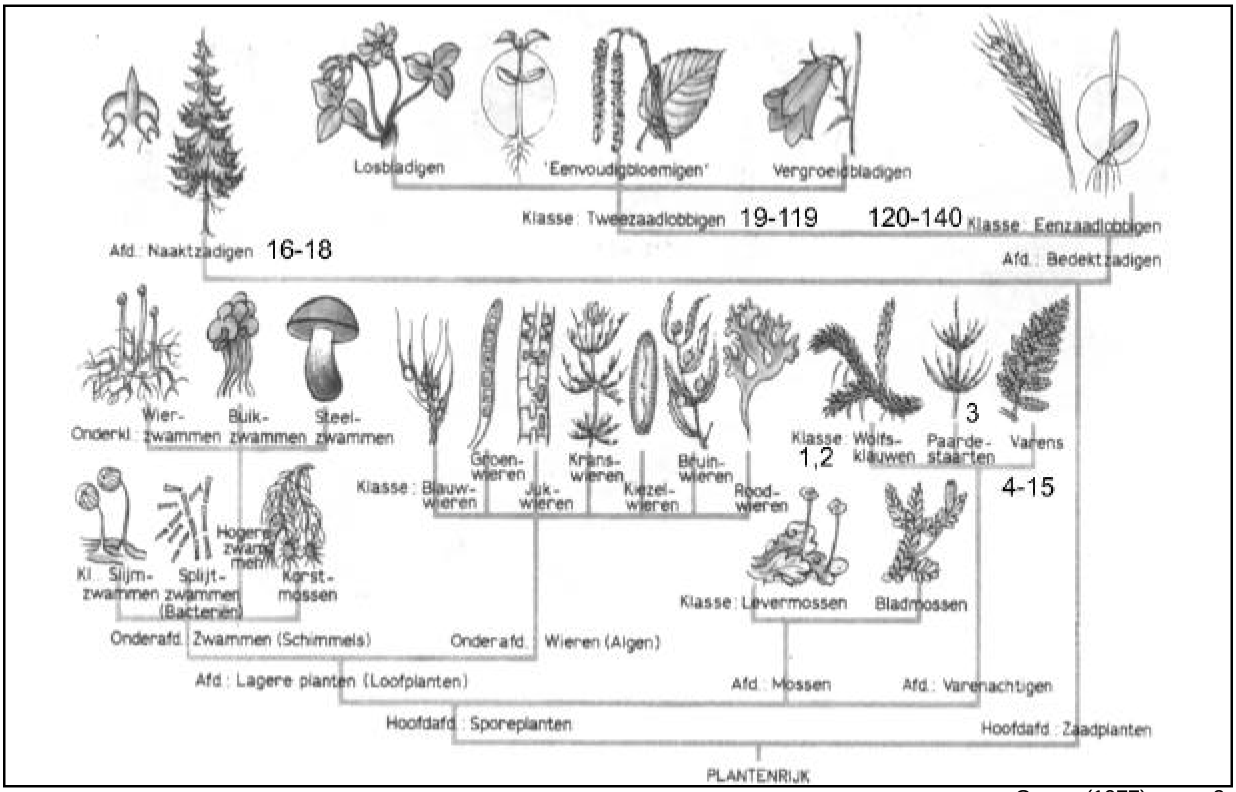
Fig. 573 *Pteridophyta*

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

5.4.4 Two-hundred-and-thirty million years ago

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)

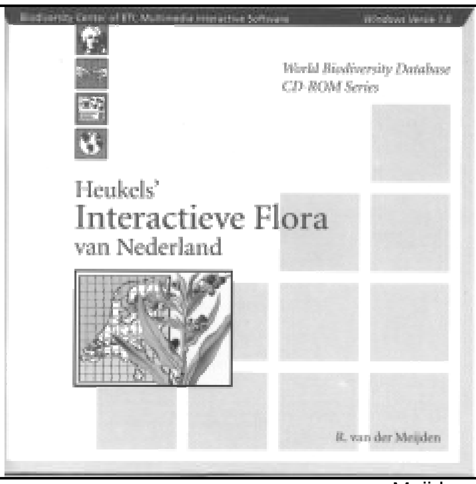


Garms (1977) page 2

Fig. 574 *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.

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. 575 and Fig. 576).
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. 575 *An interactive CD-ROM of Heukels' Flora.*

Marijnissen and Mol (1998)

Fig. 576 *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. 585).

According to recent evolutionary insights, plant taxonomy is built up as follows (see full list on page 607):

Class -*da*	**Subclass -*dae***	Super order - *florae*	Order *-ales*	Family *-ceae*	Genus *-ida*, *ids*	English name *see www.bk.tudelft.nl/urbanism/team databases biobase*
Lycopsida						
			001	*Lycopodiaceae*	*wolfsklauw*	*001*
			002	*Isoetaceae*	*biesvaren*	*002*
Equisetopsida						
			003	*Equisetaceae*	*paardestaarten*	*003*
and so on						

Fig. 577 *The taxonomy of Dutch plant families*

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 drastic changes were made to the classification system and thereby to the nomenclature, much to the sadness of many.

5.4.5 Sixty-five million years ago

The Cenozoic began with the extinction of the saurians and the advance of the mammals.[42] 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.

The last 2 million years (the Quaternary or Pleistocene) has been occupied by ice ages (glacials) and warmer interglacials (see page 37). The two most recent glacial periods, the Saalian (Fig. 578) and the Weichselian (Fig. 579), were interrupted by the Eemian interglacial period.

