9 The Shifting Baseline Syndrome in Restoration Ecology

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The Shifting Baseline Syndrome is a concept formulated by Daniel Pauly in 1995.[1] It results in a drift away from true natural conditions, and as a consequence a change in perception of ecological change varying from generation to generation. It eventually causes a continuous lowering of standards of nature and the acceptance of degraded natural ecosystems to be the normal state of nature. The Shifting Baseline Syndrome arises if scientists:

- Lack a clear unequivocal reference point of how the natural situation used to be;
- Examine an environment that is hard-to-notice and continuously changing because of man;
- Redefine what nature and natural is according to their personal experience.

If restoration ecology aims to restore natural conditions or natural processes, this syndrome will result in an erroneous starting point for restoration projects, such as a state of degradation of nature.[2] In this chapter I will show how a shift in the meaning of certain words that took place centuries ago caused an erroneous starting point in Europe for restoration projects in reserves and national parks aiming to restore natural conditions. This resulted in a loss of biodiversity that was naturally present. Because of a shifted baseline, this loss was accepted as normal, because it was in agreement with what was defined as the baseline for natural.

THE RECONSTRUCTING OF THE BASELINE FOR TRUE NATURAL CONDITIONS

In the nineteenth and the beginning of twentieth century, in Europe a baseline for natural conditions has been formulated. This was done at a time that with the exception of some raised bogs and remote high treeless elevated mountainous areas, all natural ecosystems had been cultivated. Because true natural conditions were lacking, a theory of what were the

natural conditions was formulated. This theory was and still is based on three basic assumptions. First, mankind disturbed the natural conditions by cutting trees, plowing, and by introducing and grazing domestic animals like cattle. Second, when mankind withdraws, nature rebounds spontaneously to its natural state.[3] Third, because herbivores are completely dependent on plants, they follow the development of the vegetation and do not play a determining role in succession. Based on these assumptions, the spontaneous development of forest in Europe on abandoned agricultural land and pastures where domestic stock was excluded by fences, was considered to be the return of natural conditions. Therefore under natural conditions in Europe, having a temperate climate favoring trees, it was supposed to be covered with a closed canopy forest in its natural state.[4] The regeneration of the forest would have taken place in gaps in the canopy or in windblown areas, where seedlings and saplings of trees were able to grow up successfully.[5] This theory is still used extensively across Europe as a baseline for natural conditions and restoration projects in reserves and national parks.

Certain words in historic texts from continental Europe, dating from the time that the natural conditions were supposed to have been present were read as support for this theory: such words include "Forst" and "Wald" in Old-German, "forest" in Old-French, and "foreest" and "woud" in Old-Dutch. The modern meaning of these words is unequivocably, closed canopy forest. Support for former dense forests was based on the extrapolation of the modern meaning of these words back into the past.[6]

Similar to this backward extrapolation of word meanings, regulations temporarily prohibiting livestock grazing—arising the thirteenth century onwards—have been interpreted as regulations for protecting seedlings and saplings of trees in forests in order to ensure the survival of the forest.[7] This interpreation was based on the experience with livestock grazing and wild ungulates like deer from the ninteenth century onwards in forests as we know them today. These herbivores kill seedlings and saplings in the forest by trampling and browsing, and were therefore labeled as the greatest enemy of the forest.[8] Livestock, especially cattle, was said to degenerate forests by way of a retrogressive succession to a park-like landscape (or so-called wood-pasture) and then to open grassland or heathland. With the exception of perhaps small glades in the forest, open grassland was considered an anthropogenic phenomenon caused by cattle and horses that were considered alien species introduced by humans. The prolific regeneration of trees in fenced parts of pastures and wood-pastures were offered as proof of how destructive these animals were for the forest.[9]

Finally, in the first half of the twentieth century, palynologists claimed to have reconstructed by pollen analysis the history of the forest back to pre-historic times.[10] Their argument was that up to 90 percent of the pollen derived from trees. They adopted the view of the destructive role of large ungulates in the forest, concluding that under natural conditions

large, indigenous ungulates must have lived in very low densities, otherwise the former natural vegetation would not have been a closed canopy forest.[11]

THE INTERPRETATION OF HISTORICAL TEXTS

There must be a number of cautions placed on these interpretations of former texts. The landscapes referred to proved to contained not only trees and shrubs, but also open treeless areas, like open grasslands and raised bogs. Therefore, the meaning of these words shifted over the centuries. How did this shift occur?

