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Ecological possibilities for nature restoration in The Netherlands

Abstract

With the official acceptance of nature restoration as a new tool for nature protection new perspectives have been announced. In The Netherlands, the most valuable ecosystems rely on nutrient-poor habitats and on salt marshes. However, these ecosystems have suffered and still suffer considerably due to atmospheric pollution and hydrological measures among other human interferences. Other large-scale ecosystems are less difficult to restore. However, the latter ecosystems also comprise less natural values. We therefore conclude that nature protection should focus at improving environmental quality, nature restoration in the areas with the best opportunities (northern and eastern part of The Netherlands and the coastal dunes), and the proper maintenance of the actual core areas.

key words: ecological processes, nature restoration, strategies, validation

Nature under siege

With a population density of c. 400 inhabitants per km^2, The Netherlands is one of the most crowded countries in the world. About two thirds of the area is intensively used for agricultural purposes and another 8% for housing, infrastructure, etc. Only some 4% is currently occupied by terrestrial nature areas, whereas about 8% is covered by forests, the most of which has been originally planted for wood production. Dutch nature is under siege because of air, water and soil pollution, habitat destruction and fragmentation, detrimental hydrological measures, among others.

In 1990 the Dutch government accepted the Nature Policy Plan which aimed at: 1) the protection of the remaining core areas of Dutch nature, which approach was not very different from earlier policies, and 2) the creation of nature areas on places which were formerly used for other, mainly agricultural, purposes (Anonymus, 1990). The latter approach marked a breaking point with the Dutch tradition in nature conservancy. The new policy focuses at a renaturalization and restoration of vital ecological processes in a national Ecological Network. In this Ecological Network, nature elements should be connected to each other by some 50 000 hectares of new areas and another 150 000 hectares of multi-used areas, where agriculture and forestry will be adapted to nature protection. Afterwards, the concept has been worked out in greater detail (Jansen et al., 1993).

Strategies

Ecological processes take place on a great variety of temporal and spatial scales

(Jenny, 1958; Delcourt et al., 1983; Miles, 1987). Local processes on population and community level often change rapidly, whereas hydrological and geomorphological processes on a regional level generally alter slowly (Figure 1). Furthermore, geological and climatological changes often require many centuries and may influence entire continents. There is a hierarchy in these processes. Generally, geological and climatological processes dominate the lower ranked processes and form a kind of a template for these.

During man's history there is a change from an impact on a very local level on animal and plant populations in Paleo- and Mesolithic periods, to an impact on communities in Neolithic periods, to changes in regional hydrology in the Middle Ages, and on a continental and global level due to climatic changes in modern times. Although there are some reports on some occasional human influence on atmospheric quality and climate already in the Neolithic and Roman periods, it seems more incidental than a general feature as it is in modern times. Thus, man's influence on his environment becomes increasingly comprehensive. In The Netherlands, this human interference in large-scale ecological processes can be only partly compensated for in nature areas on the basis of a rather intensive, and fairly costly management. However, for a durable protection of Dutch nature restoration and/or imitation of vital ecological processes is required.

The possibilities for this restoration are determined by the current ecological, socio-economic and legislative conditions. Here, we confine to the ecological aspects to assess opportunities for nature restoration. Depending on these conditions, four strategies are suitable (Table 1) which have been officially adopted, viz.

1) The creation of large-scale nature areas (of at least 500 hectares) in which management is not allowed at all. Spontaneous ecological processes may lead to habitat variation, but it is uncertain which community structure and com-