Fig. 578 *Saalian*

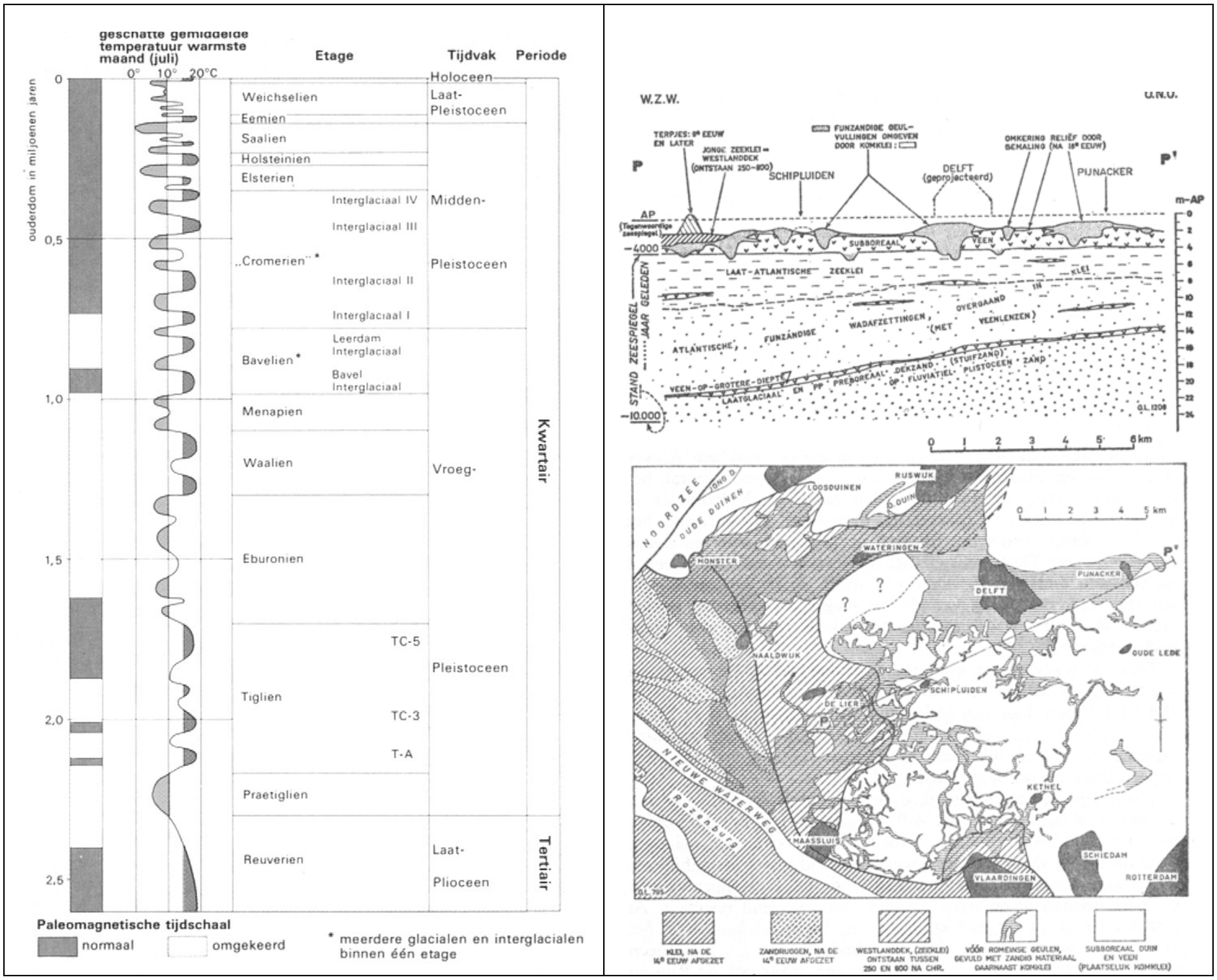
Fig. 579 *Weichselian*

The higher parts of the Netherlands were formed in particular during the Saalian.

Saalian	*Eemian interglacial*		*Weichselian*
200,000 BC	150,000 BC	70,000 BC	15,000 BC

Fig. 580 *The two most recent ice ages*

The forming of the Veluwe massif and the *Gelderse Poort* are clearly visible.
A lower areas of the Netherlands were shaped from 10,000 BC onwards (Fig. 581).

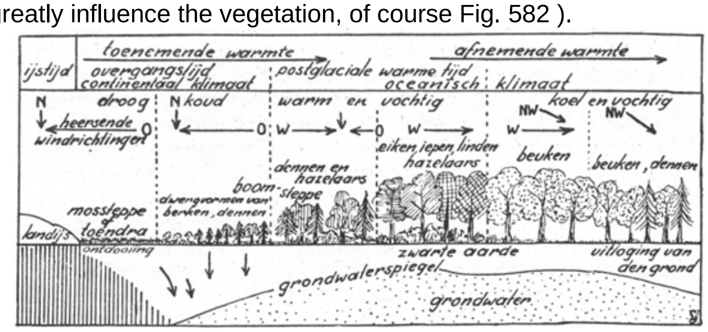


Sticht.Wetensch.Atlas_v.Nederland (1985) page 13 Faber (1966)

Fig. 581 *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[43]

