# Natural processes, animal welfare, moral aspects and management of the Oostvaardersplassen

Report of the second International Commission on Management of the Oostvaardersplassen (ICMO2)

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**Quotation of this report**

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# Summary

The Oostvaardersplassen (OVP) came into existence when the South Flevoland polder was reclaimed and large herbivores were introduced to maintain short grassland for grazing by geese (Heck cattle 1983; konik horses 1984; and red deer 1992). All three herbivores increased rapidly and they soon came to be recognised as an important component of the ecosystem. A policy of minimal intervention was adopted to allow natural ecological processes to operate. The rapid increase in herbivore numbers led to a rise in the numbers of animals dying in late winter and, in 2005, an international committee (ICMO1) was established to assess the management of the OVP. It reported in 2006 and recommended that (1) access to shelter should be improved (2) a programme of research and monitoring of herbivore populations should be developed and (3) that animals in poor condition without foreseeable chances to survive in late winter should be culled and should not be allowed to die naturally. In 2010, a prolonged cold winter reduced the condition of animals in the OVP, more animals died, and substantial numbers had to be culled. Staatsbosbeheer (SBB) was instructed to feed the large herbivores with supplementary hay and a second commission (ICMO2) was installed to evaluate the kept policy of the large herbivores in the OVP and to answer four groups of questions raised by the Minister (presented in summarized form below).

### 1. Progress in responding to ICMO1

Have the recommendations and objectives of ICMO1 been incorporated into the management of the area?

A number of recommendations by ICMO1 were followed. SBB has drawn up and published a statement of the objectives for the OVP; implemented a reactive culling policy of herbivores in late winter to avoid unnecessary suffering; has implemented recommendations concerning the monitoring of vegetation and bird populations. A number of their other recommendations (including the provision of additional shelter and the promotion of monitoring and of research) have either been ignored or have not been completely fulfilled.

### 2. Ecological aspects of management

Does the OVP operate as a predominantly naturally functioning ecosystem? How have the size and dynamics o the large herbivore populations developed and how do these developments relate to the area's natural carrying capacity? What methodology for counting of herbivores would ICMO2 recommend?

While the initial foundation of the OVP and the maintenance of its boundaries are man-made, most of the internal processes operating in the area parallel those in natural ecosystems. Total numbers of herbivores began to approach the population-based carrying capacity of the area after 2000 and, since then, cattle numbers have declined and annual mortality has risen and become more variable in all three species. If the current management regime continues, all these trends are likely to be accentuated.
ICMO2 suggests that close attention should be paid to the effects of the water regime and herbivore numbers on biodiversity in the OVP and, especially, on the extent to which management is fulfilling its commitment to Natura 2000 guidelines since several bird populations are declining.

## 3. Welfare issues under current management

Are the herbivores able to display natural behaviour? How does their welfare compare with that of herbivores in other similar systems? How successful is the current culling policy in minimising unnecessary suffering? Could culling practices be altered to improve welfare?

ICMO 2 evaluated the potential moral dilemma between the value of the existence of a 'natural area' and the value of 'animal welfare'. ICMO2 considers the status of the large herbivores in the OVP to be 'in between' fully wild and domesticated/managed. This means that both animal-oriented care and environment-oriented care has to take place. The herbivores are able to express almost all of their natural and social behaviour and ICMO2 considers that their welfare is broadly similar to that of herbivore populations in other similar ecosystems. ICMO2 accepts that natural processes imply that there will be periods of negative welfare conditions which are affected by seasonal cycles in body condition. However, there is a moral obligation on managers to take all necessary measures to minimise the extent of any unnecessary suffering. As reactive culling in late winter still represents a compromise between a policy of non-intervention and the need to minimise suffering, ICMO 2 recommends adopting a new strategy of **early reactive culling**, taking account of environment conditions.

## 4. Future management

Would the tightening of culling criteria help to raise the standard of welfare? Should herbivore numbers be limited by an annual cul? Should animals be fed in winter? What changes might be made to ICMO1's recommendations to improve management?

ICMO2 developed an integrated package of recommendations for the short term (winter 2010-2011), the medium term (until the realisation of the opening of the Oostvaarderswold) and the longer term (after the opening of the Oostvaarderwold*):* ICMO2 recommends that additional shelter should be provided by linking the OVP to neighbouring areas of woodland or forestry (specifically the Hollandse Hout and Oostvaardersbos) and the creation of 1 km of shelter ridges on the sand dump in the OVP (de Stort); that the creation of Oostvaarderswissel, a 120 m wide track connecting the OVP to the Horsterwold should be initiated; that individuals in poor condition should be culled earlier in winter; that plans should be developed to reduce herbivore number by proactive culling in emergency circumstances where large-scale starvation would otherwise occur; that artificial food should not be provided; that research and modelling of the herbivore population should be extended; and that there should be regular aerial counts of all three species. Other recommendations emphasise the need for SBB to develop more effective governance systems; to establish an effective scientific advisory board to supervise monitoring and to make specific recommendations concerning the extent, timing and selectivity of culls; to set up an internal PR committee; and to establish an external stakeholder forum to improve public involvement in management.

# Samenvatting

De Oostvaardersplassen (OVP) ontstonden toen Zuidelijk Flevoland werd ingepolderd. Om te zorgen voor kort grasland voor foeragerende ganzen werden grote grazers geïntroduceerd (Heckrunderen 1983; konikpaarden 1984; en edelherten 1992). De aantallen van alle drie soorten grote grazers namen snel toe en de dieren werden erkend als een belangrijke component van het ecosysteem. Er werd gekozen voor een beleid van minimaal ingrijpen teneinde natuurlijke ecologische processen maximaal de ruimte te geven. De snelle toename in de aantallen grote grazers leidde tot stijgende aantallen dieren die in de late winter dood gingen en in 2005 werd een internationale commissie (ICMO1) ingesteld om het beheer van de OVP te beoordelen. De commissie bracht in 2006 rapport uit en adviseerde dat: (1) de dieren over meer beschutting zouden moeten kunnen beschikken, (2) er een programma van onderzoek en monitoring met betrekking tot de populaties grote grazers zou moeten worden ontwikkeld en (3) dat dieren die in de late winter in slechte conditie zijn zouden moeten worden gedood en niet zouden hoeven wachten tot een natuurlijke dood ze uit hun lijden zou verlossen. In 2010 zorgde een lange koude winter voor een verminderde conditie van de dieren in de OVP en er moesten aanzienlijke aantallen worden gedood. Het resultaat was dat Staatsbosbeheer (SBB) de instructie kreeg om de dieren bij te voederen en dat een tweede commissie (ICMO2) werd ingesteld om het huidige beheer van de grazers in de OVP te beoordelen en om vier groepen door de minister gestelde vragen te beantwoorden (worden hieronder in verkorte vorm weergegeven).

## 1. Voortgang in implementatie van het advies van ICMO1

Zijn de aanbevelingen en doelstellingen van ICMO1 geïncorporeerd in het beheer van het gebied?

Een aantal aanbevelingen van ICMO1 werd opgevolgd. SBB heeft een beheersvisie voor de OVP opgesteld en gepubliceerd, heeft een reactief beheer van grazers in de late winter doorgevoerd om onnodig lijden te voorkomen en heeft aanbevelingen doorgevoerd over het monitoren van de vegetatie en vogelpopulaties. Een aantal van de andere aanbevelingen van ICMO1 (waaronder het verschaffen van aanvullende beschutting voor de dieren en het bevorderen van monitoring en onderzoek) werden of genegeerd of onvoldoende uitgevoerd.

## 2. Ecologische aspecten van het beheer

Functioneren de OVP als het beoogde nagenoeg natuurlijke ecoysteem? Hoe heeft zich de populatieopbouw en -omvang van de grote grazers ontwikkeld en hoe staan deze ontwikkelingen in verhouding tot de natuurlijke draagkracht van het gebied? Welke methode voor het tellen van de grote grazers zou ICMO2 willen aanbevelen?

Hoewel het ontstaan van de OVP en het handhaven van de begrenzing ervan door de mens zijn bepaald, komen de meeste interne processen in het gebied overeen met die in natuurlijke ecosystemen. Totale aantallen grote grazers begonnen vanaf 2000 de draagkracht van het gebied te benaderen en sindsdien is het aantal runderen teruggelopen en is de jaarlijkse sterfte toegenomen en variabeler geworden bij alle drie soorten. Als het huidige beheerregime wordt voortgezet, is het waarschijnlijk dat deze trends sterker naar voren zullen komen.
ICMO2 doet de suggestie om de nodige aandacht te schenken aan de effecten van het waterbeheerregime en aantallen grote grazers op de biodiversiteit in de OVP, in het bijzonder, op de mate waarin het beheer uitvoering geeft aan het halen van Natura 2000-doelstellingen, omdat verschillende vogelpopulaties aan het teruglopen zijn.

### 3. Dierenwelzijnsvraagstukken bij het huidige beheer

Kunnen de dieren hun natuurlijk gedrag vertonen? Hoe is het dierenwelzijnsniveau van de grote grazers in verhouding tot dat in vergelijkbare ecosystemen? Hoe succesvol is het huidige beheer van grote grazers in het minimaliseren van onnodig lijden? Zouden de afschotcriteria kunnen worden aangescherpt met het oog op het verbeteren van welzijn?

ICMO2 heeft het mogelijke morele dilemma beoordeeld tussen de waarde van het bestaan van een ‘natuurlijk gebied‘ en de waarde van ‘dierenwelzijn‘. ICMO2 beschouwt de status van grote grazers in de OVP als ‘zich bevindend tussen‘ volledig wild en gedomesticeerd/beheerd. Dat betekent dat zowel diergeoriënteerde zorg als omgevingsgeoriënteerde zorg aan de orde zijn. De grazers zijn in staat vrijwel al hun natuurlijke en sociale gedrag te vertonen en ICMO2 beschouwt hun welzijn als ruwweg vergelijkbaar met dat van populaties grazers in andere vergelijkbare ecosystemen. ICMO2 accepteert dat natuurlijke processen inhouden dat er perioden met negatieve welzijnsomstandigheden zullen zijn die worden beïnvloed door seizoenscycli in lichaamsconditie. Beheerders hebben echter een morele verplichting om alle noodzakelijke maatregelen te nemen die de omvang van onnodig lijden minimaliseren. Aangezien reactief beheer in de late winter nog steeds een compromis is tussen een beleid van het niet-ingrijpen en de noodzaak om lijden te minimaliseren, beveelt ICMO2 aan een nieuwe strategie door te voeren van **vroeg-reactief beheer**, waarbij ook de omgevingsomstandigheden in aanmerking worden genomen.

### 4. Toekomstig beheer

Zou aanscherping van afschotcriteria helpen om het welzijnsniveau toe te laten nemen? Zouden aantallen grote grazers moeten worden gereduceerd door jaarlijks populatiebeheer? Zouden de dieren moeten worden bijgevoerd in de winter? Op welke punten zou het advies van ICMO1 kunnen worden aangepast teneinde het beheer te verbeteren?

ICMO2 heeft een integraal pakket van aanbevelingen ontwikkeld voor de korte termijn (winter 2010-2011), de middellange termijn (tot het openstellen van het Oostvaarderswold) en de lange termijn (na de openstelling van het Oostvaarderswold). ICMO2 adviseert aanvullende beschutting te bieden door de OVP te verbinden met aangrenzende bospercelen (in het bijzonder het Hollandse Hout en het Oostvaardersbos) en het creëren van 1 km aan beschuttingsriggels in het zandstortgedeelte in de OVP (De Stort); dat gestart wordt met het realiseren van de Oostvaarderswissel, een 120 meter breed pad voor de dieren dat de OVP met het Horsterwold verbindt; dat inidividuele dieren in slechte conditie ’s winters eerder worden gedood; dat plannen worden ontwikkeld voor een pro-actief populatiebeheer in geval er noodomstandigheden zijn waarbij anders grootschalige verhongering zou optreden; dat niet wordt bijgevoerd; dat onderzoek en modellering met betrekking tot de populatie grote grazers worden uitgebreid; en dat er regelmatige tellingen vanuit de lucht plaatsvinden van alle drie soorten. Verder wordt de noodzaak voor SBB benadrukt om binnen de organisatie effectievere sturingssystemen te ontwikkelen; om een effectieve wetenschappelijke adviescommissie in te stellen voor supervisie van monitoring en om specifieke aanbevelingen te doen voor de mate, de tijdstippen en de selectiviteit van het afschieten of verwijderen van individuele dieren; om een interne PR-commissie op te zetten; en om een platform van belanghebbenden in te stellen om de maatschappelijke betrokkenheid bij het beheer te vergroten.

# 1. Introduction

## 1.1 Context

The Oostvaardersplassen (OVP) came into existence when the Southern Flevoland polder was reclaimed in 1968. A large scale wetland area gradually developed with very high natural values, especially for wetland birds. Over time subsequent governments have taken special measures to ensure the development of the area's natural qualities, such as the detour of the railway to Lelystad (decided in 1981), and the addition of land originally intended for agriculture. Large herbivores were introduced in 1983 (Heck cattle), 1984 (konik horse) and 1992 (red deer) as a nature management measure to maintain short grasslands for grazing by geese. In 1996 the management of the OVP was transferred from Rijkswaterstaat to Staatsbosbeheer (SBB).

Over the last 40 years the Oostvaardersplassen area has developed into a wetland area of international importance and has been designated as a Natura 2000 area based on the bird directive. The council of Europe awarded a European diploma for nature conservation to the OVP in 1999, which was renewed in 2009.

Since natural processes play an important role in the natural values of this ecosystem, the large herbivore species, albeit artificially introduced, over time were increasingly considered a component of the ecosystem instead of being understood purely as a nature management measure. This was formalized in 1996 by the minister of Agriculture, Nature and Food Quality (LNV) by classifying the large herbivores as wild animals, a designation that has subsequently been ratified in court. Non-intervention increasingly became an important element of management of this semi-natural system and over time natural processes were given a central position in the management and communication on the OVP ecosystem.

As the herbivore populations grew, concerns related to management also emerged.Significant winter mortality occurred in 2005 and prompted significant public and political debate. Differences in opinion amongst the advisory boards on nature conservation and animal welfare resulted in considerable dispute as to how to react to this and led to to the setting-up of ICMO1. ICMO1's advice was published in June 2006 and was adopted by the Ministry and by SBB. The package of measures agreed included a regime of intensive surveillance, systematic reactive culling, the provision of shelter, the creation of a corridor, systematic monitoring of developments against defined targets, the development of a programme of research and the provision of strong direction by the SBB management.
The severe winter of 2010 again caused public and political concern. Images of starving animals appeared on the national television generating criticism of the management regime and initiating a debate in the Parliament. The Parliament instigated additional feeding of the large herbivores, and the Minister promised to evaluate the implementation of ICMO1's advice and the current management regime with the aim of having measures ready before the winter of 2011.This moved up the evaluation from the initially intended date by one year. The Minister of LNV formulated eleven questions to be answered by the new evaluation Commission, ICMO2.

## 1.2 Questions

The following Questions have been asked by the Minister and have been considered by ICMO2.

### Ecology

1. Have the objectives and principles of the recommendations formulated by the International Committee on the Management of large herbivores in the Oostvaardersplassen (ICMO1) been incorporated into the management of the area, and if so, how?

2. Does the Oostvaardersplassen area (OVP), with its large herbivores management system, operate as a predominantly naturally functioning ecosystem?

3. How have the size and dynamics of the population of large herbivores developed and how do these developments relate to the area's natural carrying capacity?

4. What methodology for counting of herbivores, which is as reliable as possible and generally accepted, would you recommend (this question was added on August 23)?

### Animal welfare

5. Are the animals in the Oostvaardersplassen able to display natural behaviour?

6. How do the animal welfare standards of large herbivores in the OVP compare with those in other (virtually) naturally functioning ecosystems?

7. How do the animal welfare standards of large herbivores in the OVP compare with those in ecosystems managed differently?

8. Could the Commission give its opinion on the culling policy operated by SBB to prevent unnecessary suffering in sick and weak animals?

9. Could or should these culling criteria be tightened to raise the welfare standards of individual animals?

### Concluding questions

10. Do ICMO's recommendations offer scope for management interventions, including supplementary feeding and culling measures for population regulation, and if so, how much?

11. Do you feel that ICMO's recommendations should be adjusted in view of the evaluation of the area's management? If so, what changes should be made?