From the seventh century onwards a new word "forestis" appeared in deeds of donation of Merovingian and Frankish kings, written in Latin. During the following centuries this word evolved in "Forst" and "Vorst" in Old-German, "forest" and "fôret" in Old-French, and "forest," "foreest," and "voorst" in Old-Dutch. The word "Forst" still exists in modern German, "forêt" in modern French, and "forest" in modern English all currently mean a closed canopy forest.

The Merovingian and Frankish kings declared the uncultivated wilderness as "forestis nostra" (our "forestis"). They did so on the basis of Roman law that stated that everything without a clear owner (such as wilderness) belonged to the "authority." "Forestis" would have been derived from the Latin "foris" or "foras," which means "outside," "outside it," and "outside the settlement."[12] The "forestis" was the uncultivated outside settlements, arable land (fields), and hay-fields, that all had clear owners, namely person who cultivated that particular piece of wilderness. "Forestis" was a legal concept that described or confirmed the royal rights concerning ownership and user rights to the uncultivated (= wilderness). To it applied the "ius forestis" (or "forestis" law).[13] The law applied to an area in general and to every individual grass, herb, shrub, tree, and animal that lived there on land or in water. Only the king had the right to make use of these. Others needed express consent of the king, which was given by officials appointed by the king, so-called "forestarii." They issued regulations as an implementation of the "ius forestis" for local communities for pasturing cattle and pigs, collecting leaf-fodder for their livestock, and cutting firewood and getting timber in the "forestis," in order to fulfil the needs of their household .[14]

What was claimed as "forestis," was termed in common Germanic languages including Old-German, Old-Dutch, Old-Frisian, and Old English as "wold," "weld," "wald(e)," "weald," "woulds," and "woud." The word "Wald" survived up to modern German, as did the word "woud" in modern Dutch; both of which now mean: closed canopy forest. The words "wold," "wald," "weald," and "woulds" only remained in Dutch and English as place names.[15]

The grazing regulations make clear that these words referred to areas containing trees and shrubs, as well as to areas that were treeless, like open grassland where livestock was grazed and raised bogs where peat was cut. These words also included the meaning of places where the food for animals was, like grasses as well as the foliage of trees and shrubs that was cut and dried to serve as winter food were food for livestock.[16]

The wilderness that was declared "forestis" also contained light-demanding tree species such as oak (*Quercus spp.),* wild apple (*Malus sylvestris*), wild pear (*Pyrus pyraster*), and wild cherry (*Prunus avium*). These trees bore fruits (acorns, apple, pears, and cherries) called the "mast," on which pigs were fattened, while oak also delivered timber to construct buildings and ships.[17] There were also light-demanding shrub species like hazel and hawthorn (*Crataegus monogyna*) and sloe (*Prunus spinosa*) that delivered firewood.

Areas containing light-demanding species cannot have been closed canopy forests, because spontaneous developing forests in National Parks and forest reserves all over Europe show that these species do not regenerate successfully in closed canopy forests. They become ousted by shade-tolerant tree species like broad-leaved lime (*Tilia cordata*) and small-leaved lime (*T. platyphyllos*), elm species (*Ulmus spp.*), ash (*Fraxinus excelsior*), beech (*Fagus sylvatica*), sycamore (*Acer pseudoplatanus*), field maple (*A. campestre*), and hornbeam (*Carpinus betulus*). All the light-demanding tree species and shrub species do however regenerate successfully in wood-pastures. They do so in the presence of shade-tolerant tree species that also regenerate successfully in a wood pasture.[18]

A wood pasture consists of a mosaic of grassland, thorny scrub thickets with and without trees, and dispersed forests (groves) surrounded by thorny shrubs called mantle and fringe vegetation. This mantle and fringe vegetation marks the transition between grassland and grove. The regeneration takes place under densities of cattle, deer, and horses that would prevent regeneration of closed canopy forests.[19]

LARGE UNGULATES AND THE REGENERATION OF TREES IN WOOD PASTURES

A characteristic of a wood-pasture is the grazing of livestock like cattle, horses, and pigs. As mentioned before, the theory that a closed canopy forest is the natural vegetation assumes that a wood-pasture is in a state of degradation of a closed canopy forest, made that way by grazing livestock that destroy seedlings and saplings in the forest. However, in a wood-pasture trees regenerate successfully. Nonetheless, it does not take place in the forest, but outside the forest in open grassland. Seedlings and saplings grow up there close to thorny and spiny shrubs like Blackthorn (*Prunus spinosa*), Hawthorn (*Crataegus monogyna*), Juniper (*Juniperus communis*), and

