

HISTORY OF LANDSCAPE AND VEGETATION OF COASTAL DUNE AREAS IN THE PROVINCE OF NORTH HOLLAND

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SUMMARY

The factors responsible for the formation of the young dune landscape are mentioned. Six periods of landscape and vegetation development are distinguished and described phytosociologically; characteristic alliances are mentioned. The relationships between vegetational characteristics, geomorphology, climate and human interference are treated. A scheme of successional relationships is presented.

As a basis for reconstruction of the past, the present landscape and vegetation types, their successional relationships, their correlations with soil profiles, geomorphology, macro-, meso- and microclimate and their distribution and topographical interrelationships are used as fully as possible. Conclusions are necessarily largely conjectural and indicate the most likely general trends, which certainly have been reversed in most periods in many places by local destruction or disturbance of the vegetation.

From historical data it is concluded that the present relief of the higher dune landscapes was formed in its main outlines between 1300 and 1600 A.D., but that its ultimate extension was largely predetermined by the presence of older dune landscapes. Retreat of the coast and extension by transgression of high dunes towards the east occurred only locally in this period. The existing situation suggests an "old dune landscape", intermediate in age between the "old beach bank landscape" (VAN DER MEER 1952) and the "high young dune landscape". Locally a "low young dune landscape" and a "young beach bank landscape" can be recognised as further additions to the usual picture.

Factors responsible for formation of the high young dune landscape were:

1. a change in climate and a period of transgression of the sea (PONS & WIGGERS 1959-1960), culminating ca. 1350;
2. a regional increase in population and the foundation of new settlements on or near to the coast, mainly after 1150;
3. clearing of forests, resulting in a minimal forested area ca. 1500 (DOING 1962);
4. introduction of rabbits (ca. 1300) and serious "overstocking" of the dunes with these, disregarding all other interests;
5. special forms of land use, e.g. grazing, exploitation of vegetation for fencing and roofing material, fuel, litter for stables etc., removal of sand, use of areas for repairing nets, bleaching of linen etc.

Attempts to counteract these effects were made, mainly at the eastern and western limits of the area, by planting trees, shrubs and marram grass (*Ammophila*). Locally these had an important effect on present dune morphology and vegetation. After 1650 and especially after 1800 the situation improved rapidly. It is suggested that the subsequent lowering of the water table is partly connected with increasing density of vegetation and development of soil profiles.

From the study of old maps it is concluded that important changes during the last 3 centuries are practically limited to the R-landscape and corresponding parts of the C-landscape (see vegetation map in DOING 1964). Near Camperduin the coast has retreated 600 m since ca. 1680 and at the same time a new parabolic dune area has formed to the east, extending 600–700 m in the direction of prevailing winds.

After rapid flooding of wide areas, possibly from the northeastern North Sea basin, caused by rising of the sea level, six periods can be distinguished in the development of landscape and vegetation, viz.:

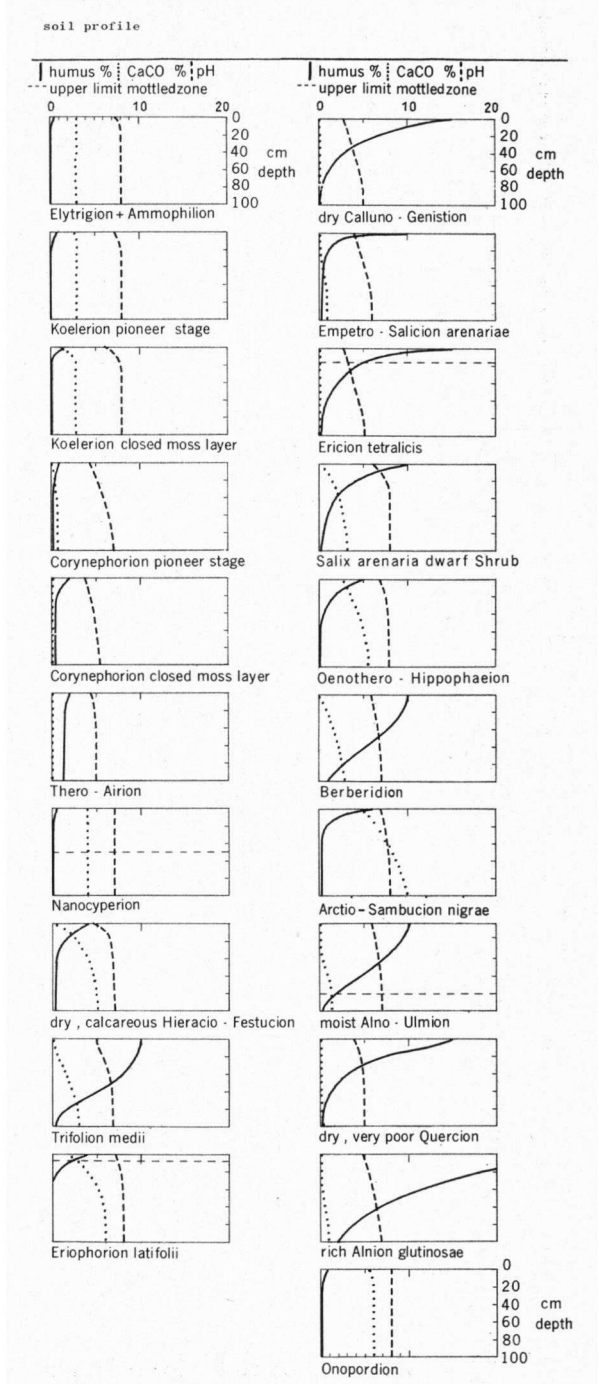
1. Formation of low, narrow beach banks, poor in lime (e.g. the one on which Uitgeest is now situated) and large salt water lagoons (late atlanticum). Initially there was possibly no dune vegetation or at most low ridges with an open *Elytrigion juncei* (DOING 1966). At present the beach banks and lagoons belong to the W-landscape, the sand is moist or covered with peat, formed in later periods.

2. Formation of low, wide groups of beach banks, moderately rich in lime further west (e.g. Limmen), combined with narrow fresh water lagoons and swamps (early sub-boreal period). Apparently large amounts of sand were available on a coast presumably sheltered by a residual and gradually disappearing ridge of sand (former coast of southwestern North Sea basin?) (BAAK 1936). The most likely situation regarding vegetation is a ca. 2 m high foredune with *Elytrigion* and a second, slightly higher dune ridge with *Ammophilion*. Older dune ridges would have carried *Koelerion albescentis* or *Corynephorion canescentis*, primary moist valleys *Eriophorion latifolii* or *Alnion glutinosae*. Migration of many species from riverine and pleistocene areas probably occurred on a large scale in this period. At present these formations belong to the W-landscape, the sand is dry or moist, mostly leached and locally blown to somewhat higher dunes in period 5.

3. Formation of low, parabolic "old dunes", rich in lime, further west, situated largely in the same areas as the present "young dunes", but, north of Egmond and south of Wijk aan Zee, they were considerably more extended towards the west (late sub-boreal). Apparently there was still a surplus of sand but the coast was more exposed than in period 2 (temporary lowering of sea level after disappearance of the "ridge of Baak"?). Extension of *Ammophilion*, *Hippophae*-shrub and *Berberidion*, in the now already old beach bank landscapes development of *Alno-Ulmion*, *Quercion roboris-petraeae*. Locally, cultivation for cropland: *Chenopodium muralis*.

4. Retreat of the coast, local destruction of the old dune landscape and formation of cliffed low young dune landscape, accumulation of shell frag-

Fig. 1. Survey of main vegetation types with data on: alliance, subdivision, dominant species, other species, species richness, root profile, present extension, former extension, landscape type, soil profile.