## 1.3 Remit

The remit of ICMO2 is:

a) to evaluate the management of large herbivores in the Oostvaardersplassen and the implementation of the recommendations given by ICMO1 in 2006 and
b) to provide concrete advice on both the short and the long term management of large herbivores in the Oostvaardersplassen, and guidance on ethical and ecological issues issues related to their management.

## 1.4 Approach

### Approach

The Commission was formally installed by the Minister of LNV as from July 1, 2010 and included specialists in the fields of animal welfare, veterinary medicine, ecology, nature conservation and governance. An independent secretariat was contracted to support the Commission. Preparatory activities started in July and included the organisation of data collection and meetings.
Two members of ICMO2 performed a preliminary audit regarding the quality of available population data on the herbivores after it became clear that there was a mismatch between the reported numbers of Heck cattle (based on birth and death rates), and the actual numbers observed in an overall census.
Independent analysis of monitoring data for different bird species, (especially those listed in the Natura 2000 designation papers) was commissioned by ICMO2 to SOVON, in which the trends of characteristic bird species, within the OVP were compared with trends in numbers at a national level. This helps in assessing to what extent management of the OVP has caused these changes or whether these trends are driven by regional changes.
The first

meeting on September 17-19 started with a field visit and discussion with the senior management and wardens of SBB. This was followed by a discussion on the Oostvaarderswold plans with the regional Minister of the province of Flevoland, Mrs Anne Bliek in the presence of a representative of the Minister of LNV, and the director of SBB.

The commission reviewed its task and recognised that it would only be possible to respond to the last two questions of the Minister after a thorough review of the full range of objectives declared for the area under Natura 2000 legislation and, subsequently, by SBB. Only against such a background of clearly defined objectives would it be possible for the Commission to examine to what extent past and prevailing management practices have been effective in delivering the ecological objectives that had been identified. The management of the large herbivore populations also needed to be evaluated from a moral viewpoint in relation to their implications for animal welfare and public opinion.
During the first meeting (September 17-19, 2010) the Commission took evidence from SBB on the field and management situation and from Rijkswaterstaat.This included a thorough assessment of the monitoring results (published and unpublished) that are currently available. This led to the formal evaluation of the extent to which the recommendations of ICMO1 had been implemented (and reasons for any failure so to do). The Commission also began to compile answers to the Minister's initial questions on the ecological functioning of the OVP and worked to establish the full framework necessary to underpin future management recommendations (Minister's questions 10 and 11).

The time between the meetings was needed for gathering missing information, data analysis, to study background information and to develop a framework for ethical analysis.

On September 24, ICMO2 sent a letter to the Minister containing a judgement on the reliability of data, a final answer on question 4 (counting method) and preliminary answers on questions 2 and 8. Subsequently, ICMO2 addressed the remaining ecological and animal welfare-related questions raised by the Minister (questions 1 - 9). In framing the advice for future management ICMO2 employed a scenario approach to the problems observed. For each problem a series of alternative solutions was developed and the advantages and disadvantages of each solution were listed (see Appendix IV). ICMO2 felt that this approach was essential for explaining why some solutions were recommended while others were not endorsed. After discussing the relative strengths and weaknesses of all possible solutions, the Commission reviewed current management practices and attempted to assess where these needed to be changed in order to ensure delivery of its ecological objectives within an appropriate ethical framework. In this way, ICMO2 has developed an integrated package of recommendations for the short term (winter 2010-2011), the medium term (until the realisation of the opening of the Oostvaarderswold, a measure strongly supported by the Commission) and the longer term (after the opening of the Oostvaarderwold). The contents and the recommendations of the report have been unanimously agreed by all ICMO2 Commission members.

## 1.5 Views and principles

To be able to provide coherent recommendations, ICMO2 adopted specific views and principles on
a) Ethical considerations
b) Natura 2000 targets, intervention and natural processes
c) Carrying capacity
These are dealt with below.

### Ethical considerations

To structure discussions about the ethical dimension of current and possible future management of the OVP, ICMO2 used a conceptual framework for identifying the fundamental moral questions in the relation to the OVP and its management. The full framework is given in Appendix I.
ICMO2 considered that the fundamental moral questions are:

What duties do we have as a society towards animals in the OVP?

The moral evaluation and public acceptance of management practices largely depend on whether these free-ranging animals are understood to be truly wild living or effectively as “kept” and managed by man. However, whether considered wild or “kept”, there is a moral obligation on managers to take all necessary measures to minimise the extent of any unnecessary suffering.

What are the objectives for the OVP and do these objectives result in moral conflicts that are related to the duties towards the animals?

ICMO2 considers the existence of an area as OVP in itself to be of high value for society from an educational, recreational and as well nature conservational point of view. However, management of systems of this kind may result in a moral dilemma between the value of the existence of a ‘natural area’ and the value of ‘animal welfare’. ICMO2 strongly feels that open communication on objectives, developments and, not the least, ethical considerations is of crucial importance to improve societal understanding and acceptance of the management of the area.

If so, how should we deal with animal-related moral conflicts that result from the objectives of the OVP?

In answering this question we identified a number of questions that need to be answered in order to structure a response to the fundamental moral questions posed above.

Are the OVP large herbivores a tool to achieve certain nature management goals or an integral component of the ecosystem?

ICMO2's ethical considerations are based on the main objective of the OVP Nature Reserve, defined as 'the conservation and further development of a marshland ecosystem of high natural value as a habitat and breeding area for wild marshland birds and mammals.' Although the three large herbivore species were originally introduced to the system by man, we recognise that they have become integrated into the ecosystem and should be now considered as an important part of it. Accordingly, human intervention in the system should be minimal wherever possible.

To what extent are the OVP large herbivores wild animals, domesticated animals, or in-between?

ICMO2 considers the status of the large herbivores in the OVP to be 'in between' fully wild and domesticated/managed. This means that both specific, animal oriented care, (e.g. culling to prevent unnecessary suffering) and non-specific care (e.g. promotion of suitable habitat conditions, ecosystem processes) has to take place in order to satisfy the moral and ethical requirements for the management of these animals.

The animals occur in a fenced ecosystem of 5486 ha in total, with 1714 ha drained grasslands and roughage usable year round for the large herbivores, and 2145 ha of marshland and 1627 ha of shallow waters that are partially available. Does this restriction of the animals to a limited habitat size and resources lead to specific moral responsibilities?

ICMO2 has considered the fact that the movement of large herbivores across the OVP borders is prevented by a fence. However, a larger ecosystem (e.g. with seasonal migration) would not prevent the population to become again food limited after an increase in numbers to match the larger food availability, so this has no direct consequences for ethical considerations.

Should suffering and stress of animals be prevented at all times or are they acceptable under distinct conditions?

Following the concept of animal welfare as outlined in Appendix I, the overall welfare condition of the large herbivores in the OVP can be considered to be generally acceptable, despite limited access to shelter and restricted opportunities to migrate to find food or other resources.
However, ICMO2 accepts that natural processes potentially imply time-limited periods of less positive or even negative welfare conditions in animals (e.g. being exposed to cold or limited food), as part of the natural dynamics (e.g. natural seasonal cycles in body condition). ICMO2's criteria for welfare do not require that animals should be entirely protected from food-shortage and hunger or thirst etc, but that all individuals should have the opportunity to respond appropriately to such privation. However, ICMO2 accepts that natural processes imply that there will be periods of negative welfare conditions (e.g. when animals are exposed to cold or limited food) which are affected by seasonal cycles in body condition.
**The overall conclusion of ICMO2's ethical considerations is that long periods of food restriction resulting in large scale unnecessary suffering and subsequent starvation of animals as a result of living conditions partially created by man is morally not acceptable, and has to be prevented.**

### Natura 2000 targets, intervention and natural processes

The OVP has been designated as a Natura 2000 site, since it classifies under the EU Bird Directive. The indicated bird species are specific for wetlands. Because of its dynamic character, natural dynamics play an important role in establising the boundary conditions for these wetland values. This was recognized by the Minister and SBB, who gave natural, spontaneous ecological processes a central position in the vision on the Oostvaarderplassen with the large herbivores being considered part of the ecosystem.
As the emphasis is on the unexpected and spontaneous developments and arrival of new species without much interference, rather than trying to keep current biodiversity values intact through intensive management measures, non-intervention forms an important part of the underlying philosophy of the OVP area.
However, lack of clarity as to whether non-interventive methods adequately deliver the overall objectives for the site, together with societal concerns about welfare of the large herbivores suggest that changes in management practice might be required and the advice of ICMO1 already took a step in this. ICMO2 took a pragmatic view in the intervention discussion and has put the Natura 2000 objectives in the first place, while recognizing that natural processes may play an important role in delivering these objectives. However, ICMO2 also recognised that some intervention may be needed, either to have natural processes taking place within certain boundary conditions or to meet moral obligations towards animal welfare.

### Carrying capacity

The term carrying capacity as used by the Minister, relates to the number of animals the area could potentially support. However, the concept of carrying capacity is far from being a simple concept. Although originally adopted from a more agricultural usage, the concept, in ecology, embraces more than a simple definition of some fixed number of animals which may be supported by a given food supply.

Carrying capacity may be defined in terms of the population (**population-based carrying capacity**: the size of population which may be supported in a given environment) or in terms of the ecosystem or habitat (**ecosystem- based carrying capacity**: the population size that may be sustained without imposing gross impact and change on the system). Finally, and more recently, there has been developed a concept of social carrying capacity (or **society-based carrying capacity**). This definition includes the level of population which will be accepted or tolerated by humans (often in relation to levels of impact on agriculture, forestry or conservation habitats which may be tolerated). In consequence, questions about decisions about whether or not any given population has reached carrying-capacity, will lead to very different answers depending on which definition of carrying-capacity is employed.
These different concepts of carrying capacity and their consequences are elaborated further in Appendix III.

In addition, it should be understood that carrying-capacity may be determined by a number of limiting factors (as for example the availability of shelter, or, in some environments the availability of water), and not merely the availability of food. Further, carrying-capacities are not fixed and may show pronounced variation over time from year to year, but also in a longer term trend over time (as the community undergoes succession or other directional change). In addition, it is important to recognise that carrying capacity, however defined, may also vary markedly between seasons (for example, between summer and winter). Indeed ICMO2 considers that two of the main problems for the OVP seem to be

i) that carrying-capacity varies markedly between summer and winter.

ii) there has almost certainly been a change in resource availability over 30 years as a result of the grazing use of the OVP and associated changes in gross community structure of the vegetation and its productivity.

As an approximate proxy for population-based carrying capacity of the three herbivore ICMO2 has used historical data on births and mortality to estimate the range of numbers within which the populations of the three herbivore species are likely to fluctuate under present conditions. In Appendix III a full account of the analysis is given. The main conclusions are presented in Chapter 2.1.

# 2. Answers to the Minister's questions on ecology and animal welfare

Figure 2.1. Situation of the Oostvaardersplassen between the cities of Almere (left) and Lelystad (right) with the most important habitats: marsh / open water, grassland and adjacent woodlands.

## 2.1 Ecology

1. Have the objectives and principles of the recommendations formulated by the first International Committee on the Management of large herbivores in the Oostvaardersplassen (ICMO1) been incorporated into the management of the area, and if so, how?

ICMO2 has reviewed the extent to which the recommendations by ICMO1, as adopted by the Minister, have been followed. A full summary of the analysis is given in Appendix II. Below ICMO2 refers to specific recommendations from that appendix.
A number of recommendations by ICMO1 were followed. SBB has drawn up and published a statement of the objectives for the OVP (1.2), implemented a reactive culling policy where a high proportion (75-80%) of herbivores in poor condition in late winter are killed before they die naturally, to avoid unnecessary suffering (2.1, 2.2). SBB has implemented recommendations concerning the monitoring of vegetation (using remote sensing methods) and bird populations (5.2).

However, there are also several ICMO1's recommendations that not have been followed. In particular, SBB was not successful in implementing the ICMO1 recommendations that additional shelter should be established at the periphery of the OVP (4.1); that the herbivores should have access to Hollandse Hout, whether on a permanent basis or in emergency (4.2); that research and modelling of the OVP system should be encouraged and developed (5.2 and 7); that specific target levels for bird populations should be identified (1.3); and that supplementary food should not be provided for herbivores in poor condition in late winter (4.4).

Recommendations that have incompletely been followed, include the development of a well defined management structure and strong direction by SBB (1.1), the development of reactive culling to a level where 90% of all animals in poor condition are culled (2.3); a daily surveillance of herbivores in late winter, that covers all the relevant parts of the area (2.2); the analysis of detailed, accurate records on the timing and characteristics of animals that were culled (5.1); the provision of sufficient information to local stakeholders and their involvement in management decisions; and the development of a suitable strategy for communicating the aims of management and constraints involved to the general public (6 and 8).

ICMO2 recognizes that in some (but not in all) of the cases where the ICMO1 recommendations have not been followed, this has been beyond the control of SBB or has occurred because SBB has had inadequate resources to fullfil them. However ICMO2 believes that a high priority should still be given to fullfilling all the recommendations of ICMO1 and that, where necessary, the resources necessary to make this possible should be provided.

2. Does the Oostvaardersplassen area (OVP), with its large herbivores management system, operate as a predominantly naturally functioning ecosystem?

ICMO2 reviewed three main aspects determining the characteristics of the ecosystem: its initial conditions, its boundary conditions and its internal processes. These characteristics and the extent to which they may be considered natural/spontaneous or subject to human intervention, are summarised in Table 2.1.

Concerning the functioning of the OVP as a natural ecosystem, ICMO2 concludes over all that while the initial stages and some of the current boundary conditions are man-made or managed, most of the internal processes occur spontaneously, and are relatively complete, and hence can be considered as "naturally functioning".

Table 2.1.Important process characteristics of naturally functioning ecosystems that are dominated by large mammalian herbivores ('grazing ecosystems'), based on (Biggs et al. ; Fryxell & Sinclair 1988; Hobbs 1996; Frank et al. 1998; Olff & Ritchie 1998; Olff et al. 1999; Sinclair et al. 2008; Cromsigt et al. 2009; Hopcraft et al. 2010)

| | Process, or factor mostly **M**anaged/man-made or **N**atural/spontaneous | |
|---|---|---|
| | Drained part | Undrained part |
| **Initial conditions** | | |
| Embankment and drainage of this part of the former IJselmeer | M | M |
| Vertical soil profile and parent material | N, some parts M | N |
| Vegetation composition after sowing reed and grass/clover | M | M |
| Water courses, drainage structure, lakes | M | N |
| Geomorphological and hydrological variation due to past landscape-forming processes | N | N |
| Introduction of red deer, cattle and horses | M | M |
| Genetic variation at introduction among large herbivores | M | M |
| **Boundary conditions, external forcing factors** | | |
| Temperature | N | N |
| Rainfall | N | N |
| Sediment import and export | M | M |
| Surface water inflow and nutrient import to the park | M | M |
| Water drainage and nutrient export from the park | M | M |
| Daily (foraging/resting) and seasonal (migratory) movements of invertebrates, birds, smaller mammals across the park boundary | N | N |
| (Barriers to) colonization of red deer, wild boar and other larger mammals from neighbouring ecosystems | M | M |
| Daily (foraging/resting) and seasonal (migratory) movements of large herbivores across the park boundary | M | M |
| Entry of human visitors | M | M |

| **Internal processes** | | |
|---|---|---|
| *Geomorphology, hydrology and soil* | | |
| Lower (ground)water level | N | N |
| Upper (ground)water level | M | M |
| Water level fluctuations between lower and upper level due to daily and seasonal fluctuations in rainfall and evapotranspiration | N | N |
| Local erosion and sedimentation dynamics | N | N |
| Soil formation, given initial conditions | N | N |
| *Population regulation or organisms* | | |
| Regulation of populations of plants, invertebrates, small mammals and birds by physical conditions, food, predation and dispersal | N | N |
| Regulation of populations of large herbivores by food availability and physical conditions | N | N |
| Regulation of populations of large herbivores by predators and dispersal to other areas | M | M |
| (Micro)evolutionary changes in invertebrate, plant, birds, smaller mammal populations due to natural selection | N | N |
| (Micro)evolutionary changes in large herbivore populations due to natural selection | N | N |
| *Ecological interactions and ecosystem processes, as characteristic for grazing ecosystems* | | |
| Food web assembly, dynamics, trophic interactions above and below ground food web are strongly affected by the assembly of large herbivores present | N | N |
| Strong interactions between birds, mammals with soil formation and geomorphological factors | N | N |
| Clear resource partitioning, competition, facilitation within trophic levels, such as among large herbivores | N | N |
| Interplay between large herbivores, small herbivores (geese) and heterogeneity in vegetation structure and composition | N | N |
| Vegetation differentiation strongly responds to both geomorphological and hydrological variation, and to grazing and browsing | N | N |
| Nutrient cycling is strongly dominated by large herbivores | N | N |
| Soil fauna, and species that depend on it (eg meadow birds), are strongly affected by large herbivores | N | N |
| Large herbivores facilitate for smaller ones (eg geese) | N | N |

### Effects of ecosystem changes on bird diversity

In the list of bird species recognised within the designation of the OVP as a Natura 2000 area, minimum numbers of breeding pairs have been set for 14 species as well as minimum numbers for 19 species of non-breeding birds. As the OVP is a young and dynamic area, where the different vegetation types, relative area and species composition may vary over time, and with it the suitable habitat for particular bird species, such fixed goals are difficult to maintain. Therefore SBB has set its objectives as ranges of numbers bordered by the lowest numbers and highest numbers observed over the years.
ICMO2 addressed the question how bird numbers of characteristic species have developed over time, and how these trends relate to various environmental factors (both purely external factors and factors controlled by management) of which grazing by large herbivores is one. To that end trends in bird numbers were independently analysed by SOVON (Wiersma, 2010) and interpreted against the current knowledge of changes in bird numbers in the Netherlands and changes in some environmental factors, like total surface area of reedbeds, within the OVP.