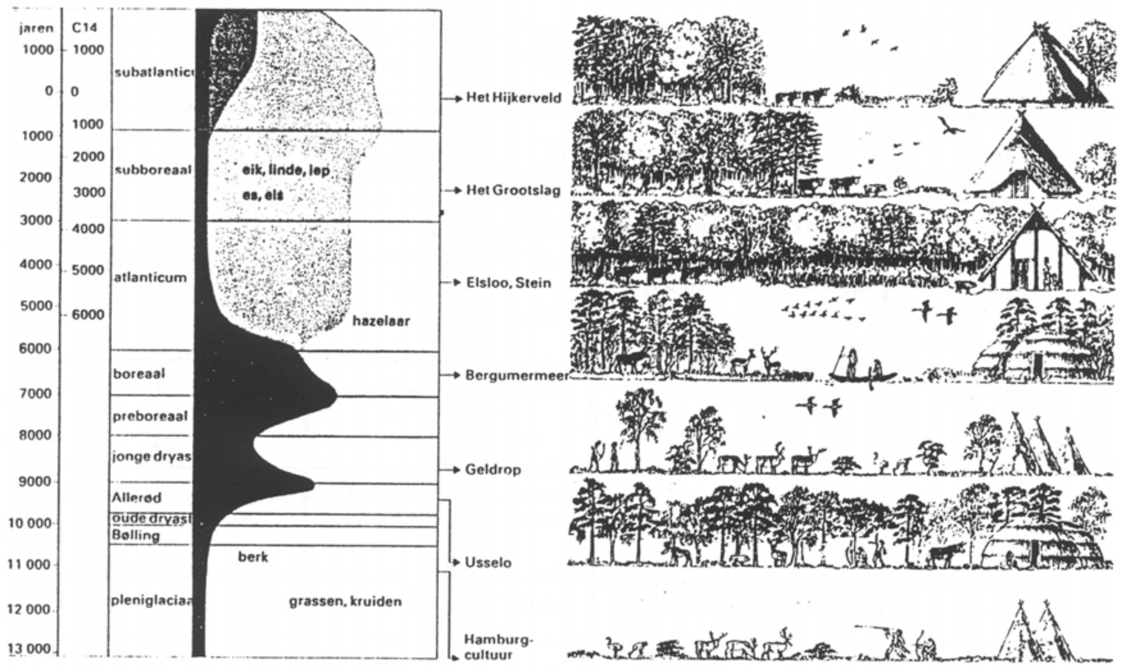
Climatic changes greatly influence the vegetation, of course Fig. 582).



Visscher (1949)

Fig. 582 *The influence of climatic changes on vegetation*

The picture that emerges from pollen dating is one of changing landscapes and habitation (Fig. 583).



Bloemers, Kooijmans et al. (1981) page 32

Fig. 583 *Landscape changes since the last ice age*

The following paragraphs give a closer picture of this.

5.4.6 References to natural history

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5.5 Valuing Nature

‘Nature’ is treated as a concept in this chapter and thus as part of a culture that values nature. This chapter gives some insight into the types of natural area that can be dinstinguished. (zie **Fig. 851**) 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.

5.5.1 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.

In valuing the Dutch flora and fauna on a European level, then 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?

As eventually, our concern is with the biodiversity of the whole world, our priority must be to assess the uniqueness of our nature within a radius of 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 a radius of 1000 km. At the national level, the radius would be 100 km and at the local level, 10 km.

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?.

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).

5.5.2 Rarity

The local rarity of a group, association, ecological group, population, community, formation, ecosystem or artifact can be expressed as the distance to the nearest x examples in the neighbourhood. If the criterium for rarity *x* equals 1, then this is the distance to the next example in the neighbourhood (within this radius, it can then be considered to be a unique example) From a given x, a radius can thus be deduced (as a frame) within 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.

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.

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.
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.
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%.
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

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[b] and also partly to what extent. 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 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 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

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

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 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
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.

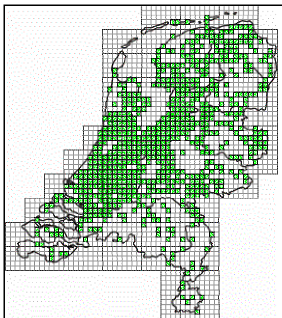
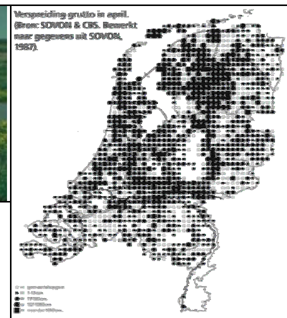
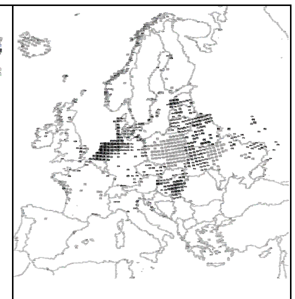
	 29AA02 The association between Golden Dock and the Marsh Fleawort in the		 Hagemeijer and Blair
Marijnissen and Mol (1998)	Foto Alterra, IBN-DLO		Beintema, Moedt et al. (1995)
Marsh Fleawort distribution	29 Class Bur-marigold	Black-tailed Godwit distribution	European presence

Fig. 584 *The distribution of two world-wide rare species*

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. 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) .

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) }.