Brambles (*Rubus spp.*), and plant species containing chemical substances that make them unpalatable for large ungulates, such as Bracken (*Pteridium aquilinum*) and Heather (*Calluna vulgaris*). They protect seedlings, saplings, and young trees against grazing and browsing by large ungulates. They are called nurse-species.[20] These nurse species establish themselves in open grazed grassland. Nurse species that spread clonally by root suckers into open grassland like blackthorn form a convex shaped scrub in which tree seedlings establish themselves on the fringe of this advancing scrub as this thorny scrub spreads.[21] In this way, a characteristic convex-shaped assemblage of trees develops, a so-called grove, in Old English called "graf," "grave," or "grove." This grove may cover many hundreds of hectares. The trees expand their crowns, shading out the light-demanding nursing scrub beneath them. Because of this, the grove becomes surrounded by a scrub called (in Old-Germanic) "hage," "haga," or "haye," but lacking a shrub layer to the interior. From the inside the grove looks like a closed canopy forest. Nurse species that do not spread clonally like hawthorn, will promote the development of an open-grown tree, that is a tree with a short trunk and a huge crown. Scattered hawthorns will promote scatted trees, forming a kind of savannah landscape.[22]

As is known from present-day wood-pastures, large ungulates enter a grove by small corridors through the scrub, and prevent inside the grove the regeneration of trees. In this way shade-tolerant tree species that can grow up under the canopy of oaks are prevented from doing so. This mechanism causes oak and other light-demanding tree species to remain part of the canopy of the grove in the presence of shade-tolerant tree species. This is contrary to what happens in forest reserves and National Parks where there is no livestock grazing; here, shade-tolerant tree species grow up under oaks species, then overgrow and kill them.

When trees became senescent and die, a gap in the canopy of the grove is formed. In the gap regeneration of trees is prevented by the large herbivores because they kill the seedlings that emerge in the gap by trampling and browsing. Fungi facilitate the process of the demise of trees, as do drought and storms.[23] As more trees die, the area of the gap grows bigger. Large ungulates bring in seeds of grasses and herbs with their dung and fur, thereby forming a grazed lawn in the centre of the grove. As more trees die, the grove changes over years from the center outwards into an ever-increasing surface of open grassland.[24] When large tracks of open grassland have developed, a micro-pattern of intensive and less intensive grazed patches develops that give light-demanding thorny shrubs the possibility to establish themselves in the less intensive, periodically used patches. There their spines get the change to harden, which takes one growing season. These shrubs then act as nurse species for young trees, and new groves will emerge from the grassland. This process is a non-linear, cyclical succession of grassland → shrubs → grove → grassland → shrub → grove → grassland, etc. The result is a shifting mosaic of open grassland, with or without scattered trees and groves.[25]

The regeneration of light-demanding trees and shrubs in a wood-pasture explains the presence of these species in a wilderness that contains shade-tolerant tree species as well as light-demanding shrub and tree species in the presence of large indigenous grazers as Aurochs (*Bos primigenius*) and Tarpan (*Equus przewalski gmelini*). These wild ungulates were still part of the European wilderness when it was declared a "forestis," but became extinct in 1627 and 1887, respectively.[26] The natural processes and landscape connected with these large ungulates, however, persisted because their domesticated cattle and horse descendants acted as proxies. Indeed, the wood-pasture system of tree regeneration in the presence of high densities of large ungulates is a proxy of the natural conditions that in the Middle Ages were called "forestis," "wald," "wold," "weld," and "woud."

CUTTING FIREWOOD AND THE REGULATION OF GRAZING DOMESTIC STOCK

The wood-pasture system also explains the regulations that were established for temporarily prohibiting the grazing of livestock, which, according to the classic theory of the high forest, are interpreted as to allow the regeneration of trees in the forest. The earliest regulations that temporarily prohibited livestock grazing date from the thirteenth century and were connected with cutting "thorns and hazel" as firewood. During this cutting, the regulations mentioned a certain number of saplings and young trees per unit area needed to be saved, namely oak and wild fruit that provided food for pigs, and oak provided timber. After the cutting (or coppicing) grazing livestock was forbidden to enter an area for three to six, and sometimes nine years.[27]

The presence of thorny species and hazel interspersed saplings of trees along with the presence of livestock answers the description of the mantle and fringe vegetation bordering the grove in a wood-pasture. The temporary prohibition of grazing livestock can be explained by the demand to protect the young sprouts growing up from the stools of the spiny shrubs and hazel after the cutting. The young sprouts of blackthorn and hawthorn will have been browsed immediately by livestock, as the spines do not harden until the end of the first growing season. The spared saplings and young trees could also be browsed because they were stripped from their spiny protectors. Regeneration by sprouting as well as the spared seedlings and saplings therefore needed protection from the animals. After only one growing season, blackthorn, hawthorn, and hazel sprouts can reach two meters high. Blackthorn and hawthorn have developed hard sharp spines then, and can nurse the spared saplings of the trees again. The sprouts of hazel are after a few years so thick and form such a shrub that it is impossible for the animals to bend a sprout over to browse its top. This makes it clear why forest regulations also mentioned that regenerating plots could again be grazed once the shoots had grown above the reach of the cattle.[28]