Seventeen of thirty-three bird species present in the OVP whose numbers have been assessed are declining, while outside the OVP they are either increasing or show no obvious tendency to decline. Only one breeding species (lapwing) in the OVP shows numbers that are increasing, while there is no general increase across the country. Another grassland species that increased in numbers in the OVP and steeper than the national trend is the golden plover. The increase in lapwing and golden plover numbers is a consequence of the increase in dry grassland area, due to a decrease in the density of thistles and woody species (willow and elderberry) and may be due to changing water levels, higher densities of grazers and alternative prey for predators (red fox).
Most declining bird species are water or reedbed-dependent, while the increasing species are grassland species, suggesting that it is the change in water management after SBB took the OVP over from Rijkswaterstaat and not the increased grazing of large herbivores that is the cause of the decline. More particularly, ICMO2 believes that this decline is a consequence of the lack of hydrological variation as a direct result of the current management of non-interference. The only significant way in which the drained part of OVP influences the undrained part, is through the numbers of Greylag geese that graze on the dry grassland, but feed on the reedbeds during moulting. Numbers of moulting greylag geese are stable at 20.000-30.000 birds, although up to 60.000 were counted in the early nineties. It is the combined grazing of the reedbeds by greylag geese and the fluctuations in the water table that have maintained the biodiversity of birds in the wet part.

Some people have expressed their concern that the increased grazing pressure affects bird populations and has caused the observed negative trends in a number of those. ICMO2 has found (as summarised above) no evidence that the present high grazing pressure would negatively affect numbers of Natura2000 species. On the other hand, nor did ICMO2 find evidence that the current high grazing pressure is a prerequisite for maintaining the numbers of most Natura2000 bird species.
ICMO-2 therefore advices SBB to engage in an active hydrological management, involving a more dynamic management of actual water levels, increasing the frequency of periodic droughts in the marshy area to reset vegetation succession and inverse the process of reduction in the surface area of the reedbeds. This means that a plan for water management should be drawn up, rather than letting the current levee that separates the drained and undrained part just spontaneously deteriorate, as is currently done.

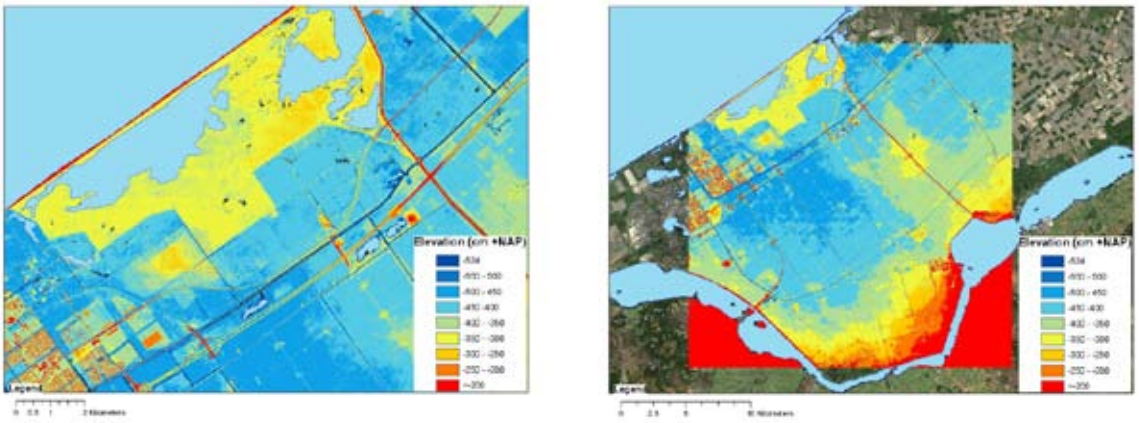

Figure 2.2. Elevation of undrained part of the OVP in Southern Flevoland. The originally lowest part (marshland and open water) has now become the highest part of the OVP.

3. How have the size and dynamics of the population of large herbivores developed and how do these developments relate to the area's natural carrying capacity?

The number of Heck cattle, konik horses and red deer in the OVP have all increased since their introduction in the early 1980's (cattle, horses) and 1990's (deer) until the year 2000. Numbers of cattle stabilised briefly in 2000 before showing a significant decline from 2005, probably as a result of competition with deer and horses for food.
Horse and deer populations are continuing to increase, though the ratio of increase in both species seems to have slowed over the last few years (Fig. 2.3).

Currently (November 2010) the estimated population sizes (> 1 year) are 250 Heck cattle, 925 Konik horses and 2.200 red deer[1].

1 ICMO2 uses the actual counts of the fall of 2010.These figures differ from the ones in the letter of Secretary of State as ICMO2 considers only individuals older than one year (see Appendix III).

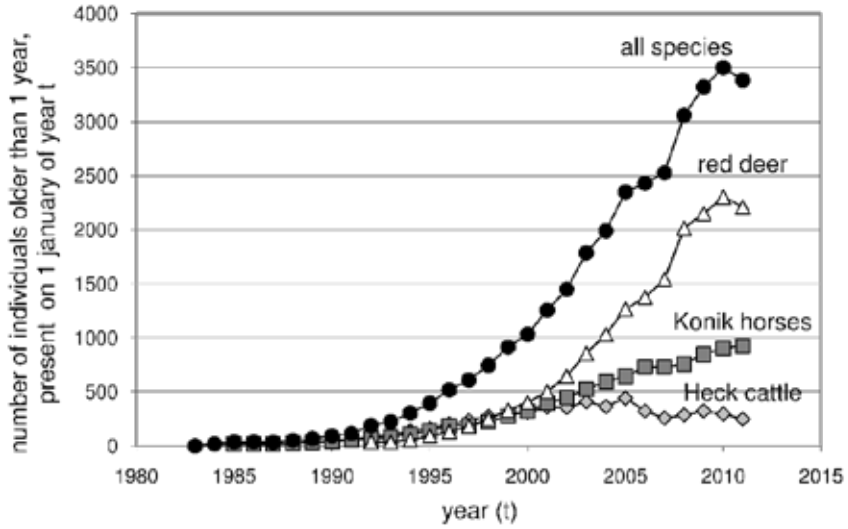


Figure 2.3. Trends in total numbers of large herbivores, red deer, konik horse and Heck cattle older than one year in the Oostvaardersplassen. Data Staatsbosbeheer. See also Appendix III.

The proportion of animals that have been culled each year in order to avoid unnecessary suffering varies widely between years in response to variation in winter severity, which increases energy expenditure and reduces food availability. The extent of between-year variation is increasing, as harsh weather accentuates the effects of high density and vice versa. Generally, levels of mortality have shown an overall increase during the last 10 years with the numbers approaching their population-level carrying capacity (see Appendix III).

As inferred from the number of necessary culls, the average body condition of the three species has declined over the last 10 years with the increase in their overall densities (see Fig. 4 in Appendix III). The decline in cattle numbers, the reduced rate of population growth in deer and horses and the increase in mortality all indicate that herbivore populations are approaching the population-based carrying capacity (but see chapter 2.2 and Appendix III for precautions with this concept) and ICMO2 concludes that a total population of 3500 individuals older than 1 year may be close to the maximum combined population size for the current ecosystem state (size, soil fertility, hydrology, proportion of different vegetation types etc).

The current population trends suggest that, if current management is maintained and ecosystem conditions remain the same, the konik horses and red deer may eventually out-compete the Heck cattle possibly within the next ten years, after which this population-based carrying capacity of 3500 individuals will be divided between konik horses and red deer.

However, the long-term dynamics of the three populations will depend on the net balance between the outcome of competition and facilitation among these species, and future changes in vegetation composition, external conditions and internal ecosystem processes, and are therefore still unpredictable.

As numbers have risen, annual mortality (and annual population size) in all three species has become more variable and, if numbers are allowed to continue to rise, fluctuations in annual mortality are likely to increase in koniks and red deer and these increases will eventually arrest net population growth. Subsequently, average numbers may either stabilise or decline slightly but high levels of variation in annual mortality between years are likely to persist, where years with higher mortality and net population decline are expected to alternate with years of net population increase due to less intra- and interspecific competition.

If grazing pressure continues to increase it is possible (but not certain) that plant productivity and the number of herbivores that the area can support on average will decline somewhat, for example due to soil impoverishment of certain nutrients. However, since maximising numbers of herbivores is not an aim of the SBB, effects of this kind are not relevant as long as unnecessary suffering of the animals is prevented by appropriate measures.

A related issue is how high grazing pressure is affecting the vegetation structure and composition of the area. It is clear that the current grazing pressure promotes short swards in the drained part of the area, and therefore prevents the regeneration of woody species in the current grasslands. Primary productivity remains very high which explains how very high large herbivore densities can be sustained in this area. At the current densities, grazing has been found to promote small-scale plant diversity but to reduce it at larger spatial scales. However, the area is currently not very important for conserving plant diversity. Instead, its role in conservation of diversity of insects and amphibians may be more important, but this has been poorly studied until now.

4. What methodology for counting of herbivores which is as reliable as possible and generally accepted would you recommend?

A reliable and commonly used method to assess numbers of large ungulates in open landscapes such as the OVP, is to perform aerial surveys from a helicopter. Animals are either counted at the time of observation or counted later from aerial photographs in the case of big herds. The advantages and disadvantages of such methodology when compared to other available methods are reviewed by for example Mayle and Staines, 1998; Daniels, 2006; Putman et al, 2011; Morellet et al, 2011.

The counting should be done both at the end of winter (late March, early April) and in autumn (October), to have an independent measurement for offspring and mortality. Such timing means that counts can be outside the breeding season, hence avoiding disturbance. Other Natura 2000 areas are monitored in the same way[2].

The helicopter is not required to fly lower than 100 to 200m. The disturbance to birds and other animals that results from this is thus expected to be low.
In order to have insight into the accuracy of the counting method, ICMO2 recommends to start with a triple count with independent counters that do not know each other's results, preferably three days at a row, and develop a monitoring protocol from the first results.

## 2.2 Animal welfare

5. Are the animals in the Oostvaardersplassen able to display natural behaviour?

ICMO2 considers that in general the large herbivores in the OVP are able to express almost their full range of natural behaviour. This includes free choice of their specific habitat, food and social and sexual partners within the OVP. The exception for the large herbivores in the OVP is the restriction by the available habitats within the OVP, while also seasonal movements between summer and winter ranges are constrained. This means that the animals are not able to find sufficient shelter and choose alternative habitats in times in times of food shortage.

2 At least in Scotland large herbivores in all Natura 2000 areas, where significant impacts have been recorded from these animals, and thus some monitoring is required of animal numbers, are counted in this way by helicopter.

6. How do the animal welfare standards of large herbivores in the OVP compare with those in other (virtually) naturally functioning ecosystems?

The Commission compared animal welfare in the OVP with other natural systems using eight criteria to assess welfare. Different ecosystems will provide the animals with different limiting factors, but it will be virtually impossible to list all limiting factors. In Table 2.2 the OVP is compared with similar systems which are "naturally" regulated. ICMO2 concludes that thereare no major differences for most criteria, except for thermal and physical welfare which is worse due to the lack of shelter and the duration of suffering before death, which is shorter compared to systems without culling and longer when compared to systems with pro-active culling.

Table 2.2. Comparison of components of animal welfare between the OVP and other naturally functioning ecosystems

| **Criterion** | **Comparison with other virtually naturally functiong ecosystems** |
|---|---|
| Level of natural mortality | Lower (due to reactive culling) |
| Duration of suffering before death | Shorter compared with natural food-limited populations (due to reactive culling aimed at reducing suffering)<br>Longer than in predator-regulated populations |
| *Freedom to adequately respond to* | |
| - Hunger, thirst, incorrect food | No difference with similar (enclosed) systems* |
| - Thermal and physical discomfort | Worse, because of lack of shelter** |
| - Injuries and diseases | Better because of isolation due to enclosure<br>Little risk of receiving diseases (eg, originating from livestock) by new individuals of large herbivores that colonize the area from outside |
| - Fear and chronic stress | Comparable |
| *Thus free to* | |
| - Display normal behavioural patterns | Comparable |
| - Adapt to changing living conditions | Comparable |

* In the OVP there might currently be a problem with copper deficiency (especially for deer and cattle).

** In the OVP large herbivores might be relatively more restricted in finding shelter compared to similar areas.

7. How do the animal welfare standards of large herbivores in the OVP compare with those in ecosystems managed differently?

For the Dutch situation ICMO2 has compared welfare conditions of the OVP large herbivores with those occurring in ecosystems where nature areas are grazed (fixed stocking densities) with domesticated livestock / or areas where wildlife is hunted (Table 2.3). Specifically, ICMO2 compared the OVP with the Veluwe area for red deer (an area with proactive hunting) and with the Lauwersmeer area for konik horse and Heck cattle (an area with regulated stocking densities).
ICMO2 concludes that there is no indication that the overall welfare conditions within the OVP are worse than within those ecosystems managed differently, although for specific components the welfare situation clearly differs.

Table 2.3. Comparison of welfare conditions of large herbivores in the OVP with those in ecosystems managed differently.

| | **OVP compared to Veluwe (red deer)** | **OVP compared to Lauwersmeer (konik horses, Highland cattle)** |
|---|---|---|
| Level of natural mortality | Lower | Lower |
| Duration of suffering before dying | Worse in OVP in case of extreme environmental conditions and too late intervention | Worse in OVP in case of extreme environmental conditions due to starvation and too late intervention |
| *Freedom to adequately respond to* | | |
| - Hunger, thirst incorrect food | Similar | Similar |
| - Thermal and physical discomfort | Worse due to lack of shelter | Worse due to lack of shelter |
| - Injuries and diseases | Similar | Similar |
| - Fear and chronic stress | Better (no population management) | Similar |
| - Display natural behaviour | Better | Better |
| - Adapt to changing living condition | Better | Better |

8. Could the Commission give its opinion on the culling policy operated by SBB to prevent unnecessary suffering in sick and weak animals?

Unnecessary suffering is understood here as prolonged suffering while meanwhile it is likely that the animal will not survive in the near future. The commission judges, that the wardens of SBB do a good job within the framework of the 2006 SBB protocol. However, the 2006 SBB protocol of late reactive culling is still a compromise between the philosophy of non-intervention and minimizing unnecessary suffering. Moreover, culling should be viewed as a part of an integrated management strategy that needs to be implemented to minimise suffering.

9. Could or should these culling criteria be tightened to raise the welfare standards of individual animals?

In its respons to the concluding questions 10 and 11, ICMO2 reviews available culling options and their advantages and disadvantages within a new integrated management strategy.

### Concluding questions

10. Do ICMO's recommendations offer scope for management interventions, including supplementary feeding and culling measures for population regulation, and if so, how much?
11. Do you feel that ICMO's recommendations should be adjusted in view of the evaluation of the area's management? If so, what changes should be made?