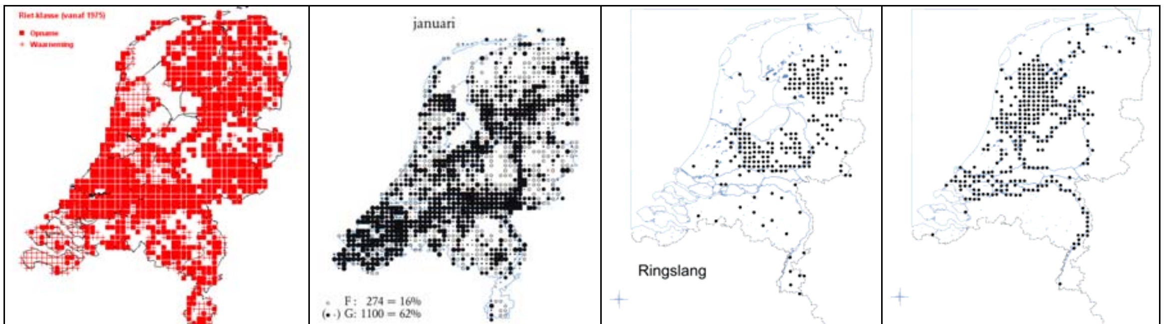
Fig. 585 *Biodiversity according to the CBS Biobase*

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.

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.
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).

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.



08 Reed class	Bean Goose	Grass Snake	Smelt

Fig. 586 *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).

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. 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.

A variety-rich phyla of molluscs, 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.

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. 587 *De Europese verantwoordelijkheid voor vogels*

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 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.

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.

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.

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.

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.

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).

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.

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.

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.

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.
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

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 rareness 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. 588 *The national responsibility for birds*

Judged by its feathered visitors, the national rareness 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 rareness, 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). 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.

5.5.3 Replaceability

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.

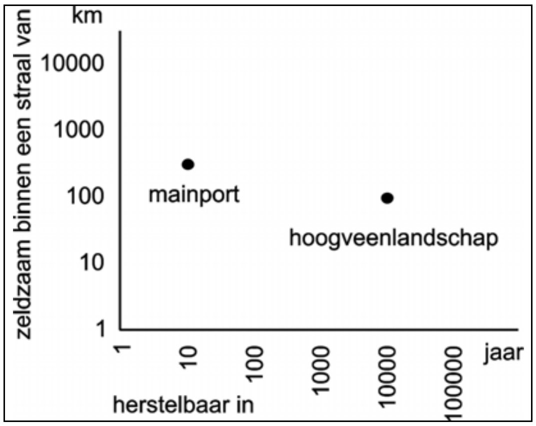


Fig. 589 *Scarcity and Replaceability*

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.

By viewing rarity in combination with replaceability, a host of methodological queries arise, but they have managerial, cultural, economical, 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.

5.5.4 Comparability Problems, which categories?

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.

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.

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 affects 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.

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 rareness of the IJsselmeer region can be relativised by the presence of the Oosterschelde. This consideration is clarified by means of an example.

5.5.5 Valuation bases

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.

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.

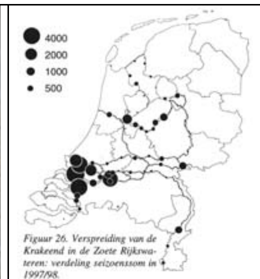
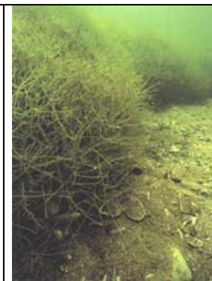
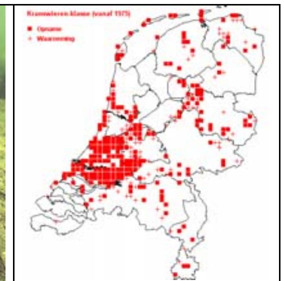
			
IVN Vecht & Plassengebied	Bekhuis, Bijlsma et al. (1988)	W.Kolvoort	Synbiosis, Alterra
Gadwall duck		04 Garland Weed Class	

Fig. 590 Similarities in distribution situations

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.

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.

5.5.6 Valuing urban nature

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 M. de Jong, 27.6.2001:
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.

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'.

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.

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.

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.

I agree with Mabelis' choice to use a number of indicator species, irrespective of their rareness and relationship to each other. If the rareness 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.

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.

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.

5.5.7 References to Valuating nature

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5.6 Managing Nature

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.

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.