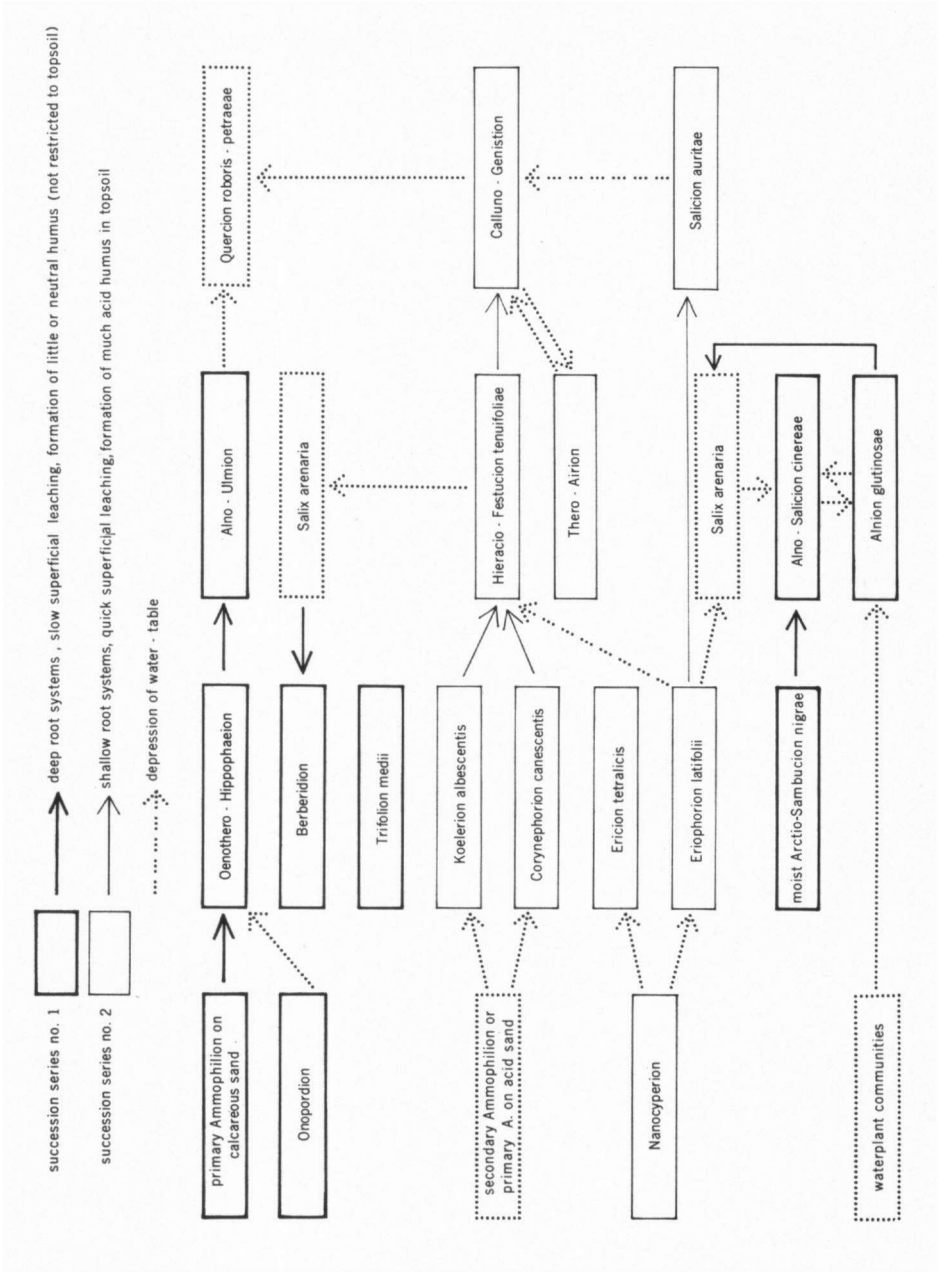


Fig. 2. Scheme of two main successional series, 1. with deep-rooting communities and mild humus; 2. with shallow rooting communities and raw humus.

ments on or near the beach (mainly in sub-atlanticum). Cooler climate. Destruction of *Elytrigion* foredune, formation of *Arctio-Sambucion nigrae*, *Koelerion albescentis* of present R-landscape, *Empetro-Salicion*. Forests with *Fagus*, *Pinus sylvestris*, *Corylus*. Extension of cultivated and grazed areas, replacement of *Quercion roboris-petraeae* by *Calluno-Genistion*, *Thero-Airion* and *Nardo-Galion*.

5. Formation of young, high, parabolic dunes (late mediaeval times), mainly resulting in intensification of the relief of the old and young low dune landscapes, in the western part also destruction of the latter and displacement of sand, locally formation of young beach banks as part of the process of straightening of the coast line, commenced in period 4 (H-landscape). Large scale extension of secondary *Ammophilion* on tops and slopes, *Nanocyperion* in valleys, later largely replaced by *Hippophae*-shrub, *Eriophorion latifolii*, birch woodlands, *Koelerion albescentis*, *Corynephorion canescentis* and *Salicion auritae*. Near settlements establishment of *Trifolion medii*, extension of *Onopordion acanthii*, still later arrival of newly introduced species (e.g. *Oenothera biennis*).