ICMO2 addresses these more far-reaching questions jointly in the next section, when offering recommendations for future management.

# 3. Answers to the Minister's concluding questions, and recommendations

## 3.1 Introduction

In chapter 2, ICMO2 provided answers to the questions 1 to 9. In this chapter the concluding questions of the Minister (number 10 and 11) are dealt with as a basis for the recommendations.

Concluding questions of the minister:

10. Do ICMO's recommendations offer scope for management interventions, including supplementary feeding and culling measures for population regulation, and if so, how much?

11. Do you feel that ICMO's recommendations should be adjusted in view of the evaluation of the area's management? If so, what changes should be made?

Based on the analysis and answers presented in chapter 2, ICMO2 prepared a list of possible management scenarios for the future. These management options - and ICMO2's assessment of their relative advantages/disadvantages - are summarised in Appendix IV. Many of the management measures considered are not mutually-exclusive but could form part of an integrated management strategy. Based on this analysis, ICMO2 makes the following recommendations.

## 3.2 Main recommendations

The recommendations presented hereunder have been unanimously agreed upon by all ICMO2 commission members.
**To improve the animal welfare situation and preserve the biodiversity of the area ICMO2 recommends a major change in the total management strategy for the OVP.**

Within the framework of the Natura 2000 objectives, the management vision of SBB, the ethical considerations, the governance reform and the experience of recent winter, ICMO2 makes recommendations in three phases because the commission recognises that management needs will change over time as early recommendations are implemented. ICMO2 consequently considered first immediate management needs, then management requirements for the medium term (2011 onwards) and finally management requirements following completion and opening of the Oostvaarderswold.
ICMO2 emphasizes that, in each case, only the complete package of measures will fulfill both ecological goals and welfare standards.

The lettering for scenarios and options refers to Appendix IV, where all measures are summarised with the advantages and disadvantages the Commission took into consideration. For five measures considered (early reactive culling, shelter, supplementary feeding and contraception and connection to the Oostvaarderswissel) further explanation is given in paragraph 3.3.

## I. Package of measures for winter 2010-2011

We recommend that until April 2011 management should:

1. Adapt a new strategy of early reactive culling which takes into account environment conditions and start implementing it on December 15.
   This includes culling of animals that are visibly in poor condition or with deviant behaviour before unnecessary suffering occurs in late winter (see 3.3 for further details). Apply the same management to all three species (A2).

2. Develop a contingency plan for a population reduction.
   Have plan ready to reduce the population if early reactive culling (A2) does not work and large scale starvation is likely to occur. If population reduction is required, ICMO2 recommends that this should mimic a population crash and that populations of one, two or all three species should be reduced at irregular intervals (A5).

3. Avoid using contraception of females in all three species (no A3). See below for further details.

4. Create at least 150 ha of extra shelter by opening adjacent Driehoek, Kotterbos (first part) and Oostvaardersbos woodland areas (see Figure I, Appendix IV): Provide winter shelter for all large herbivores by temporarily connecting part of these areas to the current grazing area (B3a).

5. Create about 500 ha of extra shelter by opening Hollandse Hout in winter.
   Provide winter shelter by temporarily connecting/including part of the Hollandse Hout to the current grazing area. About 50% of the Hollandse Hout should be included in the grazing area (B4).

6. Create 1000 m of shelter ridges in the sandy part of the OVP (de Stort), so that horses and cattle can find shelter.

7. Initiate the creation of a corridor (Oostvaarderswissel) to the Horsterwold. This pathway is an adequate short term solution to improve welfare conditions, first for red deer, and later for konik horse and Heck cattle by connecting the OVP to the Horsterwold. This pathway is located on the former spatial reservation for the A30 highway. This area has already been designated as EHS since 2006 and has never been agricultural land (B6) (see below for further details).

8. Avoid supplementary feeding.
   Allthough supplementary feeding might seem to provide a solution, ICMO2 recommends that it should not be used for the reasons given in paragraph 3.3 (C1).

9. Develop a plan for water management.
   This plan should include active measures to ensure that the habitat diversity and successional stages of these habitats are given room to develop in the long term. The plan also could include geomorphological adjustments and is vital for maintaining bird biodiversity. We leave further details to experts in this field (D3, D4).

10. Improve governance and establish a scientific advisory board (E2, E3, E4).
    Develop appropriate long-term stakeholder involvement through installation of a formal stakeholder forum.

Establish a scientific advisory board which, together with SBB, should develop an agenda of research priorities for the area, and should evaluate the results of ongoing research.
Install a taskforce to oversee the immediate implementation of the key aspects of the winter package that ICMO2 formulated.

11. Establish an internal PR committee with links to the stakeholder forum and to the scientific advisory board (see Appendix I last point).

12. Review this package shortly after April 1, 2011.
An immediate operational review is needed to adjust measures on culling for the winter of 2011/2012. This review is also needed to ensure progress on the provision of shelter.

ICMO2 considers it of high importance that the Oostvaarderswold project is fully realised (scenario B6), but accepts that this may take more time due to budget constraints.

## II. Package of measures from 2011 until Oostvaarderswold is opened for the large herbivores

- Implement the improved strategy on early reactive culling (A2).
- Implement population reduction when needed (A5).
- Open Hollandse Hout in winter (B3).
- Open Kotter Bos throughout the year (B2a).
- Evaluate experience with Kotterbos, and Oostvaarderswissel to see if Hollandse Hout can also be opened on a permanent basis.
- Take necessary steps to open the 120m wide pathway (Oostvaarderswissel) first for red deer and later for konik horse and Heck cattle (B5).
- Avoid providing supplementary food or contraception (C1).
- Implement the water management plan (D3,4,5).
- Manitain stakeholder forum and scientific advisory board (E2,3,4).
- Perform a full independent review in 2015.

## III. Measures after Oostvaarderswold is realised (Oostvaardersland)

Dependending on evaluation in 2015, the above measures will either continue or change. From the current perspective the package should be as follows

- Continue with early reactive culling (A2).
- Implement population reduction if needed (A5).
- Open Hollandse Hout throughout the year (B4).
- Keep Kotter Bos open (B2a).
- Avoid providing supplementary food (C1).
- Implement and improve Habitat/Water plan (D3,4,5).
- Maintain stakeholder forum and scientific advisory board (E2,3,4).
- Instigate review by an independent board every year.

## 3.3 Further explanation on specific measures considered

### Early reactive culling

To improve the animal welfare situation in the OVP ICMO2 recommends a major change to the system of reactive culling and promotes an early reactive culling, that is to cull animals unlikely to survive in an earlier stage of their decline. This will also take into consideration habitat conditions when determining the time and stage of culling. This is a major change from the previous system of only animal-oriented late reactive culling which euthanizes animals that are close to death and will generally result in the commencement of culling earlier in the season. The previous protocol tried to minimise overall mortality and human interference. This resulted in maximising population numbers. The now proposed strategy is aimed at minimising unnecessary suffering.
This early reactive culling is not seen as the sole measure to be adopted in minimising unnecessary suffering, but viewed as part only of a wider package of measures.

The 2006 schedule for culling used by SBB so far should be reformulated with the following principles. Criteria for culling should take into account body condition, behaviour, population density, food availability, availability of shelter and/or (harsh) weather conditions. The level of suffering experienced is subject to the trade off between internal factors of the animal and the expectation on long-term external environmental factors Figure 3.1.

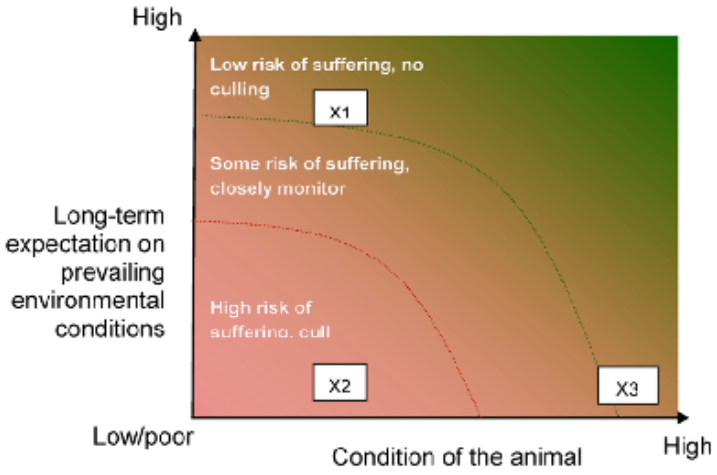


Figure 3.1. Phase plane showing the trade-off between animal condition and long-term expectation on prevailing conditions in deteriming the need to prevent long-term unnescessary suffering by reactive culling. By way of example: an animal that is in very poor body condition but experiencing good environmental conditions (X1) would not be culled, while an animal with the same body condition but in harsh long-term environmental conditions (X2) will be culled. By contrast, another animal which is in good body condition under the same harsh environmental conditions will not be culled (X3).

**Condition of the animal**

Body condition

ICMO2 would expect that animals with conditions score 1 or 2 (definition after Riney, 1960; Pollock, 1980; Gill, 1991) would normally be culled. However, animals in higher condition scores will also be culled if environmental conditions (availability of food, harsh weather) are such that animals are unlikely to be able to improve condition and thus are likely to experience prolonged suffering. A multi criteria index has to be developed for this.

Behaviour
Independent of season, animals need to be culled whatever their condition score might be, when they are displaying atypical behaviour indicative of prolonged suffering. Examples in the OVP are atactic behaviour due to Copper deficiency in red deer and severly injured animals.
ICMO2 considers that the criteria should extend to all aspects of behaviour, not simply failure to rise (apathic behaviour) when approached.

**Environmental condition**
Population density and food availability
Managers must assess the long-term availabilty of resources in relation to the population density in deciding whether or not animals have a realistic opportunity to improve condition in the near future and thus survive.

Shelter and weather conditions
Where the capacity of shelter is insufficient and/or when weather conditions are severe the lower limit in condition score for culling has to be increased. This assessment must take into account a number of independent criteria, not simply an arbitrary threshold of temperature > 10 or <10 $^{0}$C.

ICMO2 urges to translate these recommendations immediately into a preliminary protocol. This preliminary protocol must be presented for approval to the advisory board and presented to the stakeholders as soon as possible. This preliminary protocol should be refined quickly in the light of comments received from the advisory board and stakeholders. To be successful for winter management 2010/2011 active management must start within one month of the publication of the ICMO2 report based on the preliminary protocol. Once a modified version is available following the discussion with the advisory board and stakeholders, SBB must follow the protocol agreed.

Progress of this strategy will be rigorously monitored by the independent scientific advisory commitee and if it is felt that this protocol in combination with the other measures that ICMO2 recommends, is not successful in delivering the desired outcomes in terms of avoiding unnecessary suffering, early reactive culling will have to be replaced by a policy of proactive reductions (A5).

### Shelter

ICMO1 considered lack of shelter in the OVP that was present in 2006 a welfare problem for large herbivores, particularly the cattle. ICMO2 considers this still holds. Shelter thus needs to be improved to reduce unnecessary suffering and improve animal welfare. This improving of shelter therefore represents an important step in complying with our ethical considerations.

Livestock in the Netherlands is commonly housed in barns in winter. This is clearly not appropriate for animals in the OVP which are free-ranging, and considered in-between wild and domestic. However the natural behaviour of large herbivores includes seeking for and making use of shelter. Therefore, providing the animals with access to some form of shelter is necessary to fulfill a key criterion for animal welfare. In the OVP natural vegetation should provide shelter to allow animal to benefit from windbreaks, to enable them to escape from driving rain and to reduce their exposure to extreme weather events such as snow or ice. At present, much of the marshland ecosystem gives little to no facility for shelter and in addition grazing has denuded vegetation in some scrubby areas of the OVP leaving little understory. Thus additional reserve areas with woody vegetation, up to animal height, are needed. The Hollandse Hout, the Kotterbos and the Horsterwold (if connected to the OVP) , are all capable of this function. Large herbivores will browse on the vegetation during winter access and find shelter. ICMO2 does not wish the habitat in shelter areas to be become rapidly degraded and thus risk it becoming less effective in subsequent winters. Thus, for the short and medium term, the new shelter areas should be opened for winter access only and allowed to recover in the spring and summer. For the short term, year-round access is not desirable in spite of the potential for the expected improvement of the biodiversity of the areas due to grazing because ICMO2 has decided to prioritise animal welfare above biodiversity improvement of these neighbouring area for the short run. For the long term, the impact of year-round opening on the impact on wood cover and population development should be further studied, based on appropriate studies on the consequences of grazing and browsing for these woodlands.

### Supplementary feeding

There are a number of reasons that ICMO2 opposes the provision of supplementary food over winter. When any form of supplementary feeding is provided as crisis management, it is generally too late for it to be effective; animals have already exhausted body fat reserves and have entered a physiological state where they are committed to catabolism of body protein. This is usually irreversible even if alternative food is offered. Even before this stage, among the ruminants (cattle and deer) rumen structure and the composition of digestive microflora shows significant seasonal change, with the structure and microbial

flora adapted to maximum utilisation of coarse forages of low digestibility over winter. Provision of high-quality or high nutrient diets at this time can directly cause death through acidosis.
Prophylactic feeding over a longer time period also has significant disadvantages. In effect it simply increases the winter carrrying capacity of the ecosystem, allowing herbivore populations to increase and stabilise at a new, higher level. This means that there will still be insufficient food over winter (and thus mortality) while contributing to higher grazing levels in the summer which may be excessive for conservation objectives.
Further: supplementary feeding over winter causes concentration of animals around feeding sites, leading to increased aggression, with the stronger animals monopolising the food at the detriment of weaker ones that would need the food more than the ones that will eat it. In addition it leads to increased local environmental damage around the area of the feeding sites, and increased risk of transmission of disease. A fuller treatment of the problems associated with supplementary feeding is offered by, for example: Peek et al., 2002; Putman and Staines, 2004.

### Contraception

Contraception - and thus the prevention or reduction of recruitment of animals to a population - often appears an attractive alternative to culling. The following methods can be used for contraception of animals:

- surgical (gonadectomy, vasectomy and salpingectomy),
- hormonal (oral contraceptives, depot-injections or slow-release implants),
- immunocontraception.

Surgical methods are in no way practical to be used in the OVP and hormonal treatments are generally not particularly effective in reducing population growth. A number of immunocontraceptive technologies, however, are potentially available and in limited trials have proven to be effective in reducing reproductive rates in enclosed populations of large herbivores (deer, cattle and horses) (e.g. Bertschinger, 2010; Asa & Porton, 2005).

There are in effect two categories of reversible immunocontraceptive treatment:
i) inoculation of adult females with porcine zona pellucida (PZP) vaccine, which encourages the animal to produce a generalised immune response against zona pellucida tissue – leading to a rejection of the zona pellucida of its own eggs, preventing implantation. Three initial injections have to be given in the first year followed by an annual booster in order to be effective in horses, cattle and deer.
ii) inoculation of females with substances (GnRH agonists or GnRH vaccines) which produce effect on the animal's own endogenous Gonatotrophin –releasing hormone (GnRH inhibition) resulting in a failure to ovulate. Under this treatment females become functionally sterile.

Both treatments however require capture and treatment of a high proportion of the total female population of each species, and require repeated treatments in successive years. Capture and handling of the animals on a regular basis is not only strongly interventive but carries associated welfare issues of high stress and possible injury in capture; in addition, actual injection of slow-release formulations (under either treatment) is commonly associated with abscessing. Finally, PZP treatments suppress implantation, causing females to return to oestrus regularly through the season, prolonging the breeding season; this in turn causes significant disruption to social behaviour, again with significant welfare implications.
Finally contraceptive treatment, by either method is prohibitively expensive, because slow-release implants can only be administered in sedated animals and even if products are used that can be darted, animals need to be individually identified, thus costs run easily up over a thousand euro per animal per year.

### The Oostvaarderswissel

The Oostvaarderswissel (Oostvaarders track) is a 120m wide pathway from the OVP to the Horsterwold (Figure 3.2). This pathway is an adequate short term solution to improve welfare conditions, first for red deer, and later for konik horse and Heck cattle by connecting the OVP to the Horsterwold (B6 in Appendix IV). The Oostvaarderswissel is mainly located on the former tracé for the A30 highway (Adelaars tracé). The Adelaarstracé has never been agricultural land, has already been designated as EHS (National Ecological Network) since 2006, and is owned by SBB. The connection to the Horsterwold is also owned and managed bij SBB. The most important investments still needed are related to building ecoducts.