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

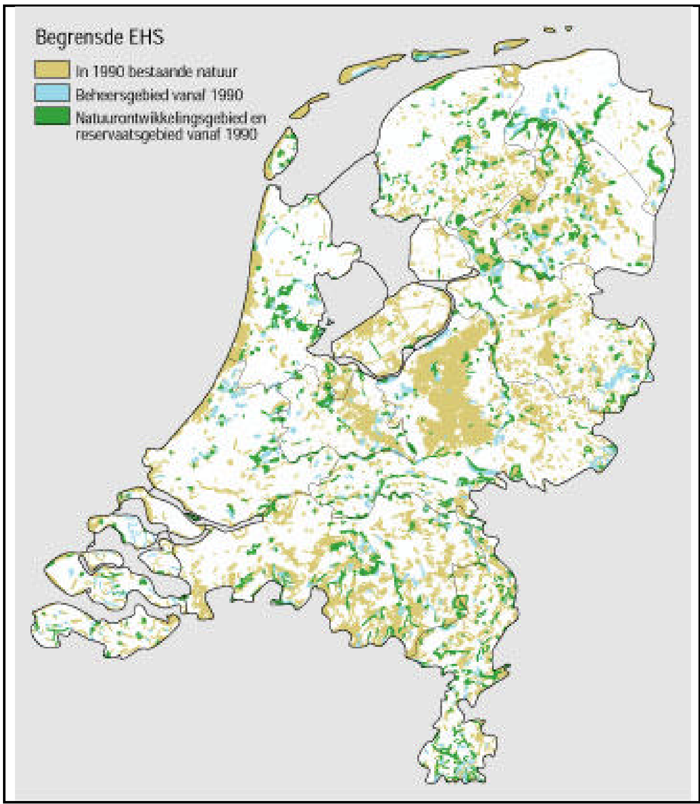
Fig. 591 *Presumed perspective*

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(zie blz. **Fout! Bladwijzer niet gedefinieerd.**), 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.

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

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



LNV (2000)

Fig. 592 *The EHS for the Netherlands*

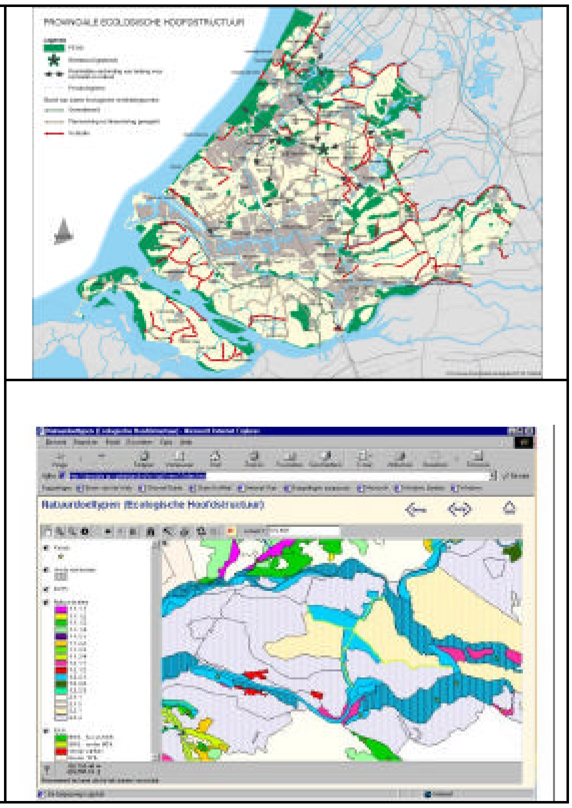


Fig. 593 *The EHS worked out on Internet for the province of South Holland and the Gelderse poort*

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.				
3. 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
4. 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. 594 *Overview of nature-target types*

The nature-target types are specified according to physical-geographical region (Fig. 595).

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	11	20	392	113	132

Bal, Beije et al. (1995)

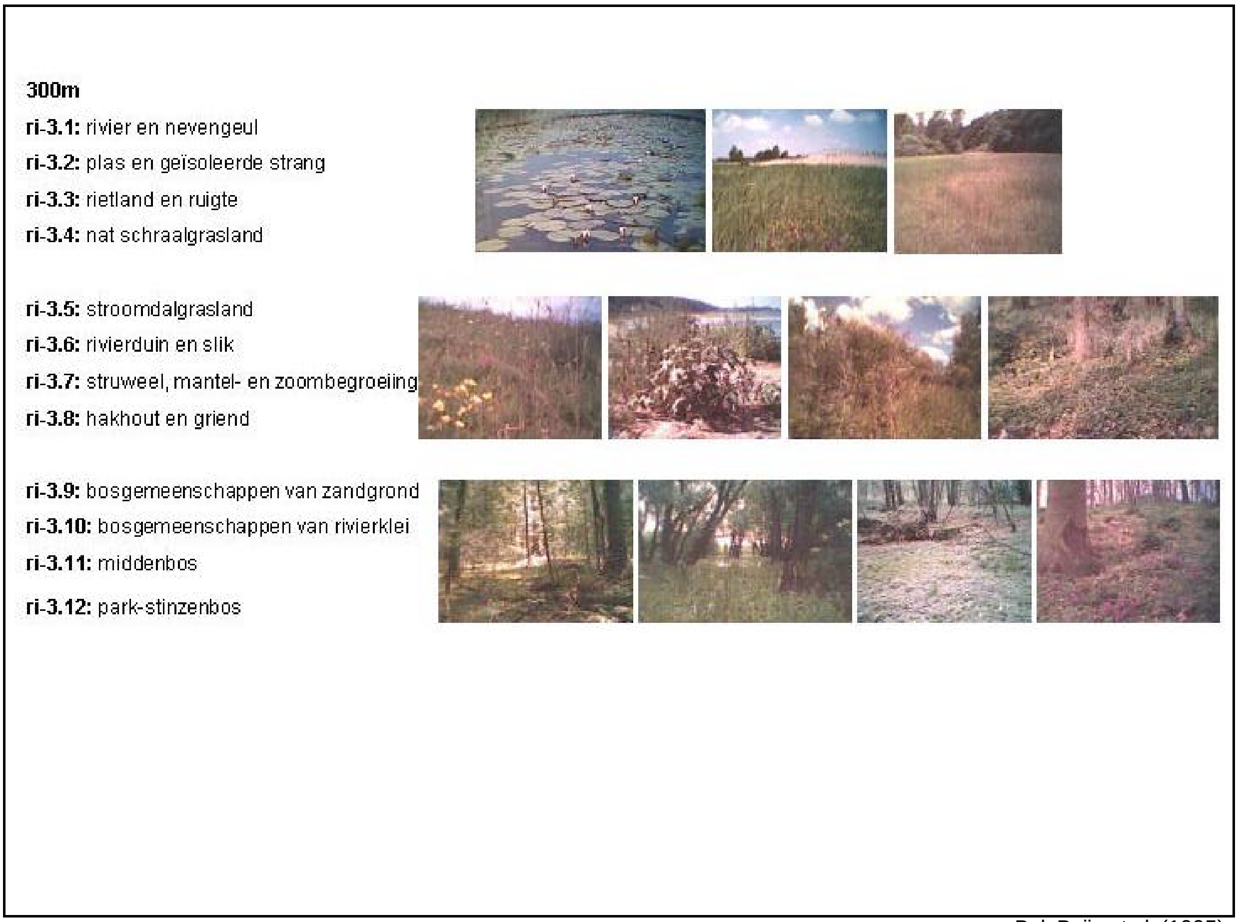
Fig. 595 *Nature-target types per* ***physical –geographical region***