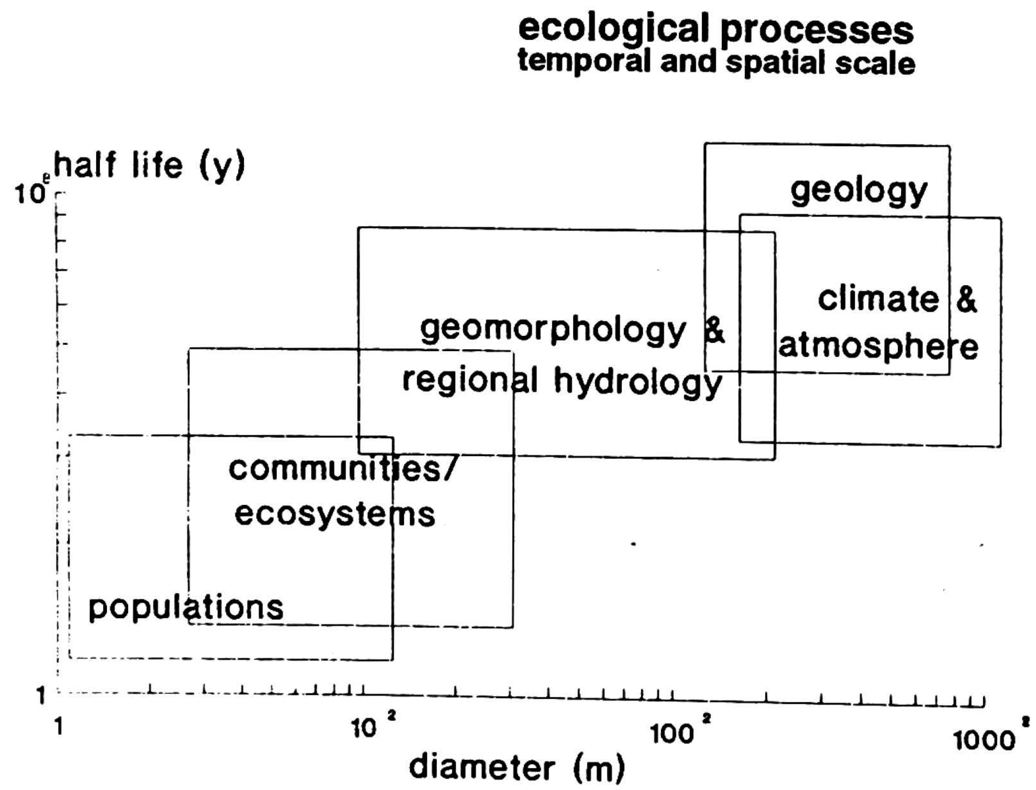

FIGURE 1. Relation between space and time of a number of ecological processes (modified from Olff, 1992)

TABLE 1. The four distinguished strategies of nature protection characterized in the potential positive (+) and negative (–) effects

Strategy type	Predictability	Durability	Genetic variation	Social acceptance	Costs lay-out	Costs maintenance
1	–	+	+	–	–	+
2	±	+	+	±	–	+
3	+	–	±	+	+	–
4	+	–	–	+	+	+

position will establish. For such a densily inhabitated country like The Netherlands, this strategy is not very applicable·apart from the Wadden Sea, as the availability of space and unpolluted areas are in general limiting factors;

2) The creation of large areas in which some human interference is necessary to create or to restore initial conditions for the ecosystems desired. This human interference aims at e.g. the reconstruction of hydrological and soil conditions, and sometimes also at the re-introduction of animals (e.g. large herbivores). Local management regimes are regarded to maintain a certain community. This kind of management is not allowed. Again, only relatively large areas (500 or 1000 hectares or more) are required.

3) The maintenance of a desired community by local management regimes concerns mainly already existing nature areas. In general, frequent human interference is needed which can be regarded as an imitation of traditional agriculture, e.g. mowing, sod cutting, coppicing, etc. In modern agriculture, however, these practices have generally been abandoned already for decades. Much of the current natural values in The Netherlands highly depend on this strategy. Because of its intensive and costly management it can only be applicable in rather small areas.

4) Finally, if nature protection cannot be the only objective, multifunctional use of areas may be aimed at. Examples of this strategy are forests used for wood production and/or recreational purposes, that may be importance for nature conservation, and halyands and pastures in agricultural use, in which birds breed. The minimum area to adopt this strategy has not been given as it highly depends on the other users.