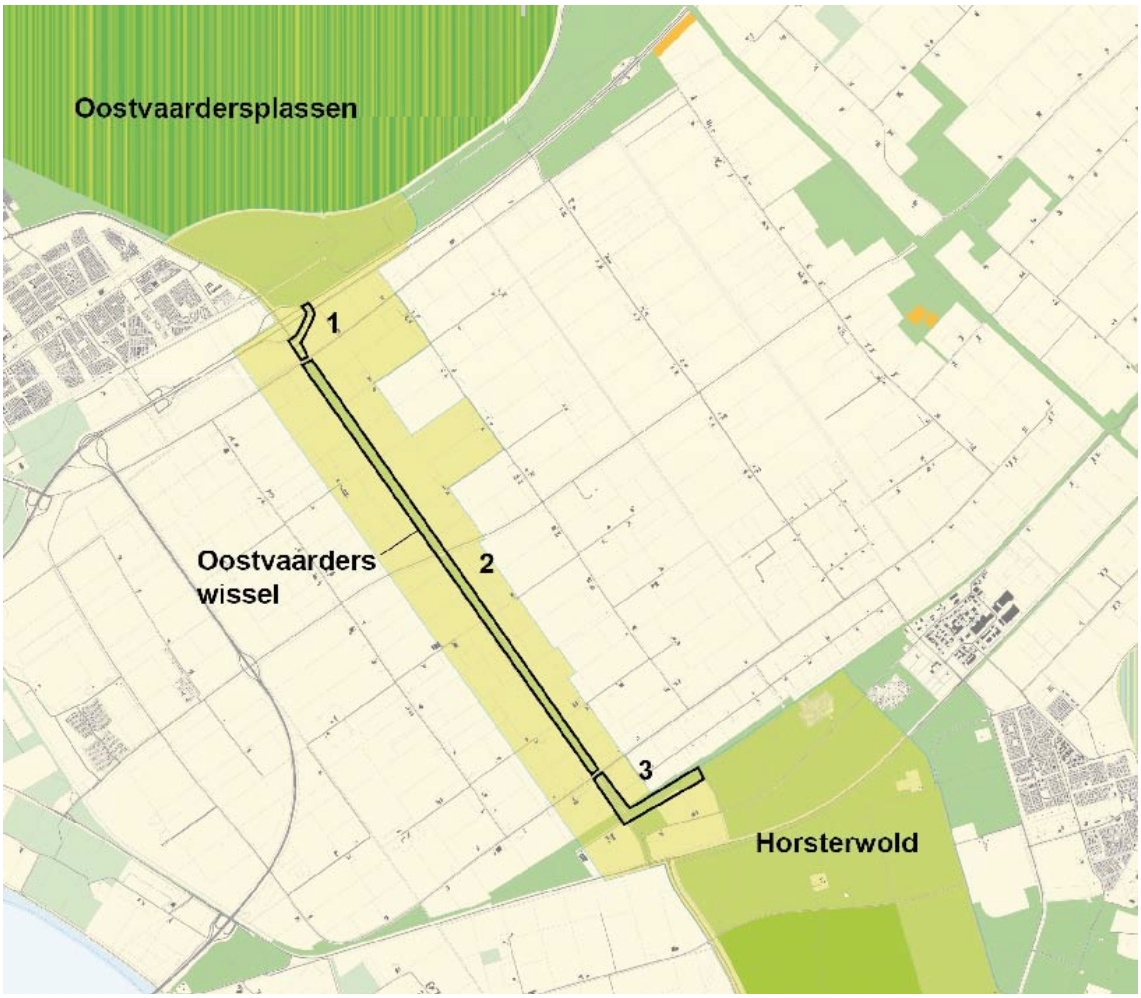


Figure 3.2. Location of the Oostvaarderswissel, a 120 m wide pathway connecting the OVP with the Horsterwold. Total surface area: 134 ha. Present ownership and management situation:
1) connection to OVP;
2) Adelaarstracé, part of the EHS since 2006, owned and managed by Staatsbosbeheer;
3) connection to Horsterwold.


Figure 3.3. Design of the Oostvaarderswold connecting the OVP to Horsterwold.

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# Appendix I

## Ethical considerations on welfare of large herbivores in the Oostvaardersplassen

### Some remarks on the framework

**Aim**
The aim of this framework is to structure discussions about the ethical dimension of current and possible future management of the OVP.
This includes (a) reflection on what we should do from a moral perspective in any such situation (b) postulation of the relevant ethical questions specifically in relation to the OVP, and (c) an outline of the steps that need to be taken to answer those questions.

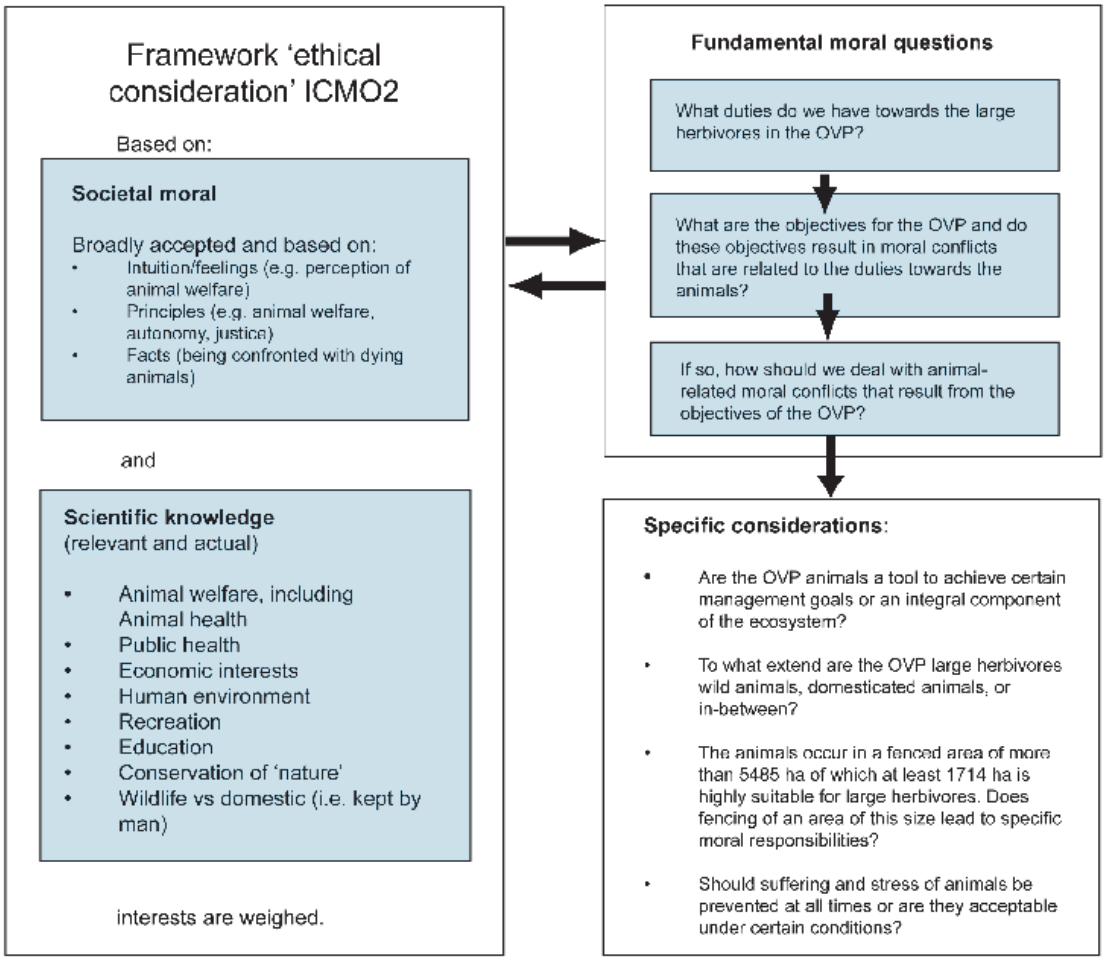
**Structure: dynamic character**
Ethical reflection starts by taking intuitions/feelings, ethical principles and morally relevant facts seriously (see the left side of the framework scheme below). The assessment of and reflection on the intuitions, principles and facts result in specific fundamental moral questions (see the right side of the framework scheme below). These fundamental questions focus attention on more specific considerations and questions. The relation between the left and the right side of the framework, however, is dynamic. If the fundamental questions and specific considerations result in changes in the practice, it mostly influences the aspects of intuition and facts, but may effect the interpretation of principles at the left side.

**Relevance**
The framework helps to combine otherwise incompatible moral and factual aspects. As both aspects play a crucial role in welfare issues related to the OVP, the framework is offered to help focus the discussion.

### Animal welfare: not a purely scientific concept

Within the context of the OVP, issues about animal welfare are primarily based on the societal concern about how animals are to be treated to reduce the risk of unnecessary suffering.
In general, the concept of animal welfare is affected both by broadly shared public moral values or attitudes and more objective analysis of the animals' biological functioning. In spite of the plurality of values and norms with respect to animal use, there is a clear consensus on the importance of animal welfare. However, the interpretation and moral evaluation of the value of animal welfare differ between cultures, regions, time, and persons and may even differ in different situations. The interpretation and evaluation of a mouse's welfare, for example, depends on whether it is evaluated in terms of a companion animal, laboratory animal, or pest.

To identify the potential moral dilemmas of the situation in the OVP, the following framework has been used:




### What duties do we have towards the large herbivores in the OVP?

There is no systematic research on the public opinion about the OVP. However the high profile of the issues and the number of public statements and discussions suggest that a proper moral evaluation of the introduction and current management of large herbivores in the OVP is of high relevance. More specifically, the moral evaluation and public acceptance of management practices seem to depend on whether these free-ranging animals are understood to be truly wild living or effectively domestic or "kept" and managed by man, such as holds for livestock or managed populations wildlife animals.
One argument in the public debate is that the large herbivores in the OVP should not be viewed as wild animals but as animals kept by men, because they have recently introduced in the area by and their movement is restricted by non-natural borders (i.e. fences). Long periods of food restriction and starvation of animals as a result of living conditions created or restrained by man is broadly understood by the Dutch society as morally inacceptable, and thus to be avoided. However, legally, the large herbivores in the OVP have been categorized as wild animals, which reduces the formal need for an intervention-based management (see also: Swart, 2005). To answer the question what our duties towards the large herbivores in the OVP are, the objectives for the OVP have to be identified.

### What are the objectives for the OVP and do they result in moral conflicts?

Our considerations are based on the assumption that the main objective of the Oostvaardersplassen Nature Reserve is

> 'The conservation and further development of a marshland ecosystem of high natural value as a habitat and breeding area for wild marshland birds and mammals.'

The ecological analysis shows that the 'internal conditions' of OVP are assessed to be mostly natural (i.e. following biological processes) while borders are man-made (i.e. not following biological processes, see Table 2.1). This situation may result in a moral conflict if the assessment of our duties with respect to animals freely living in 'nature' differ from that with respect to domestic animals (as above, and see Swart, 2005). But, as Keulartz (2010) puts it: "The notion of a clear-cut borderline between wildness and domesticity should be replaced by the idea of wildness and domesticity as endpoints of a broad continuum, a transitional zone in which it is not a question of 'either-or' but of 'less or more'. Our obligations of care should vary according to the direction of the transition along this domesticity-wildness continuum, from specific care aimed at individual animals to non-specific care aimed at their habitat, and from artificial controls to natural controls."

Swart (2005) states: "We have a duty to domestic animals because their environment - that's us - constitutes their life. This implies giving care to the individual animal because individual circumstances determine the animal's need'. However, non-specific care also applies to domestic animals, i.e. care that is not individually directed and is expressed by legislation. Examples include regulations to prevent exaggerated humanisation or exploitation of domestic or research animals.
To a certain extent specific and non-specific care exclude each other since general non-specific measures prevent active intervention in an animal's existence, but they do not rule each other out completely. Moreover, Swart recognises that wildness and tameness must be considered as gradual concepts and, therefore, specific and non-specific care is gradually related to the level of wildness or domestication."

The views from these two articles integrate moral perspectives on wild, domestic and 'in between' animals.

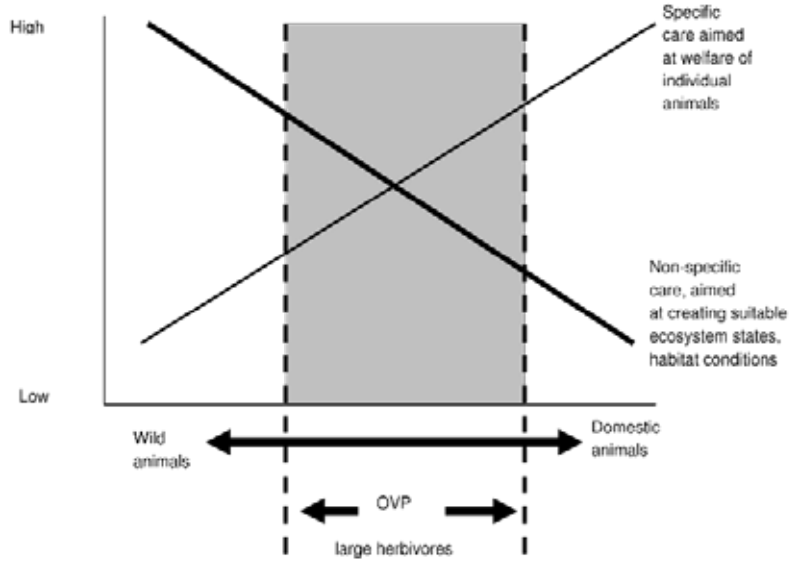



Figure 1. Specific care and non-specific care as a function of the level of domestication or wildness In OVP large herbivores (adopted from Swart, 2005).

Whether wild or 'managed', ICMO2 considers that welfare of the large herbivores in the OVP should be considered in relation to their ability adequately to react to

- hunger, thirst or incorrect food
- thermal and physical discomfort
- injuries or diseases
- fear and chronic stress

and thus, the freedom to

- display normal, species-specific behavioural patterns and
- adapt to changing living conditions (with the exception of migration-related behaviour).

It should be noted that "the ability to react to" is the key point of the above statement (Ohl, in prep.), which is different from stating that hunger and physical discomfort should be avoided at all time. **In addition, whether considered wild or "kept", there is a moral obligation on managers to take all necessary measures to minimise the extent of any unnecessary suffering.**

**Specific considerations with respect to the objectives of the OVP**

- Are the OVP large herbivores a tool to achieve certain management goals or an integral component of the ecosystem?

Although the three large herbivore species were relatively recently introduced to the OVP by man, we recognise that over time they have become integrated into that system and should be now considered to part of the ecosystem, they have been rewilded (see Table 2.1). The argument that they were introduced does not mean that they can never be assessed as wild. The same has been done with other animal species in the Netherlands, like the rabbit, mouflon and fallow deer which are now considered an integral component of the ecosystems in which they occur. Also, red deer have been exchanged and introduced between countries in Europe during the last centuries at a large scale, mostly for hunting purposes. Yet they are considered an ecosystem component wherever they occur.

- To what extend are the OVP large herbivores wild animals, domesticated animals, or in-between?

**ICMO2 considers the status of the large herbivores in the OVP to be 'in between' fully wild and domesticated/managed (see figure 1 of this Appendix). This means that both specific care (animal oriented, e.g. early reactive culling to prevent unnecessary suffering) and non-specific care (promotion of suitable habitat conditions, ecosystem processes) has to take place to reflect the moral and ethical considerations for these animals.**

- The animals occur in a fenced ecosystem of 5485 ha in total, with at least 1714 ha usable for the large herbivores. Does this restriction of the animals to a limited habitat and resources lead to specific moral responsibilities?

ICMO2 has considered the fact that the movement across the OVP borders for large herbivores is restricted by a fence. However, a larger ecosystem would not prevent the population from being food limited after an increase in numbers to match the larger food availability, so this has no direct consequences for ethical considerations.