5.6.2 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. 596).

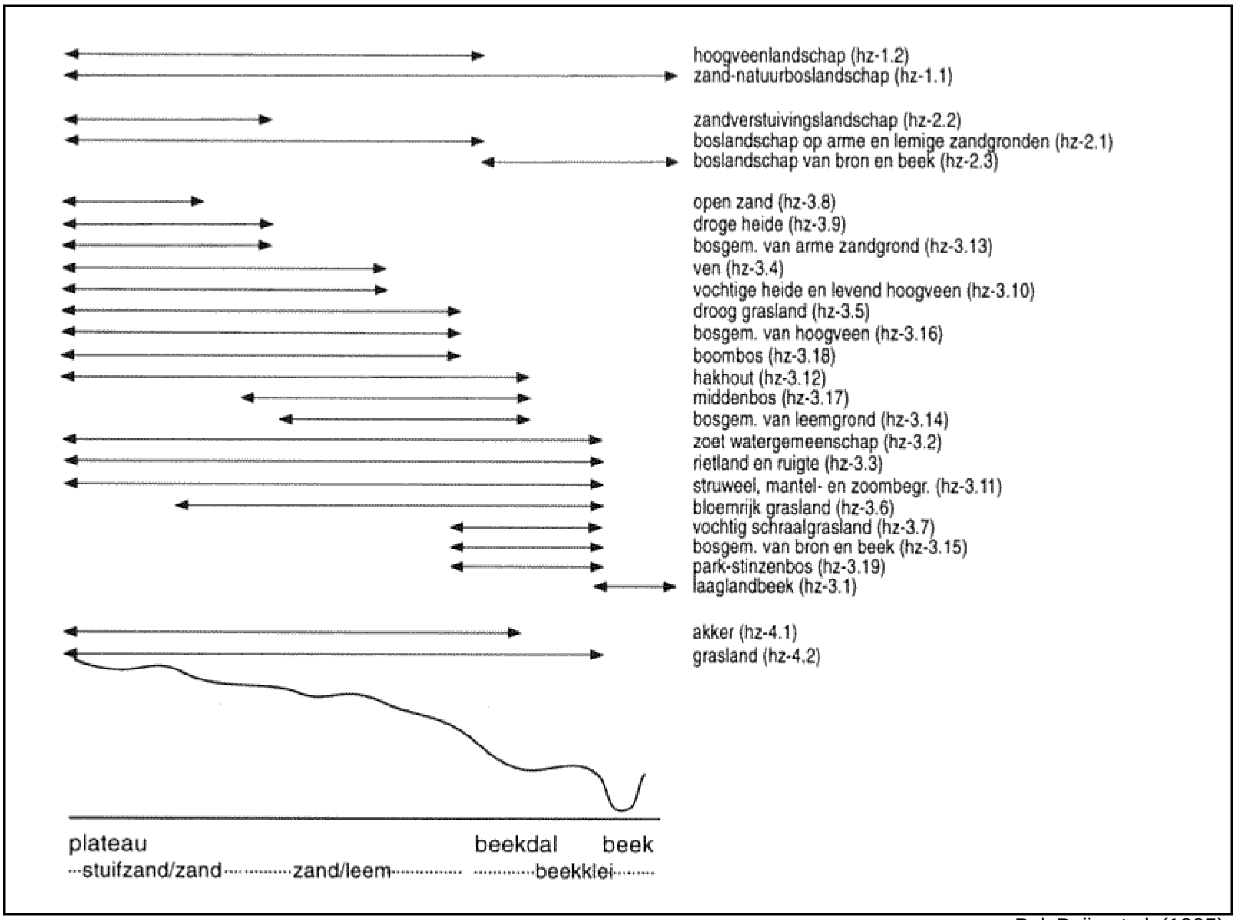
Bal, Beije et al. (1995)

Fig. 596 Nature-target types for the **higher sandy soils**



Bal, Beije et al. (1995)

Fig. 597 *Nature-target types for* ***the higher sandy soils — 300 m.***



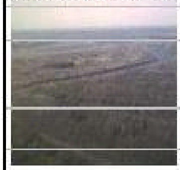
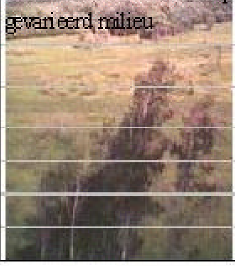
Bal, Beije et al. (1995)