It is a premise in both first strategies that they will lead to a certain degree of what is called "self-regulation" (as no continous maintenance regimes are required). One may question whether the minimum sizes of the nature areas required for the adoption of this strategies are realistic. For the original peat bog landcape several thousands of hectares are regarded as a minimum size on the basis of the co-existence of all relevant landscape elements (Pons, 1992). For stream valleys there is a requirement of at least 10 000 hectares derived from the presence of all indicative species (Van der Hoek & Higler, 1993) and in the Yellowstone ecosystem in the United States an area of even 5 milion hectares is considered too small to obtain a "self-regulating ecosystem" for grizzly bears (Chase, 1987). In the U.S. there is a lot of experience in the larger nature reserves which have been subjected to relatively small human disturbances (Chase, 1987). It has taken and still takes much effort to compensate for these minor disturbances. Thus, one cannot exclude that in the near future some interference is needed to compensate for undesired phenomena also in areas which have suffered much more from previous human disturbances and are maintained now according to the first two strategies.

Values of the Dutch nature

The consequences of the Treaty on Global Diodiversity (UNCED, Rio de Janeiro, 1992) have led by the idea of the Dutch policymakers that primarily (a)biotic conditions for the maintenance of global biodiversity should be protected or restored. Furthermore, species occurrence indicates (the quality of) abiotic conditions. Thus, the importance of each territory to global nature protection can be derived from biogeographical and ecological information of its indigenous species.

In The Netherlands this approach has been largely adopted by the determination of species indicative for global biodiversity, which a) have a limited distribution area, and/or b) have a low density (i.e. they are rare on a national scale and may therefore be regarded as species with a small global population sizes, and/or c) show a distinct decline. These species are considered the "target species" for Dutch nature protection (Jansen et al., 1993).

In particular species of nutrient-poor and salt or brackish habitats occur rather-abundantly in the group of species which The Netherlands should pay special attention to (Figure 2) (Verkaar, in prep.). These species are notably found in communities of the Littorelletea, Isoeto-Nanojuncetea, Secalietea, Nardo-Callunetea, Festuco--Brometea, Asteretea tripolii. Oxycocco--Sphagnetea, and Alnetea glutinosae. Significantly less than one would expect on the basis of the distribution of all vascular species, these species occur in communities of nutrient-rich soils of the Chenopodietea, Molinio-Arrhenatheretea, Plantaginetea majoris, Artemisetea vulgaris, and Phragmitetea (Figure 3).