### How should we deal with animal related moral conflicts that result from the objectives of the OVP?

ICMO2 concludes that from an ecological point of view, the OVP should be understood more as wilderness than as a managed/man-made ecosystem as the OVP internal processes can be clearly characterized as 'natural'. Thus in general, non-specific care aimed at the habitat is justified. However, given the fact that the OVP-wilderness is artificially restricted by man-made border, has relatively low habitat diversity, the direct consequences of this restriction for the welfare of large herbivores (e.g. starvation due to inability to migrate and find food) should be managed. Perhaps above all such considerations, whether considered wild or "kept", there is a moral obligation on managers to take all necessary measures to minimise the extent of any unnecessary suffering.

**Assessment of the welfare of OVP large herbivores**
ICMO2 considers that the large herbivores can in general follow biological imperatives and mechanisms and, crucially, are free adequately to react to

- hunger, thirst or incorrect food
- thermal and physical discomfort
- injuries or diseases
- fear and chronic stress

and thus, have the freedom to

- display normal, species-specific behavioural patterns and
- adapt to changing living conditions (with the exception of migration-related behaviour).

However, it should be understood that natural processes potentially imply time-limited periods of less positive or even negative welfare conditions in animals (e.g. being exposed to cold or limited food) as part of the natural dynamics (e.g. natural seasonal cycles in body condition). This is accepted. Our criteria for welfare above, thus stress not that animals should be protected from food-shortage (hunger) thirst etc, but simply that they shall have the opportunity to respond appropriately to such privation.

Following this line of thought, the overall welfare condition of the large herbivores in the OVP is generally acceptable (i.e. in accordance with natural demands), while being limited by the absence of possibilities to find shelter and to migrate to find alternative sources of shelter or greater diversity of food types.

To optimize welfare conditions in the three species of OVP large herbivores, it is therefore advised to

- progress with the opening of the Hollandse Hout during the coming winters (B4 in appendix IV)
- progress with the formation of the connection to the Horsterwold through the Oostvaarderswissel as quickly as possible (B7 in Appendix IV)
- progress with opening acces to the Kotterbos as soon as possible (B3b in Appendix IV)
- consider the opening of the Oostvaarderswold and de Driehoek for all three herbivores
- create additional shelter ridges within the current OVP on the sandy areas of "De Stort"
- change the system of reactive culling to an early reactive culling, that is to cull animals unlikely to survive in an early stage of their decline and take habitat conditions into consideration, when determining the time and stage of culling (A2 in Appendix IV).

See appendix IV for a map and surface area of the different areas mentioned.

### Care of the ecosystem

The ICMO2 considers the existence of an area as OVP in itself to be of high value for society from an educational, recreational and as well nature conservation point of view, which may result in a moral dilemma between the value of the existence of a ‘natural area’ and the value of ‘animal welfare’. Next to the advices given above, ICMO2 feels that it is necessary to

- establish a Scientfic Advisory Board with independent scientists with relevant experience (receiving input from interested bodies), and task them with the production of an adequate monitoring system and the construction of an acceptable management plan, taking the moral dilemma between the value of a ‘natural area’ and ‘animal welfare’ into account (See also E4 in Appendix IV).

### Open communication

ICMO2 realizes that the public (and political) discussion on the OVP is a multidimensional one. A variety of organizations and groups recently published position papers or approached ICMO2 with their own evaluations and reports on the OVP’s large herbivores. Depending on the specific background and interest of these organizations, their position and advice widely differed (e.g. re-organising the management of the large herbivores to an organic-farming type; totally removing large herbivores from the OVP; full care of existing individual animals while preventing further reproduction). It is obvious, that the basic objectives of the OVP as well as management developments and ethical considerations are at least unclear to the public and interest groups.
The ICMO2 therefore strongly feels that open communication on objectives, ongoing developments and, not the least, ethical considerations is of crucial importance to improve societal understanding and acceptance and therefore advises to establish an internal PR committee with links to Scientific Advisory Board and stakeholder groups (E5 in Appendix IV) and spread the message that (i) herbivore populations are commonly food limited; (ii) mortality in late winter is a natural feature of herbivore populations and occurs in populations at low density as well as in those at high density; (iii) feeding animals in poor condition to allow them to survive merely defers their deaths to another year and is not a sensible option; (iv) everything possible is being done to avoid unnecessary suffering (in general) and starvation mortality in late winter (in particular); (v) development of biodiversity in the OVP as an ecosystem is imbedded in the management plan. Make the internal PR committee answerable to the Scientific Advisory Board.

# Appendix II

## ICMO2's evaluation of recommendations made by ICMO1 (2006)

| **Recommendations ICMO1** | **Statements SBB on implementation ICMO1 Advice** | **Review ICMO2** | **Explanation/Questions** |
|---|---|---|---|
| 1.1 Aim for a well defined management structure and strong direction by management board of the State Forest Service (SBB) for the management of the OVP. | Action plan by the SBB SBB Task force has been created SBB internal team, with people from different disciplines, took care of implementation. | Until very recently, senior management has not followed the advices. | Until the beginning 2010 intermediate management was lacking, resulting in failures in top-down and bottom up communication. Efforts of the director started 3 years ago and resulted from 2010 onwards in noticeable improvement of the management and leadership situation. |
| 1.2 Draw up and publish a detailed statement of the objectives for the OVP. | The OVP development vision has been drawn up by the SBB. The N2000 management plan is expected to be adopted by SBB in mid-2011. Elaboration plan of the Oostvaardersplassen vision, has yet to be drawn up and adopted by the SBB. | Goals for the OVP have been formulated in The Natura 2000 designation. | Goals could have been defined more clearly and be related to management. |

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| 1.3 Include specific objectives for birds, specifying the threshold with upper and lower limits for each species and their habits, related to Natura 2000 targets for the OVP. | The threshold for the numbers of the various bird species has been included in the N2000 designation order. SBB recently provided a document with the requested ranges. | Population ranges of target species have been set by SBB based on observations. | The ranges provided are not a suitable instrument for management as they could allow uncontrolled decline.<br><br>The ranges were defined because of the dynamics and unpredictable nature in the area. |
| 2.1 A reactive policy needs to be adopted. This policy best responds to the need to minimize unnecessary suffering of animals with injury, disease or condition that renders them unlikely to survive. | SBB has followed and implemented the recommendation of reactive policy by monitoring, an appropriate method for culling, aiming for a maximum percentage of active culling of animals that need to be culled for welfare reasons, and an increased number of people who are able to do the culling. | SBB has adopted a reactive policy. | The commission notes that the recommended culling policy is followed, but was in isolation from other management measures and therefore was not enough to minimize unnecessary suffering. |
| 2.2 During winter months (February – mid April) the entire population need to be monitored on a daily basis during this period. | SBB performs daily monitoring from 1 January to the end of April in the form of daily, or often several daily, surveillance rounds. | SBB is performing daily surveillance, but with current resources they cannot visit all corners of the area frequent enough during critical periods of the year. | |

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| 2.3 The State Forest Service should aim to cull 90% of the animals requiring culling while they are still capable of standing. | The culling percentage achieved by the SBB fluctuates between 74,3% and 89,7%. | SBB has indeed aimed at reaching the 90%, but only achieved 75-80% during the critical periods.<br><br>Capacity, protocol and record keeping have been insufficient. | With all constraints we understand the limitations in the field, the wardens experienced while striving to reach the 90%. |
| 3.1 Heck cattle appear to be most susceptible to competition<br>If this process eventually leads to a reduced number or even the loss of all cattle from the OVP system, then this should be accepted as being a natural outcome of resource competition. | The population figures for the Heck cattle show that the population is decreasing. | SBB has followed the recommendation not to take additional measures to stop the decreasing trend. | |
| 4.1 ICMO recommends that woody vegetation be encouraged in permanent exclosures on the periphery of the reserve to provide wind breaks for the animals. | Management did not believe in that system and saw opening up neighbouring woodlands as an alternative.<br><br>SBB has focussed on opening the Driehoek and Kotterbos woodland areas to provide immediate shelter for the short time and meanwhile stimulating the development of the Oostvaarderswold as a long term solution. | The advice has not been followed. | The advice was to provide substantial amount of shelter. In fact the shelter was considered an essential component of animal welfare. |

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| 4.2<br>a. ICMO proposes that the Director of the SBB conduct a thorough investigation of the likely effects of inclusion of the Hollandse Hout on a permanent basis.<br><br>b. Meanwhile the Hollandse Hout should be used as a reserve pasture and shelter area (during bad winters and other crucial times). | SBB has investigated the issue of permanently opening up the Hollandse Hout to all three species in 2007.<br>In December 2009 the municipal council of Lelystad decided not to allow herbivores into the Hollandse Hout for the time being and work towards a broader vision.<br>A final decision is expected early 2011. | a. Investigation has taken place.<br><br>b. Opening of the Hollandse Hout has sofar not been implemented. | Hollandse Hout could have been a solution for winter 2009/2010. Attempts have been made, but did not succeed due to resistance of the city council of Lelystad and the water management board (related to the crossing of the animals over the Knardijk).<br><br>ICMO2 stresses the importance of opening the Hollandse Hout at the shortest term possible. |
| 4.3 ICMO recommends that the ecological corridor to the Horsterwold is accomplished as soon as possible and opened to all three species. | The Oostvaarderswold project is in course of realisation: at the end of 2010 60% of land is purchased; early 2011 first parts of the plan will be realised.<br>The new national government has decided to stop its financial support to the project; province wishes to continue. | Oostvaarderswold project has been implemented at the highest speed possible sofar. | We greatly appreciate the high level of effort and ambition put in this project by all parties involved under the guidance of the province of Flevoland. |
| 4.4 ICMO does not recommend artificial supplementary feeding. | In March 2010, SBB has provided supplementary feeding on request of the minister after a motion by the Parliament. | ICMO’s advice has not been followed. | We note a political decision, that was contrary to ICMO’s advice, was taken. |

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| 5.1 ICMO recommends that the system of herbivore management is evaluated annually. Detailed records of the timing, condition and disease status of all animals culled or dying naturally need to be maintained over this period to allow the success of this policy to be assessed and should be available to public scrutiny. | Throughout the entire year, SBB monitors animals that die naturally or that are culled as part of the reactive management.<br>SBB publishes a summary on mortality data on its website three times a year, and figures in an external newsletter. | No detailed data on age and sex categories, and specific mortality dates were available and accessible to the public. | Adequate population statistics should be produced and published, including field counts of total numbers. |
| 5.2 An improved system of environmental monitoring needs to be investigated, which records the numbers, distribution and breeding success of important bird populations, the structure and dynamics of plant communities, and the distribution, breeding success and condition of the mammalian herbivores. This needs to be combined with analysis and modelling to identify current processes, predict future trends and set thresholds to acceptable change. | Vegetation monitoring using remote sensing has been carried out<br>Bird censuses every year have been maintained.<br>Consideration has been given to monitoring and modelling needs. | No systematic modelling of ecosystem processes has been set up as a tool for management.<br><br>The data on Natura 2000 bird species are incomplete.<br><br>Other biodiversity than among plants and birds is not monitored.<br><br>Monitoring data have been poorly published in literature. | |

| | | | |
|---|---|---|---|
| 5.3 ICMO recommends that a complete review of the management system is conducted after 5 years, based upon accumulated new data and more informed evaluation of alternatives. | | Remit of ICMO2. | ICMO2 notes that a number of substantial issues have already arisen before the 5 year period. |
| 6. ICMO recommends that a communication expert be assigned to plan and execute this objective. | In 2006, SBB has drawn up a community strategy and a communication plan.<br>The SBB has allocated additional PR manpower to the OVP and brought in an additional employee on the ground.<br>SBB deployed many communication activities. | SBB recently installed the middle management and experts for communication.<br>This is however very late.<br>A dedicated OVP communication manager is missed. | Efforts in communication are recognized, however Involvement of (local) stakeholders is still insufficient.<br>ICMO2 recognizes that due to the public debate and in agreement with SBB the Ministry took control over communication strategy. |
| 7. a. SBB should obtain scientific guidance with a view to identifying the key research opportunities presented by the OVP.<br>b. Previous modeling work (Groot Bruinderink et al., 1999) should be updated and extended to assess the consequences of grazing for the extent, distribution and quality of the habitats of internationally important birds, and therefore for their abundance. | Over the past few years, SBB invited scientists, but often on an ad hoc basis.<br>According to SBB, its own funds available for research are quite limited. | a. Little research is done in the OVP. Therefore understanding of the ecological functioning of the OVP is still poor.<br><br>b. Adjusting modelling work has not been done. | a. An expert group was advised, but never installed. The expert group was meant as a research management interface.<br>In view of the unique status of this area much more research should have been done.<br>On September 23, 2010 a first step has been made to involve researchers in the OVP on a larger scale. This is however very late. |

| | | | |
|---|---|---|---|
| 8. ICMO recommends that the Minister charges the Director of the SBB with personal responsibility to implement the recommendations above. This will include definition of strategic goals, the provision of resources, development of a formal management plan, and publication of yearly progress reports against defined targets. | The OVP core team of the SBB sends annual reports to the SBB director.<br>The SBB director provides the direction for OVP every three months.<br>The SBB director is personally involved in OVP matters. | The director was given personal responsibility for implementing the recommendations by the Minister in October 2006.<br><br>We miss clear priorities and transparent annual progress reports against defined targets. | The allocation of available funds requires clear priorities. |

# Appendix III

## Developments in size and dynamics in populations of Heck cattle, konik horse and red deer in the Oostvaardersplassen

Background document regarding the question:

**How do developments in size and dynamics of the populations of the large herbivores relate to the area's natural capacity?**

This appendix contains a background analysis aimed at better understanding the overall trends of koniks, Heck cattle and red deer presented in Fig. 2.1 (Chapter 2). For this, we analysed the main current components of population regulation (birth and death rates), and how they have changed over time and with density. But before reporting the results, we first elaborate different definitions of the term carrying capacity, as the use of different definitions has led to a lot of confusion in the public debate around the OVP until now.

### Three definitions of carrying capacity

In her questions, the Minister has asked how the developments in the numbers of individuals of the different large herbivores relate to the areas natural or carrying capacity. In effect this question seeks to determine what would be the upper limit in terms of numbers of large herbivores that can be sustained in the area in the long term. Unfortunately, this question does not have a straightforward answer; although originally adopted from a more agricultural usage, the concept, in ecology, embraces more than a simple definition of some fixed number of animals which may be supported by a given food supply.
There are in practice three quite different definitions currently used in the literature for the carrying capacity of an area; all three are valid elements of the concept, but lead to different conclusions on the number of animals that can be sustained.

**Population-based carrying capacity**
The first definition of carrying capacity is the long-term average number of individuals in any given population which can be sustained over time, with annual fluctuations around this mean. Mathematically, it is the K parameter of the logistic growth equation, which defines where a population will stabilise as the result of intra-specific competition for some limiting resource (usually, but not necessarily, food). The same species in different environments will have a different carrying capacity, so carrying capacity also depends in large part on environmental conditions. In addition, it should be understood that carrying-capacity may be determined by a number of limiting factors (as for example the availability of shelter, or, in some environments the availability of water), and not merely the availability of food. This is because the birth and death rates in the population depend on the net energy balance of individuals, which has an energy income side (food intake) and a loss side (activity, costs of thermoregulation related to shelter etc.).

It should be noted that this definition of carrying capacity is defined in the absence of other species and the presence of competitors, or interactions with other species will change the effective carrying capacity for any given population. The concept also presumes that the environmental conditions are constant over long time spans. Yet we know that carrying-capacities are not fixed and may show pronounced variation

over time from year to year, but also in a longer term trend over time (as the community undergoes succession or other directional change). In addition, it is important to recognise that carrying-capacity, however defined, may also vary markedly between seasons (for example, between summer and winter). In consequence, this definition has limited applicability in the assessment of current densities. Within the OVP environmental (e.g. soil) conditions still change rapidly and all three species occur in large numbers. Even though the carrying capacity of the OVP according to this definition is unclear, its underlying mechanisms in terms of density-dependent birth and death rates can be studied, which we deal with below. Further, the concept can be applied to determine upper and lower limits to populations which may be observed as populations respond to changing environmental conditions.