Fig. 598 *Nature-target types for* ***higher sandy soils in local profile***

5.6.3 Nature-target types in fluvial areas

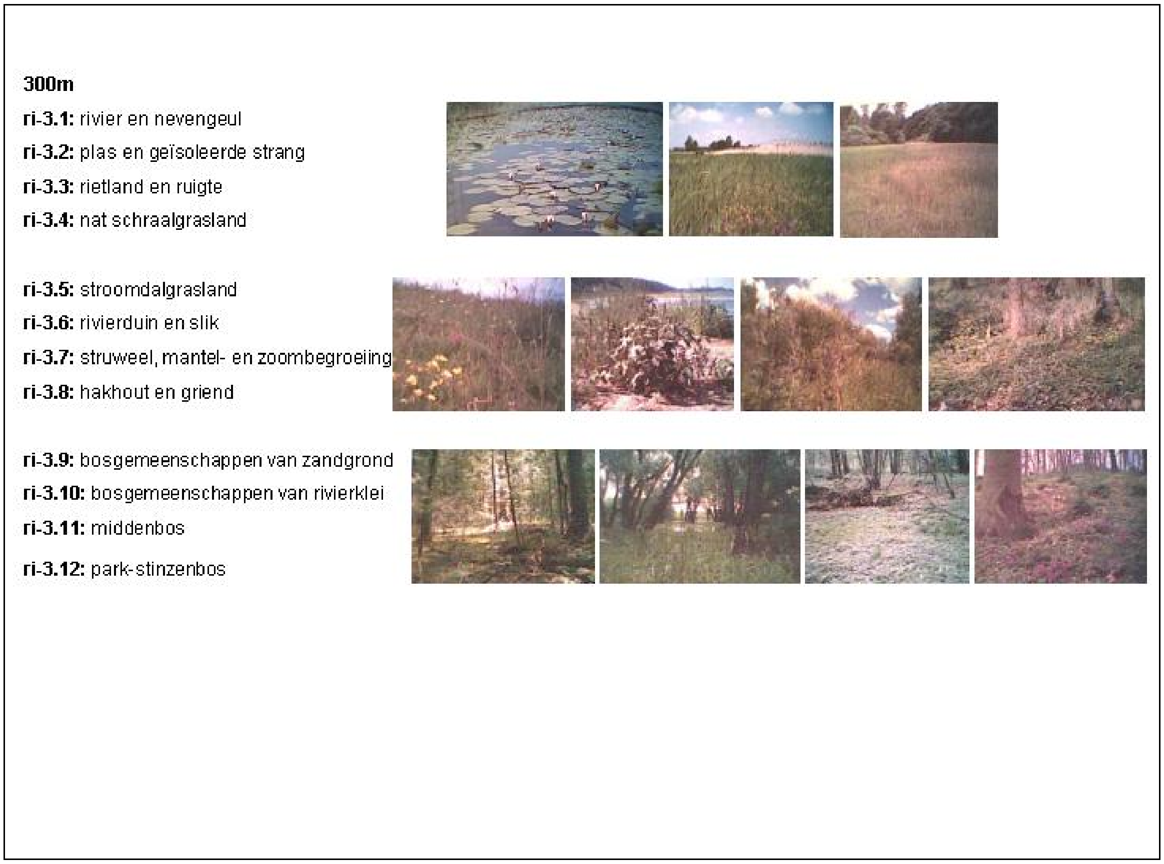
For The Fluvial Area, the following nature types have been established as targets (Fig. 599).

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	

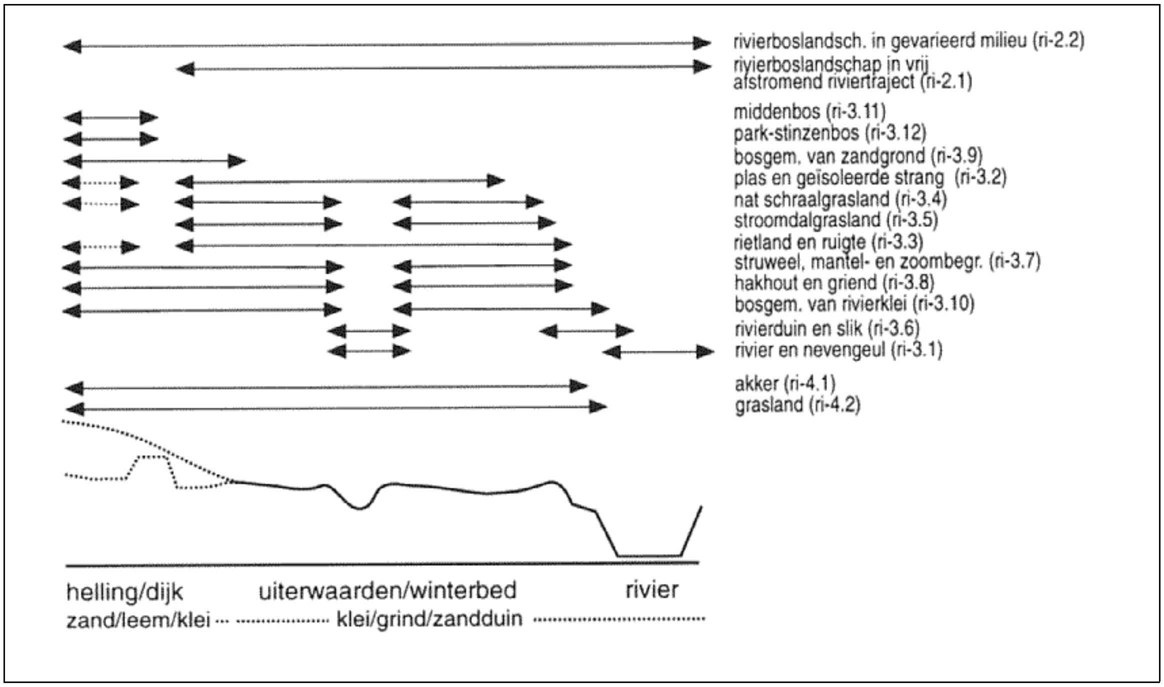
Bal, Beije et al. (1995)