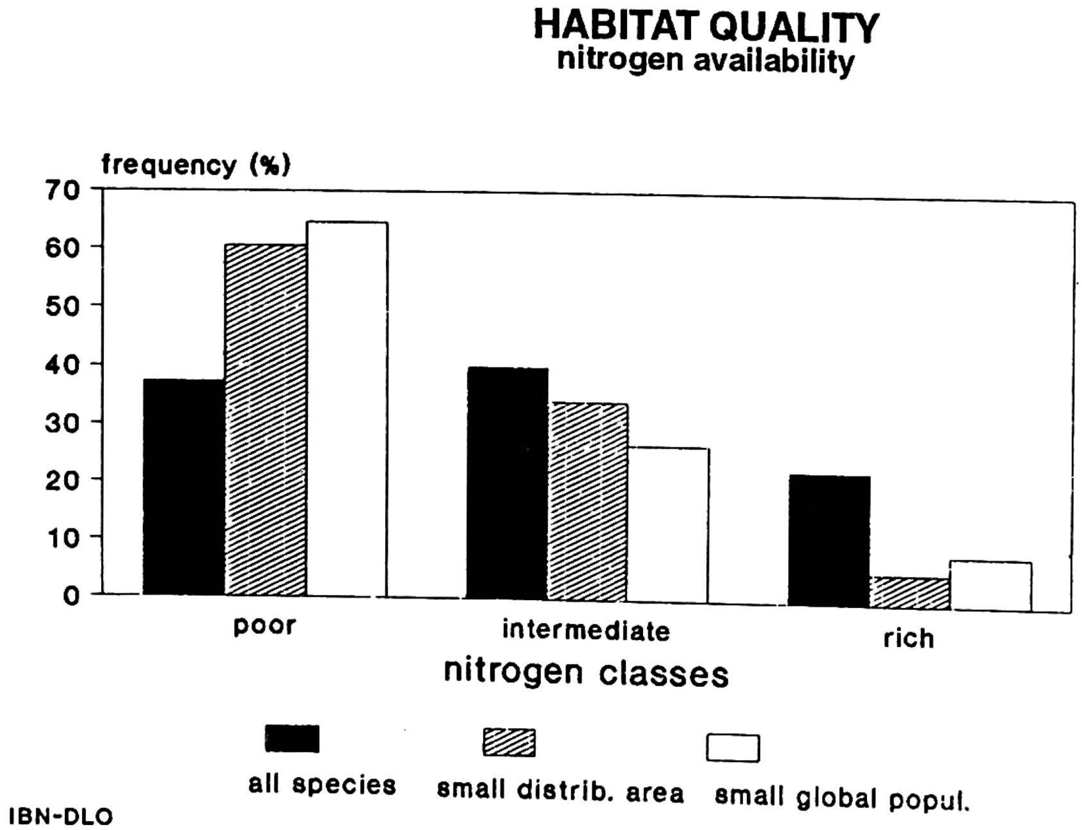

FIGURE 2. The frequency distribution of the assessed nitrogen availability in the habitats of all Dutch vascular plant species, species with a limited distribution area, and species with a small global population size. Nitrogen availability is based on Ellenberg's indicator values (1 = Ellenberg's values of 1–3, 2 = 4–6, and 3 = 7–9). Ellenberg's indicator values (R) are ranking from 1 (= very nitrogen-poor) to 9 (= very nutrient-rich)

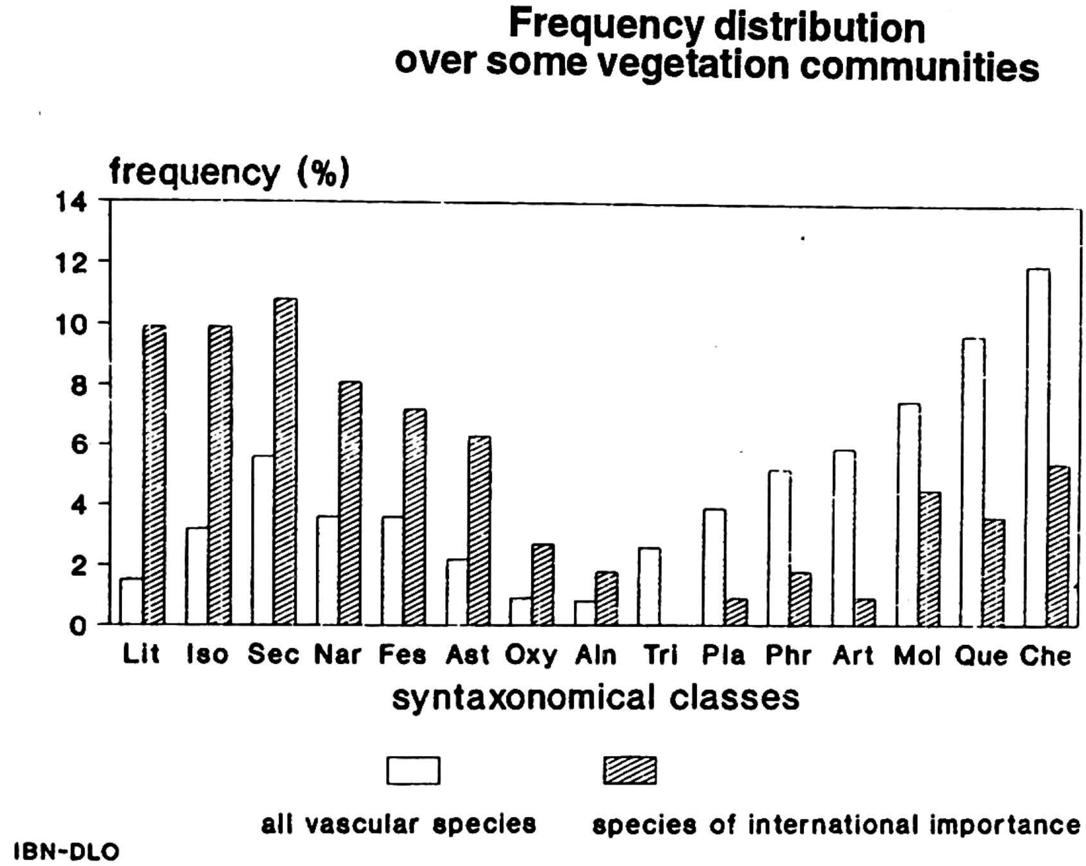

FIGURE 3. The frequency distribution of indicator species of a number of syntaxonomical classes for all Dutch vascular plant species and for species of international importance