**Ecosystem-based carrying capacity**
The second definition of carrying capacity is the long-term average population size or density of one or more species that results in a particular desired state (as defined by man) of the ecosystem, e.g. a forest, a mosaic of grassland and forest, or a short grassland. In this perspective, other arguments than the large herbivores and its food alone are taken into consideration. In practice, we can define a carrying capacity of large herbivores for the OVP that results in a particular proportion of the dry grassland that is occupied with tall, rough vegetation, which houses high densities of small mammals, and therefore is suitable habitat for certain desired species that hunt these, such as buzzard, harrier or kestrel. The problem with the very young OVP landscape is however that we do not have a clear historical reference of what we would like the landscape to look like, besides our personal preferences or legal obligations as Natura 2000. This is very different from old cultural landscapes like De Hoge Veluwe, where we can define a density of red deer that preserves the general way the landscape looks like, and preserves the other species that have been there for centuries.

**Society-based carrying capacity**
The third definition of carrying capacity is the number of large herbivores, given a certain wildlife management strategy, which are likely to be tolerated by society at large (Decker & Purdy 1988, Decker & Richmond 1995, Kilpatrick et al. 1996, 2007). Also called a “social carrying capacity” or “wildlife acceptance carrying capacity”, this ‘limit’ of acceptance is often determined in relation to levels of impact on agriculture, forestry or conservation habitats but may also refer to the level at which the effects of competition for resources on animal welfare are still found to be ethically acceptable to most people in society. The acceptable density is therefore a combination of natural processes of population growth, habitat conditions, environmental conditions, and our interference with the process of mortality (e.g. through reactive or proactive culling, or no culling at all).

These three different definitions will result in very different large herbivores densities identified as "the carrying capacity" of the OVP. In fact, we think that a lot of discussion in Dutch society on the OVP has been caused by different interest groups implicitly using different definitions of carrying capacity. ICMO2 accepts all three as valid definitions of carrying capacity, and therefore recommends that any use of this term must be fully qualified to specify clearly which meaning of the word is intended, and also to pay good attention on the underlying concepts and assumptions that lead to these three definitions. For the habitat-based carrying capacity, this is done in this report in its sections on biodiversity changes in relation to changes in grazing and hydrology. For the society-based carrying capacity, this is done in the section on ethics and animal welfare. In this appendix, we will further elaborate the considerations that are relevant to the population-based carrying capacity. This is important as this sets a baseline towards the other definitions of carrying capacity. Specifically, many problems around the OVP have arisen because the habitat-based and society-based carrying capacity may be lower than its population-based carrying capacity.

### How to analyse population regulation and density-dependence

The OVP large herbivores densities are currently mostly regulated by food availablility in combination with physical stress during the winter. However, there are other possible equilibria that a population might experience than regulated by food and winter conditions. Population numbers may instead be regulated by predators, parasites, disease or territory size. However, for the Oostvaardersplassen large herbivores, we can outrule these factors as no evidence for the importance of parasites or disease in the area is present, predators of the large herbivores do not occur, and territory size limitations are not important due to their social nature.
In mathematical terms, the concept of population-based carrying capacity implies that when a population grows over time, its per capita (per individual in the population) should decline proportionally with population density, as individuals are expected to compete more for food with individuals of the same species when the population size gets closer to the carrying capacity for the area. The resulting development of the population size from an initial exponential phase to a final carrying capacity is called logistic growth. For simplicity, a logistic growth model that is appropriate in discrete time is often used, which is often a reasonable approximation for species that live in a seasonal environment, and reproduction and mortality occur in clearly defined, separate seasons, as is the case with the OVP. The population size of a species in the next year Nt+1 can then be predicted from the population size in the current year Nt with the so-called Ricker model as

$$N_{t+1} = N_t e^{r_{\max}\left(1-\frac{N_t}{K}\right)}$$

where K is the carrying capacity of the population, and rmax is the maximal (initial) per capita rate of population increase, reflecting the maximum net reproductive rate in the absence of any strong resource competition between individuals of the population.

When the size of a population approaches its population-based carrying capacity, it is undergoing population regulation, which may come in different types. The type of population regulation can be identified by plotting the per capita birth and death rates of a population per year against the population density at the start of that year. This provides an alternative way to find the carrying capacity of the population (given its assumption of single-species dynamics and constant habitat): it is the population size at which the per capita birth rate, and the per capita death rate are equal. The four main possibilities that are generally found in wildlife populations are (Sinclair et al. 2006):

**Type 1**: the birth rate is independent with population size, while the death rate increases linearly with population size. This is expected for population with a strong positive energy balance during the reproductive season, but a negative energy balance during the winter.

**Type 2**: the birth rate declines linearly with population size, while the death rate is constant with population size. This type is expected when resource limitation and thus body condition mostly affects the rate at which females get pregnant, or successfully can lactate their young. So this is expected when strong negative energy balance occurs during the reproductive season but less during the winter (which is not common).

**Type 3**: the birth rate declines linearly with population size, while the death rate increase linearly with population size. This is expected in environments where a negative energy balance is important both during the summer and during the winter, which can occur in situations with strong interspecific competition for food combined with lack of shelter

**Type 4**: the birth rate is constant with population size, while the death rate increases exponentially with population size. This is expected for population with a positive energy balance during the reproductive season, but a negative one during the winter, which has a bigger effect per individual when the population approaches carrying capacity.

**Population development and regulation of the OVP large herbivores: methods**
The populations of all three species in the OVP have been estimated by the SBB managers over the last 15 years by counting the number of young produced per species per year, by counting the number of natural deaths, and by counting the number of animals shot. The latter two measures were collected separately for calves/foals and for individuals older than 1 year. Combining these observations with the initial densities counted in 1996, the number of individuals that was expected to be present in each year was calculated. It should be noted that this is not the best possible method (see our reply to question 4 in the main report), as small errors (e.g. births or natural deaths missed) will accumulate over time, and increasingly lead to mistakes in the estimated number present.
As a result, ICMO2 therefore recommends in the main report that these estimates are replaced by true annual counts of the numbers of each species present in future. Detailed population counts over the coming years may help to correct the estimates from the past. However, we expect that this will not very strongly affect the conclusions that can be drawn from the current data.

We calculated the population trends for each species since their introduction, restricting analysis to individuals older than 1 year only. Each calculation started with the number of individuals present on January 1 of year t. Then, the number of individuals present on January 1 of year t+1 was calculated as the population size at January 1 of year t, minus the number of deaths of individuals older than 1 year in year t, and the succesfull recruitment of individual into this age class during year t. This last parameter was calculated as the total number of births during year t-1 minus the total mortality of individuals younger than 1 year during year t. We choose to focus our analysis on the individuals older than 1 year because this number is much less sensitive to the specific moment in the year at which the density is evaluated, due to uncertainties in the counting of juveniles until now.

Furthermore, we plotted the per capita rate of change of the populations versus the population size on January 1 of year t, and fitted exponential or linear regressions through the relations. This was done only for those population densities larger than 100 individuals, as too low numbers result in imprecise estimation of per capita effects. We used the total mortality (natural and culled) during year t divided by the number present on January 1 of year t as the death rate of this age class. For the birth rate into this age class, we used the total number of offspring in year t-1 minus the death rate of offspring in year t, assuming that most mortality occurs during January to March, which the field reports of the mortalities confirmed.

Using these methods, the initial population size and observed death and birth rates allowed the calculation of the population trend over time. In the fall 2010, a full field census was done to confirm the estimated numbers. In all three species, the observed differences were quite different from the estimated numbers. In the Heck cattle, the observed number was lower than expected (-438), while the other two species were not very different. Discussion on the census methods with the managers revealed that this is most likely due to underestimation of calve mortality during the winter in this species. In konik horses (+107) and the red deer (+675) the observed numbers older than 1 year were higher than expected, which means that birth rates may have been overestimated, possibly due to double counting of young individuals. To accommodate these differences, a constant correction factor for the number of births per year was introduced, which was multiplied with the observed birth rate to get a corrected birth rate. This parameter was adjusted for each species so that observed and predicted numbers were similar in each

species for the end of 2010. The calculated correction factors were for cattle: 0.79, for horses: 1.04 and for red deer: 1.15. It should be noted that this includes an assumption, which requires additional validation. However, the observed temporal trends are not expected to be affected by this assumption very strongly, as the recruitment and death rates variation were really observed (and probably with the same mistakes each year) and the final numbers were fixed.

## Population development and regulation of the OVP large herbivores: observed patterns

Figures 1, 2 and 3 (this Appendix) provide a summary of the monitoring data that have been collected so far by SBB with respect to the population development and mechanisms of population regulation for the OVP large herbivores.

**Heck cattle**

The Heck cattle were introduced in the OVP in 1983 as a small group of 32 individuals from a variety of source populations in Germany, Austria and Switzerland. This population has now grown to an estimated number of around 300 individuals (Figure 1a). The analysis of density dependence (Fig. 1b), showed that both birth and death rates were density dependent, corresponding to Type 3 dynamics of population regulation as outlined before. The population reached its highest abundance around the year 2000. During the last decade, years with net population growth alternated with years with net population decline (Fig. 1a).

Between 5 and 90% of the adult individuals that have died in the population each year over the last 10 years have been culled by the managers (Fig. 4a). As they only cull animals that are in very poor condition and that will not make it over the next weeks to come, and now aim to shoot 90% of the animals that are in this state, it can be concluded that most mortality during the last 5 years is due to food limitation. During the last 5 years, with the intensity of intraspecific competition increasing as the population approaches carrying capacity, also half of the calves now die of food shortage. This response came later than observed in the adults.

**Konik horses**

The konik horses were introduced in the OVP in 1984 as a small group of 20 individuals from a variety of source populations in Poland and Belgium. This population has now grown to an estimated number around 1000 individuals (Fig. 1b). This would suggest that the population is close to its population-level carrying capacity (given the presence of the current numbers of Heck cattle and red deer), but has not reached it yet. Statistical reasons make it in this case also more difficult to estimate the population-level carrying capacity. The analysis shown in Figure 2a suggests also a carrying capacity around 1.000 individuals for the current situation. Figure 2a also shows that density dependence is found both in the per capita death rates and the per capita mortality rates, so a type 3 population regulation, similar to the Heck cattle.

The analysis shown in figure 2 suggests that the population may reach its (population-level) carrying capacity during the next 1-5 years from now, given the current abundance of the other large herbivores. However, it is unclear to what extent competition with the red deer will affect the long term population numbers, whether the two species will coexist or one will outcompete the other. Further, continued decline in the number of Heck cattle in the system may also affect final population trajectories. Similar to the Heck cattle, between 20 and 90% of adult koniks that have died in the population over the last 10 years have been culled by the managers (Figure 3a). So also for this species, it can be concluded that food limitation is an important factor in population regulation. During the last 5 years, with the intensity of intraspecific competition increasing as the population approaches carrying capacity, also 20-60% of the calves now die annually of food shortage.

**Red deer**

The red deer were introduced in the OVP in 1992 as a small group of 42 individuals from a variety of source populations in Scotland and the Netherlands (Veluwe). This population has now grown to an estimated number around 2500 individuals (Figure 1b). Figure 1b suggests that the population is close to its carrying capacity, given the current primary productivity and abundance of other herbivores, but has not reached it yet. Statistical reasons make it also in this case also more difficult to estimate the carrying capacity. The analysis shown in Figure 3a suggest a carrying capacity of around 2300 individuals. Figure 1b also shows that in this species the per capita birth rate slightly strongly declines with population size (similar to the Heck cattle and koniks), while the death rate increases linearly with population size. Therefore, population regulation in this species also occurs according to type 3, and is characteristic for food-limited population growth.

The analysis shown in Figure 3 suggest that the population under the current conditions (environment, other herbivores) will reach its carrying capacity during the next 1-5 years from now. Between 40 and 90% of the red deer that have died in the population over the last 10 years are typically culled by the managers (Figure 3c). So also for this species, it can be concluded that ultimately up to half of the mortality in the population can be due to density-dependent food limitation. During the last 5 years, with the intensity of intraspecific competition increasing as the population approaches carrying capacity, also 10-40% of the calves now die annually ultimately of food shortage (but directly by culling to avoid long-term suffering).

The analysis shown yield that as a large herbivore community, all three species are now getting close their joint population-level carrying capacity (Figure 2.3 in Chapter 2). As the large herbivores only really use the dry part of the OVP for foraging, it means the three species together have around 2000 ha foraging area at their disposal. Detailed observations of spatial segregation are not available, but all species seem to use the entire area. Currently (nov 2010) the estimated population sizes are 250 Heck cattle, 925 konik horses and 2.200 red deer, at densities which lead to strong intraspecific competition during the winter. The resulting food shortage (indirect, ultimate cause of dying) and culling (direct, proximate cause of dying) regulate the populations around these numbers. The rates of reproduction are also shown to be highly density-dependent, which means that higher culling rates (e.g. pro-active) will lead to increases in the rate of recruitment, which makes more culling necessary.

The total number of individuals is of about 3.400 large herbivores on an area of about 2.000 hectares, implies about 1.5 animals per hectare older than one year, which is a high density compared to other natural areas with large herbivores. It shows that the soil and vegetation have a unique capacity for very high primary production, and the area is therefore very suitable in principle to support large populations of each of the three large herbivores species. In agricultural situations, such a density of large herbivores can only be achieved with very high inputs of fertilizer and manure, with negative side-effects in nutrient losses to the surface and groundwater. It is not at all clear yet how this high density can be maintained from a nutrient cycling perspective by at least 5-10 years now without clear external nutrient inputs. This requires further investigation. Possible explanations may involve the seepage of nutrients through groundwater from the IJselmeer, nutrient inputs by geese, nitrogen fixation by legumes (clovers) and high internal nutrient recycling by the grazers.

### Population-based carrying capacity, population regulation, and reactive versus proactive culling

In the OVP, a system of late reactive culling is currently practiced. This means that those individuals that are likely to die from resource limitation within the next weeks are shot. This form of late reactive culling is therefore not regulating the population - only those individuals are shot that are already in extremis and thus would almost certainly die anyway. The primary goal of the late reactive culling is to prevent from what is seen by parts of the general public as unnecessary suffering.

An alternative model of culling is proactive culling of the population, which is generally done in large herbivores in temperate ecosystems during the fall. This strategy sits on the other end of the scale from low to high interference with natural processes. This can either take the form of sport hunting or the form of management culling. Proactive culling implies that a significant part (often between 20 to 50% of the population) is shot or otherwise removed with the result that the population is artificially maintained below carrying capacity. This means that healthy individuals are killed, and the managers need to devise clear criteria of which individuals to take (e.g. in terms of age, sex ratio, dominance position). This annual setting back of the population density to a level significantly below the carrying capacity causes food limitation due to intraspecific competition during the following winter to be less severe. The measure therefore enforces itself. Proactive culling makes more proactive culling necessary in the future, as the internal mechanisms for population regulation (reduction of birth and increased death rates with higher densities) are replaced by an external mechanism of population regulation. Because all animals are in excellent condition, they reproduce at their maximum rate, which makes the killing of more animals necessary.

Another, intermediate model of intervention is the early reactive culling that ICMO2 recommends for the OVP. This means that animals are shot at an earlier stage, before prolonged unnecessary suffering occurs. This strategy implies that there is a higher chance than with late reactive culling that animals are killed that would have survived otherwise. This is because the likelihood of their survival can be less well estimated than in the case of late reactive culling. The net effect on the population numbers of this new practice are still unclear and need to be evaluated, but we expect that it will lead to a slow but steady downward trend of the numbers. But this will depend on whether the slightly increased mortality is fully or partially compensated by more reproduction.