6. Stabilisation (since ca. 1650), desiccation (since ca. 1800), increase of density of vegetation, afforestation (extension of *Alno-Ulmion*, *Quercion roboris-petraeae*), formation of more developed soil profiles, excavation, agriculture and horticulture in lower parts of all landscape zones. Desiccation has led to the extension of *Hieracio-Festucion tenuifoliae* and *Calluno-Genistion* in young dunes at the expense of *Eriophorion latifolii*, *Salicion auritae* and *Ericion tetralicis*. Leaching of sand in the more densely vegetated areas has led to the extension of *Rosa-Koelerion*, *Dicrano-Cladinion*, *Rosa-Corynephorion*, *Empetro-Salicion*, *Berberidion*. In valleys, mainly in abandoned cultivated land, recent extension of birch woodlands, high *Hippophae* shrub, *Salix arenaria* dwarf shrub, *Calamagrostis epigeios* grassland. Gradual decrease of secondary *Ammophiletum*, *Oenothero-Hippophaetum*, *Nanocyperion*. After the myxomatosis epidemic, decrease of *Trifolion medii* and some forms of open *Koelerion*, increase of *Empetro-Salicion*, *Berberidion*, *Alno-Ulmion* and some more closed forms of *Koelerion* and *Hieracio-Festucion*. With leaching of the soil and fires, low *Hippophae*-shrub tends to degenerate into *Koelerion*, poor in species. In the areas near the "lime limit" south of Bergen, *Corynephorion* and *Thero-Airion*-species penetrate the *Koelerion*, *Rosa pimpinellifolia* is replaced by *Calluna vulgaris* and *Quercion*-species establish in dry *Alno-Ulmion*.

REFERENCES

- BAAK, J. A. (1936): *Regional petrology of the southern North Sea*. Wageningen.
- DOING, H. (1962): De buitenplaatsen en bossen langs de binnenduinrand van Noord- en Zuid-Holland. *Natuur en Landschap* 16 (4).
- (1964): Vegetatie. In: Recreatie en natuurbescherming in het Noordhollands Duinreservaat. Suppl. 2. *Meded. ITBON* Nr. 69C.
- (1966): Beschrijving van de vegetatie der duinen tussen IJmuiden en Camperduin. *Meded. Landbouwhogeschool Wageningen* 66(13).
- MEER, K. VAN DER (1952): De bloembollenstreek. *Versl. Landbouwk. Onderzoek* 58(2).
- PONS, L. J. & A. J. WIGGERS (1959-1960): De holocene wordingsgeschiedenis van Noord-Holland en het Zuiderzegebied. *Tijdschr. Kon. Ned. Aardrijksk. Genoot.* 76-77.

alliance	subdivision	dominant species	other important species	number of species	root system	present area	former area	main landscape types
A White dunes <i>Elytrigon juncei</i> <i>Ammophilon arenariae</i>	exposed situations	<i>Elytrigia juncea</i> <i>Ammophila arenaria</i>	<i>Honckenia peploidis</i> <i>Ammocalamagrostis baltica</i> <i>Elymus arenarius</i> <i>Festuca rubra</i> var. <i>arenaria</i> , <i>F. junceifolia</i>	very small very small small	rather shallow deep deep	very small small small	small large small	Aj Aa, Ar, As Aa, Ar, As
	sheltered situations	<i>Ammophila arenaria</i>						
B Grey dunes on calcareous sand <i>Koelerion albescentis</i>	pioneer stage	<i>Tortula ruralis</i> <i>Koeleria albescens</i> <i>Erophila verna</i> <i>Cerastium semi-decandrum</i> <i>Carex arenaria</i> <i>Festuca rubra</i> var. <i>arenaria</i> <i>Hypnum cupressiforme</i> var. <i>lacunosum</i> <i>Campothecium lutescens</i> <i>Cladonia foliacea</i> , <i>mitis</i> , <i>furcata</i> <i>Dicranum scoparium</i>	<i>Phleum arenarium</i> <i>Sedum acre</i> <i>Silene otites</i> , <i>conica</i> <i>Bromus tectorum</i> <i>Rubus caesius</i> <i>Oxonia repens</i> <i>Ammophila arenaria</i> <i>Ammocalamagrostis baltica</i> <i>Taraxacum sect. vulgaria</i> <i>Rosa pimpinellifolia</i>	small large	shallow rather shallow	small very large	rather small very large	K, R, A, II Ks K, R
	stage with closed moss layer							
C Grey dunes on acid sand <i>Corynephorion canescens</i>	pioneer stage	<i>Corynephorus canescens</i> <i>Cornicularia scutellata</i> <i>Cladonia foliacea</i> , <i>rangiformis</i> <i>Carex arenaria</i> <i>Festuca rubra</i> var. <i>arenaria</i>	<i>Rhacomitrium canescens</i>	small	shallow	large	large	Ca
	stage with closed moss and lichen layer	<i>Dicranum scoparium</i> <i>Polytrichum juniperinum</i> <i>Hypnum cupressiforme</i> <i>Cladonia impexa</i> , <i>mitis</i> , <i>sylvatica</i>	<i>Rosa pimpinellifolia</i>	rather small	very shallow	small	small	Ca Cb