In The Netherlands, a firm majority of the target species are found on the Pleistocene sandy soils in the southern and eastern part of the country, in the coastal sand dunes, and on the loess and chalk soils in the extreme south-east. On nutrient-rich clayey soils in the south-west, the western and nothern parts, only a few vascular target species may occur. For animal species this picture does not differ too much. Therefore, there is a clear correlation between the numbers of plant and animal species per region which were considered targets (Figure 4).

Opportunities for nature restoration

On the basis of concepts shown in figure 1, we have tried to identify areas in which abiotic conditions are relatively favourable for nature restoration. Demands derived from three major processes have been assumed to be crucial for the developmental potentials, i.e. the quality of regional geomorphology, the quality of regional hydrological processes, and the atmospheric quality. These demands were related to the conditions in each of a total of eight terrestrial regions (Farjon et al., 1994). These regions have been previously distinguished on the basis of physical and geographical properties (Anonymus, 1990). Generally, geomorphological quality was determined by the variation of soil conditions that are found in the region concerned. Hydrological quality was in most of the regions classified by the occurrence of a certain amount of seepage water of good quality. Finally, atmospheric quality was characterized by classifying the deposition of nitrogeneous and acidic compounds. Additionally, in river marshes and fenlands surface water dynamics and the degree of phosphate limitation respectively were considered vital characteristics. In the extreme south-east, the presence of chalk substrates, of sources of upwelling water, and the quality of the upper stream have been characterized.