Fig. 599 *Nature-target types for **The Fluvial Area***



Bal, Beije et al. (1995)

Fig. 600 *Nature-target types for **The Fluvial Area — 300m***.



Bal, Beije et al. (1995)

Fig. 601 *Nature-target types for* ***The Fluvial Area in local profile***

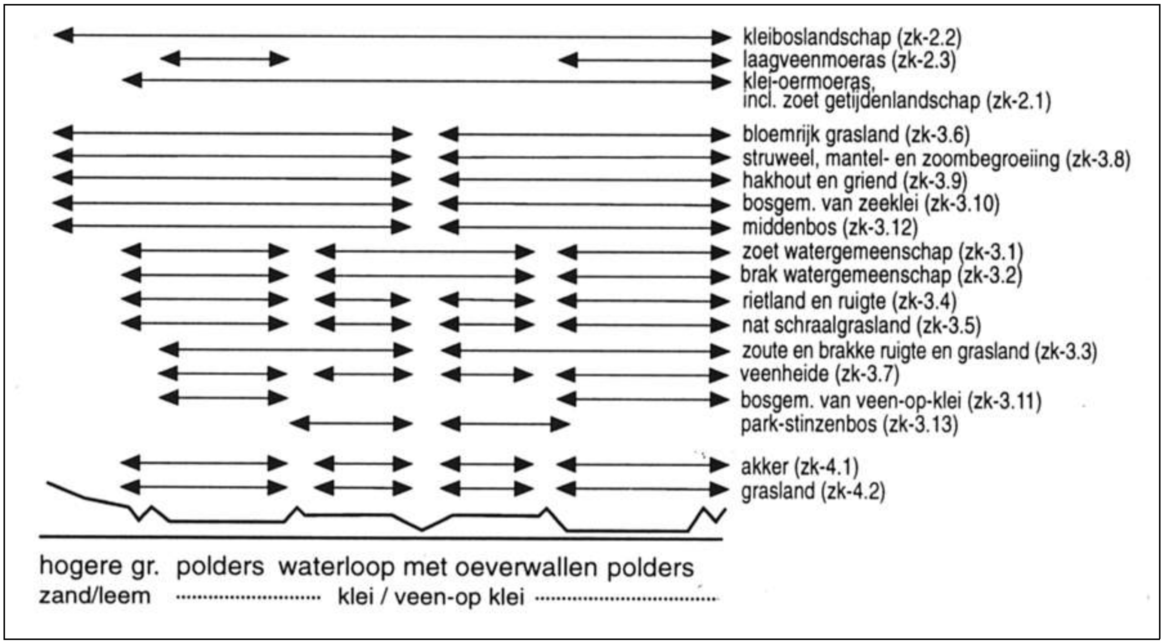
5.6.4 Nature-target types for the Marine-clay areas

For the Marine-clay areas, the following nature types have been established as targets (Fig. 602).

3km	>1km	300m	100m
	zk-2.1: clay–primeval morass (including freshwater tidal landscape) **zk-2.2:** wooded landscape on clay **zk-2.3:** laagveen 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-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	**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

Bal, Beije et al. (1995)

Fig. 602 *Nature-target types in* ***Marine-clay areas***



Bal, Beije et al. (1995)

Fig. 603 *Profile of nature-target types in Marine-clay areas*

5.6.5 Urban nature

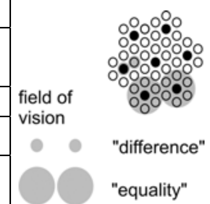
The relation between abiotic factors in urban areas and diversity of plant species is examined on 8 levels of scale. Hypotheses on the abiotic origin of this diversity, especially within cities, are listed on each level of scale. They are supported by examples from the cities of Zoetermeer and partially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

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?

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?

For the time being, we will choose the following points of departure (hypotheses):

Variation effective for the vegetation	in a radius of approx
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.	



Scale paradox

Jong (2000)

Fig. 604 *Hypothetical working variations per scale-level in urban-nature subsoils*

The scale paradox in urban architecture (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.

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.

Thanks to Johan Vos (Zoetermeer), Pieter Stolwijk (Enschede) and Kees Groen (Floron) we will now try, using their examples from Zoetermeer and where necessary also from Enschede, to prove the above hypotheses. In doing this, we would like to point out gaps in our knowledge for the benefit of further research and to draw readers’ attention to existing knowledge (T.M.deJong@bk.tudelft.nl).

5.6.6 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. In **Fout! Verwijzingsbron niet gevonden.** 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).

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. 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.

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.

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).

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
Fout! Verwijzingsbron niet gevonden. 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. 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.

5.6.7 References to Managing nature

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