The regulations of grazing livestock make sense if they are read within the context of the wood-pasture system. They refer then to the thorny scrub that as the mantle and fringe vegetation borders the groves and nurses the saplings of the trees. The regulations aimed to protect the sprouting stools of the thorny scrub and hazel that were cut as firewood and the saplings that temporary were deprived from the protection of the spiny scrub, because it was cut as firewood. As the regulations show, some thinning among saplings was done to promote the forming of trees with big crowns that produced much mast (acorns, pears, apples, and cherries) for pigs.[29] Stools of young oaks that were cut because of the thinning also sprouted. So if one wanted a tree, just one sprout on a stool had to be spared. In this way trees of different ages could be grown to deliver mast as well as timber for ships and buildings, resulting in standards being developed from the thinned saplings. If the temporary prohibition was meant to protect seedlings and saplings against livestock in a high forest—as foresters and scientists explained these regulations in the nineteenth and twentieth centuries—instead of the three to six years written in the regulations, some fifteen to twenty years would have been necessary for the stems of seedlings to grow sufficiently thick to withstand the animals bending them down to browse the top.[30]

In conclusion: For protecting seedlings in the forest, the regulations make no sense. For protecting vegetative regeneration of sprouting stools and saplings or young trees in the mantle and fringe vegetation of groves in a wood pasture, they make excellent sense.

THE DEVELOPMENT OF NATURAL REGENERATION IN THE FOREST

In the eighteenth century people wanted firewood in blocks instead of bundles of sprouts that were delivered by the coppice. For blocks the sprouts had to grow thicker. To achieve this the time between two successive cuts was extended from three to six years in the Middle Ages by way of thirty and fifty, even eighty years. The number of sprouts on the stool was eventually diminished to one.[31] The single stem was cut after eighty years. At such age stools do not sprout again. To obtain the "regeneration" of wood (as material) a new generation of trees had to be planted. Beech was favored, because it produced good firewood for a household and the best charcoal for the industry, whose demand for charcoal rose strongly because of the industrial revolution. A beech of eighty years flowers from the age of thirty years onwards and forms seed from which seedlings emerge. Because they are shade-tolerant, seedlings can sustain the shade of the canopy for several years. Foresters in the German country Hessen discovered in the first half of the eighteenth century that if they cut a tree at the age of eighty years, seedlings grew up in the gap because they received more daylight. In this way in the nineteenth century a technique was developed whereby the canopy was

thinned by harvesting single trees in order to give seedlings in the gaps the possibility of growing up, while remaining trees were left standing in order to create a micro climate that sheltered the seedlings and saplings against frost and dryness. After forty years of successive thinning, the last old trees were felled and a new generation of trees had replaced the old one. This technique is today known as shelterwood or selective cutting.[32]

The regeneration of trees from this technique took place in the forest and was called "natural" because the new generation of trees emerged from seed that has spontaneously fallen from standing trees. This was opposite to artificial regeneration that consisted of sowing seed and planting young trees.[33] However, "natural" regeneration was not the regeneration of trees in the natural situation. In Germany initially the "natural" regeneration (of *natürliche Verjungung*) was distinguished from the regeneration in the wild (*Holzwildwuchse*). During the nineteenth and twentieth centuries this distinction disappeared and "natural regeneration" became current for the forestry technique as well for the regeneration in the wild.[34] Human intervention like plowing the soil to create a good germination bed for seed and removing undesirable species of trees, shrubs, herbs, and grasses with chemicals were and still are part of "natural" regeneration. Therefore "natural regeneration" in all the forestry books does not mean what it suggests.[35]

"Natural" regeneration was first developed with the shade-tolerant beech; later it was copied for the light-demanding oak. As with beech, the canopy of standing oak trees was gradually thinned over a period of 40 years. Yet for almost a century all "natural" regenerations of oak failed. Oak seedlings died. By trial and error was found that the opening of the canopy of an oak forest should be faster and the last trees to be removed within ten years so as to give oak seedlings full daylight. During this ten-year period and afterwards, much human assistance was necessary. Shade-tolerant tree species, such as beech, lime, ash, elm, and hornbeam, had to be eradicated, along with grasses and forbs that produced shade.[36] Thus, without significant human management, oak could and still cannot regenerate "naturally." This empirical evidence supports what is observed in forest reserves all over Europe: Oak cannot regenerate spontaneously in a forest growing also shade-tolerant tree species.