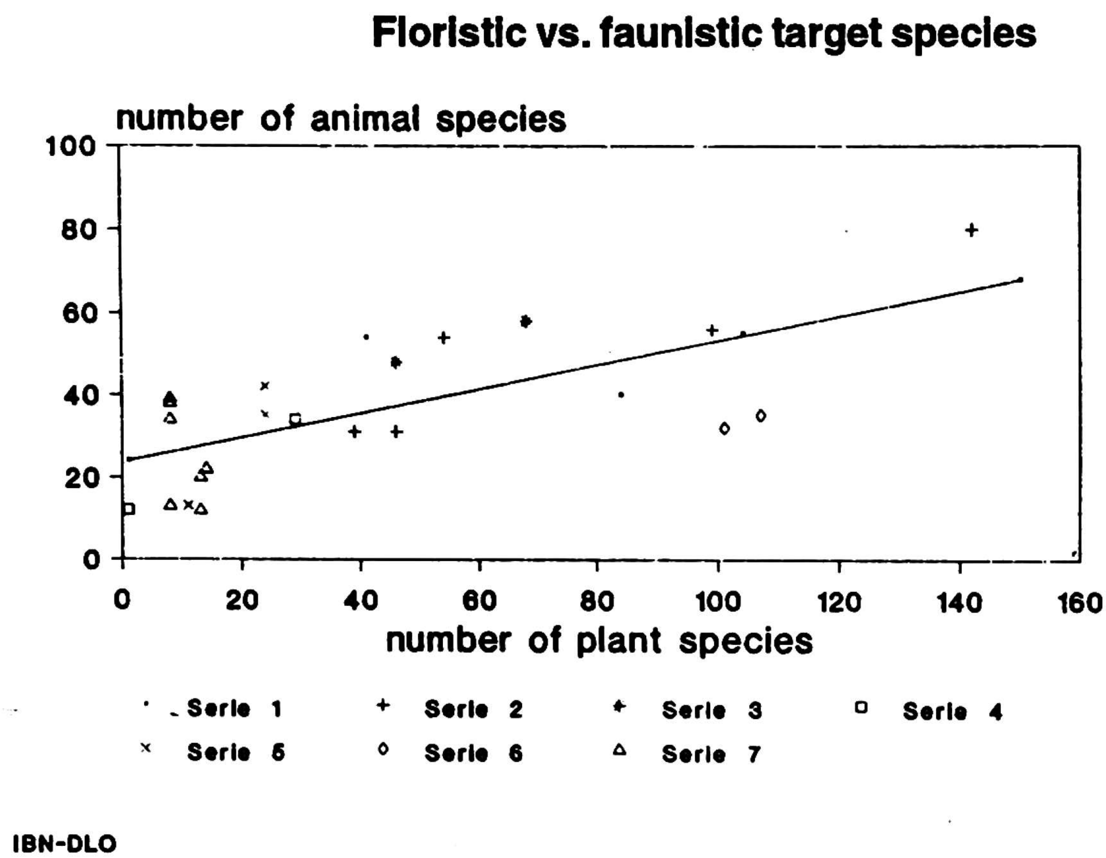

FIGURE 4. The relation between plant and animal target species for large-scale nature restoration according to Jansen et al. (1993). The distinguished regions are: 1 = loess/chalk district; 2 = stream valleys on Pleistocene sands; 3 = valleys of the main rivers; 4 = fenlands; 5 = mires on clay; 6 = coastal dunes; 7 = (formal and actual) tidal areas. The drawn line fits for $y = 23.7 + 0.295 * x$ ($r^2 = 0.491$, $P_{one\text{-}sided} << 0.001$)

The outcome of this study was compared with data on the distribution of some indicative plant species. In the chalk district in the extreme south-east, in river marshes and in the coastal dune area, we did indeed find the largest number of indicative plant species on places that were determined to have the best conditions for nature restoration. However, in other regions there was not a good fit with both approaches. We suppose that this differentiation is due to the limited selection of the used plant species, and imperfections in the data of abiotic conditions for inland dunes and in biogeographical data of recently reclaimed areas on clayey substrate. Moreover, the discrepancy between actual vegetation and ecological potentials may also contribute to this differentiation.

In spite of the mentioned imperfections of the study, we conclude that in general potentials for the restoration of inland and coastal dunes, fenlands, and stream valleys are rather limited with only a few exceptions, whereas there are ample good perspectives for e.g. mires on clay (Figure 5). However, the latter region does not house many target species. Furthermore, although abiotical conditions for nature restoration are fairly good in the chalk district, socio-economic conditions may be unfavourable. This complicates the current policy somewhat: The regions most valuable for nature protection only have a limited number of areas which are appropriate for restoration. E.g. in the Pleistocene sand region, the southern part has a rather bad atmospheric quality, whereas the Veluwe district in the central part does not show much hydrological variation by the lack of sufficient seepage water. Thus, in the Pleistocene soils of the eastern and northern part of the country the best initial conditions for nature restoration are found. From an ecological point of view, according to the first two strategies comprehensive hydrological units, i.e. enti-