D Open vegetation on stable surface Thero-Airton	Aira praecox, carvophylla Agrostis tenuis Teesdalia nudicaulis Juncus bufonius	rather small	very shallow	very small	very small	CI
Nanocypetion		small	very shallow	very small	small	Re
E Closed perennial grassy and herbaceous vegetation Hieracio-Festucion tenuifoliae	Festuca tenuifolia	very large	shallow	large	small	R, K, C
Trifolion medi		very large	deep	small	small	R, K
Eriophorion latifolii Nardo-Galton	Schoenus nigricans Molinia caerulea	large rather small	shallow shallow	very small very small	rather large very small	Re C, Re
F Dwarf shrub Calluno-Geniston	Calluna vulgaris	small	rather shallow	large	small	CI
Empetro-Salicion arenariae	Salix arenaria < 1 m Empetrum nigrum Erica tetralix Salix arenaria < 1 m	rather large small small	rather shallow rather shallow rather shallow rather deep	small small very small rather small	small small small rather small	Kc CI K
G Low shrub Oenothero-Hippochaetion	Hippochaet rhannoides ± 1 m Myrica gale Sarcothamnus scoparius	small small small	deep rather shallow deep	very large very small very small	very large large very small	H CI C, K

alliance	subdivision	dominant species	other important species	number of species	root system	percent area	former area	main landscape types
H Tall shrub Beriberidion		<i>Crataegus monogyna</i> <i>Euonymus europaeus</i> <i>Ligustrum vulgare</i>	<i>Rosa rubiginosa</i> , <i>caulina</i> <i>Berberis vulgaris</i> <i>Polygonatum odoratum</i>	rather large	deep	rather small	small	Kb, Hb
Arctio-Sambucion nigrae	dry: moist	<i>Sambucus nigra</i> <i>Hippophae rhamnoides</i> > 1 m	<i>Anthriscus caucalis</i>	rather small	deep	small	rather small	Ar, Rh
Alno-Salicion cineretae		<i>Salix multinervis</i>	<i>Salix arenaria</i> > 1 m	rather small	rather deep	very small	rather small	R, H, K
J Woodland Alno-Ulmion	moist: wet	<i>Betula pubescens</i> , <i>pendula</i> <i>Quercus robur</i> <i>Ulmus carpinifolia</i> <i>Fraxinus excelsior</i>	<i>Acer pseudoplatanus</i> <i>Prunus padus</i> <i>Populus alba</i> , <i>nigra</i> , <i>tremula</i> , <i>canescens</i> <i>Urtica dioica</i> <i>Geum urbanum</i> <i>Lonicera periclymenum</i> <i>Polygonum vulgare</i> <i>Pteridium aquilinum</i> <i>Cirsium palustre</i> <i>Mentha aquatica</i> <i>Lythrum salicaria</i>	very large	very deep	rather large	rather small	Hb, Kb, We, Wv
Quercion roboris-petraeae	poor: extremely poor soil dry: moist	<i>Betula pubescens</i> , <i>pendula</i> <i>Quercus robur</i> <i>Populus tremula</i> <i>Alnus glutinosa</i> <i>Betula pubescens</i>		rather large	very deep	rather small	rather small	Cb, Cw, Cb, Ww
Alnion glutinosae	rich: poor soil			rather large	rather deep	very small	small	Wv
K Weed communities Onopordion		<i>Echium vulgare</i> <i>Oenothera biennis</i> <i>Chenopodium div. spec.</i>	<i>Verbascum thapsus</i>	large	deep	small	small	Rb, H
Chenopodion muralis			<i>Datura stramonium</i>	rather large	rather shallow	small	rather small	R