HOW LIVESTOCK BECAME A THREAT FOR THE FOREST

With the development of "natural" regeneration, the regeneration of trees moved from outside a grove (forest) in a wood-pasture system in which seedlings were protected against livestock by thorny scrub, to the inside of a forest in which seedlings were not protected against large ungulates, as thorny scrubs could not thrive because of shade. Grazing livestock therefore became a problem for "natural" regeneration of trees and judged as the greatest threat to the forest. Foresters promoted removing livestock from what was

still called "Forst," "forêt," "Wald," and "woud," while reserving "Forst," "Wald," and "woud" for the production of wood materials.[37] This new way of managing the forest became possible in the eighteenth century after the development of the so-called New Agriculture. The potato was introduced on a large scale as a foodstuff for mankind as well as for pigs, making oak as a source of mast for pigs useless. Grass species that were specially bred for a high production of food livestock became available as seed and made it possible to create grazing areas for livestock that were more productive than grazing areas in the "Forst," "Wald," and "woud." The total spatial separation of livestock grazing and wood production was the result in the nineteenth century. Livestock grazing was abolished in the "Forst," "Wald," and "woud."[38] The "Forst," "forêt," "Wald," and "woud" foremerly meaning a park-like landscape came to mean a closed canopy forest in which trees regenerated "naturally."

In combination with the assumption that spontaneous vegetation on abandoned agricultural land resulted in the forest as natural vegetation, the baseline for natural conditions shifted from a wood-pasture system to a closed canopy forest. This shift meant that in wood-pastures that were declared forest reserves or national parks in the nineteenth and twentieth centuries—among them the famous National Park Bialowieza—cattle and horses were removed as they were considered to be alien, introduced species, and so an "unnatural" part of the system. This forest as the baseline for natural included that remaining wild ungulates such as red deer were reduced by culling to such low densities, that they did not prevent trees to regenerate in the forest. As a consequence, the park-like wood-pastures formerly rich in species developed into closed canopy forests low in biodiversity. All light-demanding plant species disappeared, among them two oaks that are associated with more insect species than any other plant species.[39] All wild fruit species likewise disappered together with indigenous shrub species. Animal species thriving in this mosaic landscape of open grassland, groves, solitary trees together with all the edges that are characteristic for this landscape, disappeared—to include many butterflies and song birds. The result was an enormous loss of biodiversity.

REWILDING OR GARDENING?

The shift of the meaning of words in historic texts, currently meaning closed canopy forest, deprived indigenous, large ungulates in Europe from their natural role of structuring and functioning natural ecosystems. This caused and still causes a great loss in biodiversity in the name of nature conservation. In order to prevent this, their role needs to be restored. To achieve this goal, large natural areas must be established, and the role of the large indigenous ungulates, in particular, must be reincorporated in these systems, as ungulates fulfill key roles in creating park-like landscapes

Figure 9.1 The wood-pasture Borkener Paradise in Germany. In the foreground is an oak surrounded by hawthorns that act as nurse species for the oak. Behind it lies a grove surrounded by a scrub of flowering blackthorn. Such groves advance into the grazed grassland at a rate equal to that of the advancing outer edge of the scrub. (Photograph by Frans Vera)

that harbour the indigenous biodiversity. The promotion of the role of large ungulates demands human interference, because in many places they have to be reintroduced, especially wild cattle and horses. From the perspective of plant and animal species currently deprived of their partners by human interference, reinstating their role is not gardening, but simply (re)wilding.

NOTES

1. Daniel Pauly stated in 1995 in his essay *Anecdotes and the shifting baseline syndrome of fisheries*: "Essentially, this syndrome has arisen because each generation of fisheries scientists accepts as a baseline the stock size and species composition that occurred at the beginning of their careers, and uses this to evaluate changes. When the next generation starts its career, the stocks have further declined, but it is the stocks at that time that serve as a new baseline. The result is a gradual accommodation of the creeping disappearance of resource species, and inappropriate reference points for evaluating economic losses, resulting from over fishing, or for identifying targets for rehabilitation measures."
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9. Tansley, *The British Islands and their Vegetation*; Tansley, "The Use and Abuse of Vegetational Concepts and Terms;" Krause, "Die Heide. Beitrag zur Geschichte des Pflanzenwuchses in Nordwesteuropa."
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