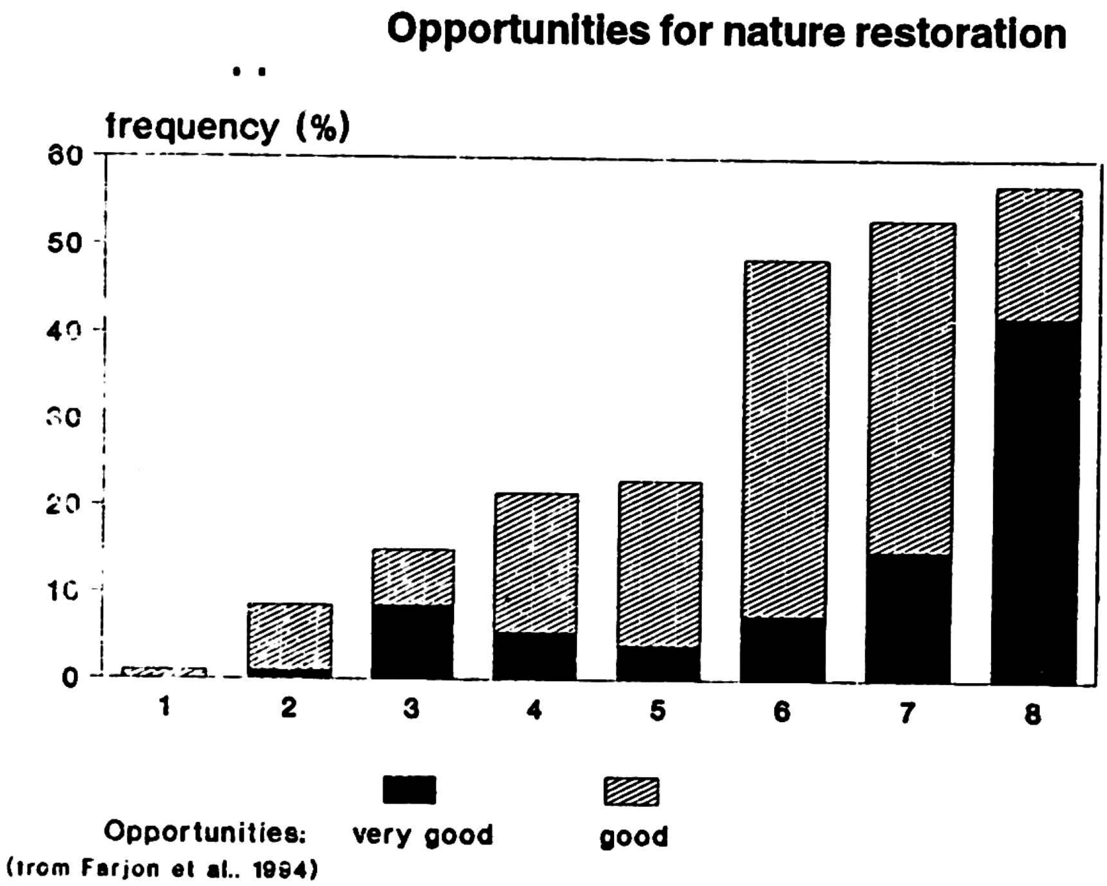

FIGURE 5. The frequency distribution of sites with good and very good opportunities for nature restoration per region. The distunguished areas are: 1 = inland dunes; 2 = fenlands; 3 = coastal dunes; 4 = stream valleys on Pleistocene sands; 5 = valleys on rivers, not dammed; 6 = valleys of rivers with dammed up water; 7 = loess/chalk district; 8 = mires on clay (from Farjon et al., 1994)

re watersheds, may be selected here, as part of a large-scale ecological network. In the dune area an entire hydrological unit may be an island in the Wadden Sea. Both options should entail the restoration of very valuable ecosystems in the view of conservation of the global biodiversity. It is, however, unclear whether socio-economical factors will allow such.

Conclusions

No doubt the Nature Policy Plan has considerably stimulated new developments in nature protection in The Netherlands. After decades of habitat destruction and deterioration of the remaining nature reserves, both strict environmental policies and restoration of nature and large ecological networks provide a new and creative atmosphere for conservationists. However, if validation takes place in an international, biogeographical context, the most valuable ecosystems appear to be much more difficult to restore than the less valuable ones. This complicates the options, viz. either the restoration of some less valuable, but large-scale nature areas to demonstrate the public the success of the new policy or the restoration of the most valuable and vulnerable ecosystems of which the probability for success is less certain. This dilemma underlines the need for a very strict environmental policy and for a very efficient communication with the public. Hereby, there is a real challenge to ecologists to convince poly-makers and the public that all measures are needed to contribute to the maintenance of global biodiversity.

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Streszczenie

Ekologiczne możliwości odtworzenia zasobów przyrody w Holandii: Ochrona przyrody w Holandii objęta jest obecnie kompleksową polityką państwa. Po okresach dewastacji środowiska naturalnego wprowadzenie konsekwentnej polityki ekorozwoju przyczyniło się do odbudowy zasobów przyrody oraz odtworzenia sieci powiązań ekologicznych na dużych obszarach. Obecnie ochrona przyrody w Holandii jest ukierunkowana na poprawę jakości środowiska, odbudowę zasobów i utrzymywanie obecnie chronionych obszarów. Działania te koncentrują się głównie w północnej i wschodniej części kraju oraz na wydmach położonych wzdłuż wybrzeży.