Fig 1a

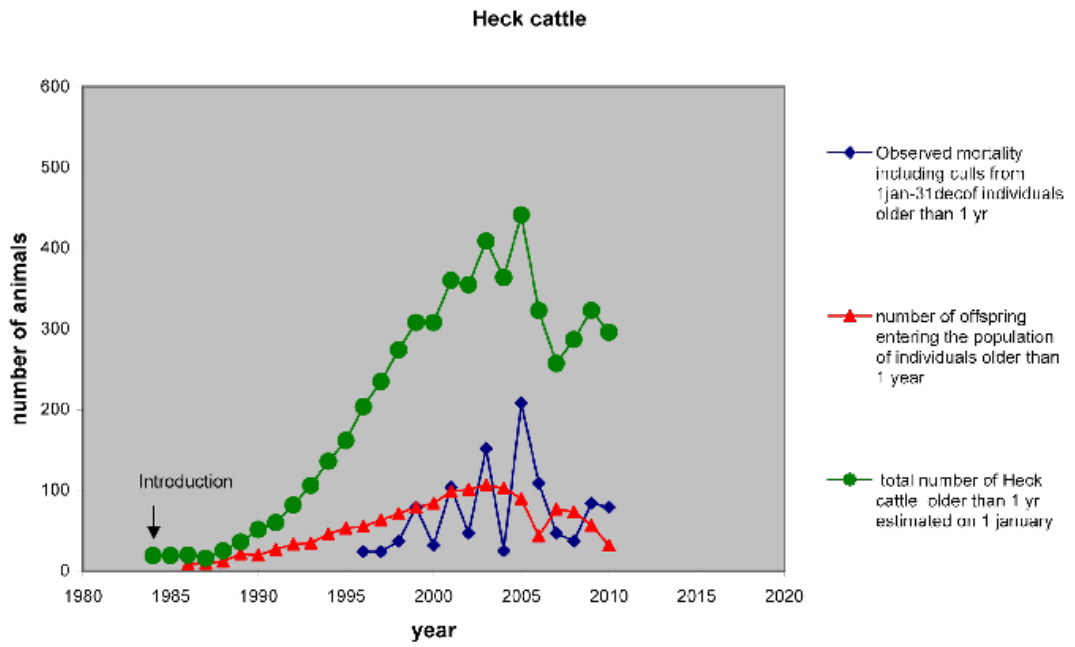

Heck cattle
number of animals
year
Introduction
Observed mortality including calls from 1jan-31decof individuals older than 1 yr
number of offspring entering the population of individuals older than 1 year
total number of Heck cattle older than 1 yr estimated on 1 january

Fig 1b

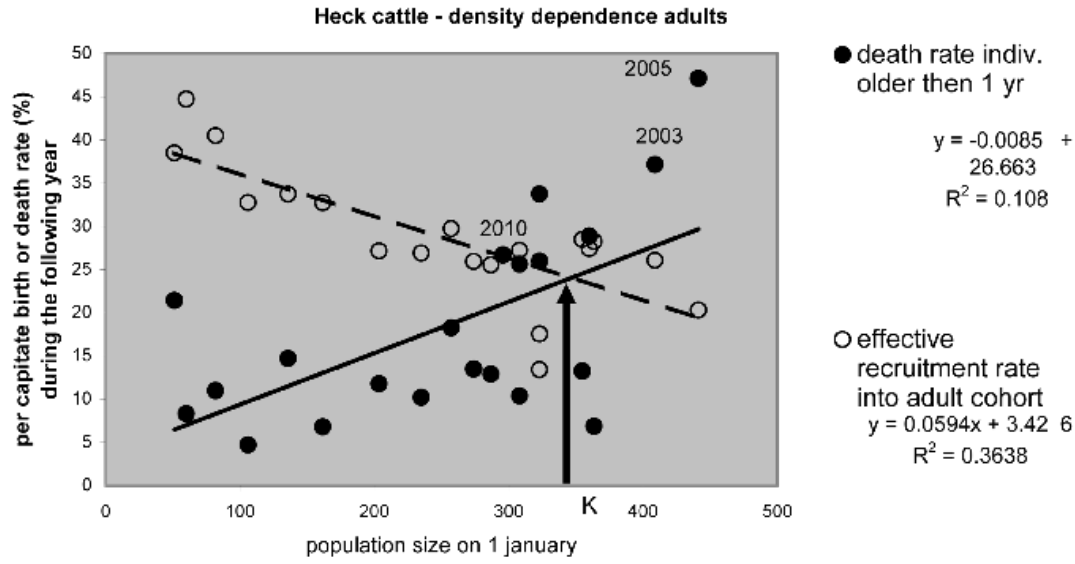

Heck cattle - density dependence adults
per capitate birth or death rate (%) during the following year
population size on 1 january
2005
2003
2010
K
death rate indiv. older then 1 yr
y = -0.0085 + 26.663
R2 = 0.108
effective recruitment rate into adult cohort
y = 0.0594x + 3.42 6
R2 = 0.3638

Fig 2a

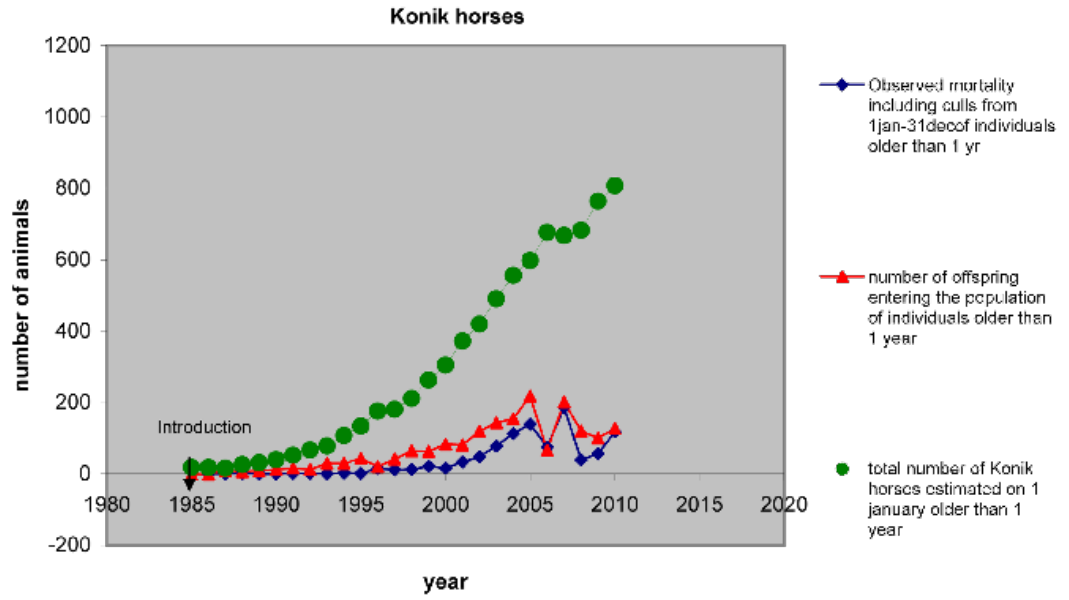

Konik horses
number of animals
year
Introduction
Observed mortality including culls from 1jan-31decof individuals older than 1 yr
number of offspring entering the population of individuals older than 1 year
total number of Konik horses estimated on 1 january older than 1 year

Fig 2b

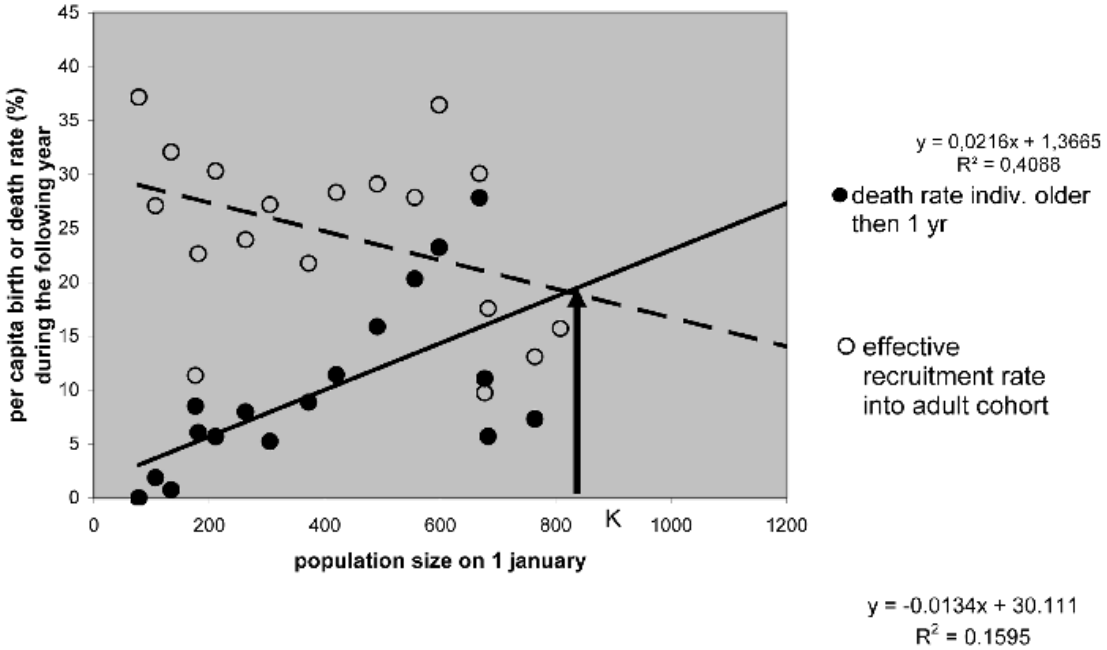

per capita birth or death rate (%) during the following year
population size on 1 january
K
y = 0,0216x + 1,3665
R² = 0,4088
death rate indiv. older then 1 yr
effective recruitment rate into adult cohort
y = -0.0134x + 30.111
R² = 0.1595

Fig 3a

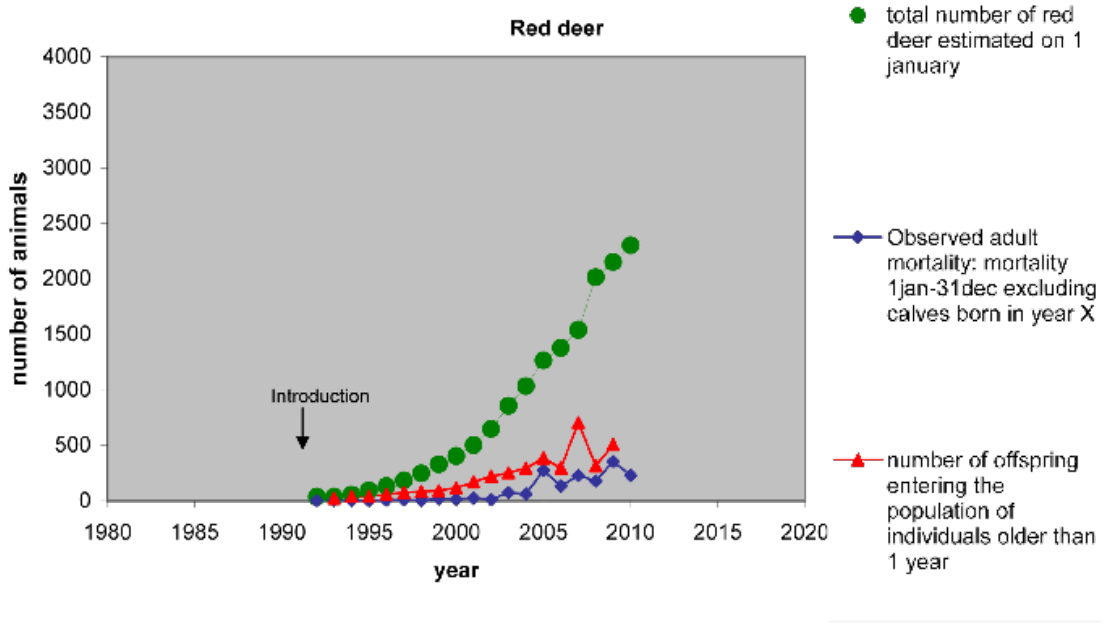

Red deer
number of animals
year
Introduction
total number of red deer estimated on 1 january
Observed adult mortality: mortality 1jan-31dec excluding calves born in year X
number of offspring entering the population of individuals older than 1 year

Fig 3c

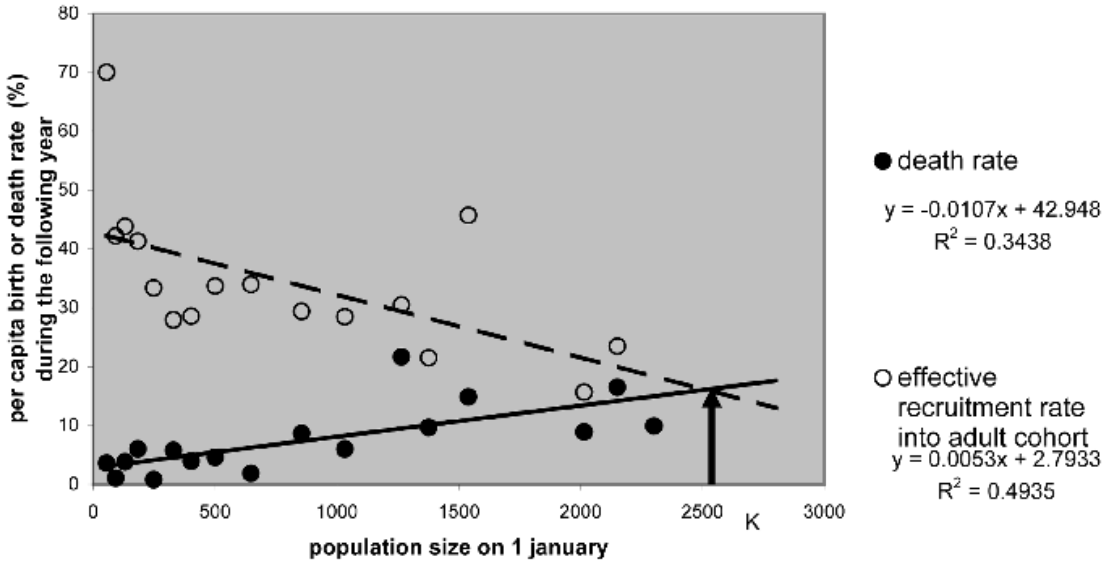

per capita birth or death rate (%) during the following year
population size on 1 january
K
death rate
y = -0.0107x + 42.948
R2 = 0.3438
effective recruitment rate into adult cohort
y = 0.0053x + 2.7933
R2 = 0.4935

Fig. 4a Heck cattle

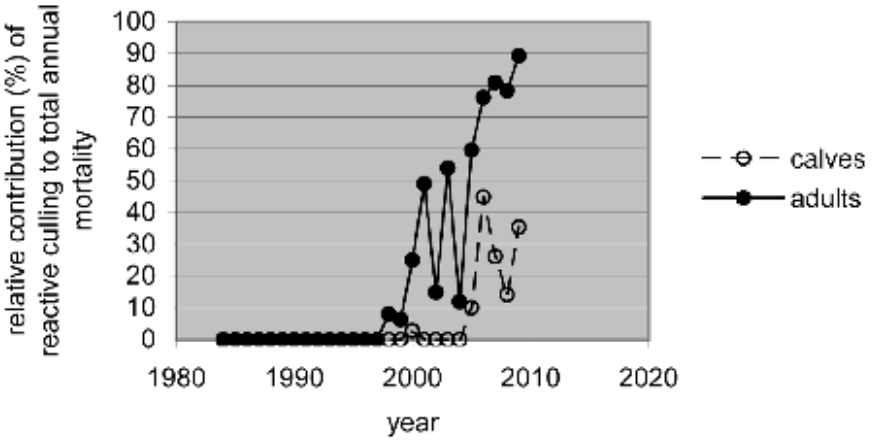



Fig. 4b konik horses

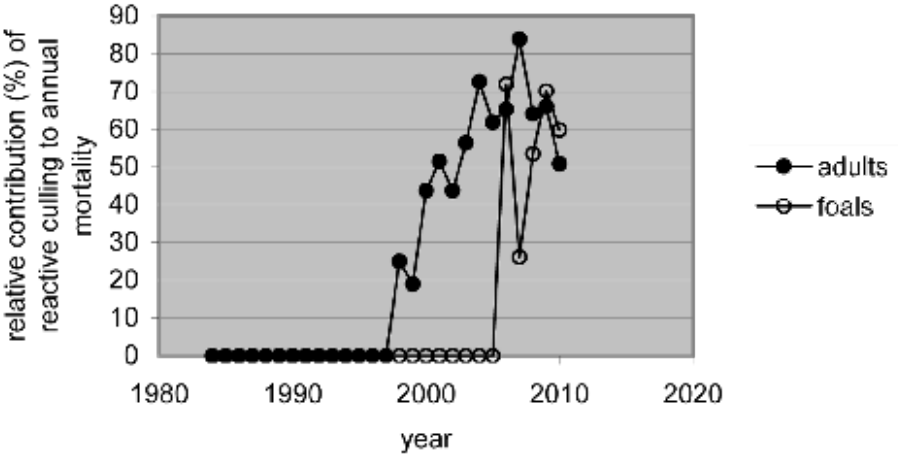
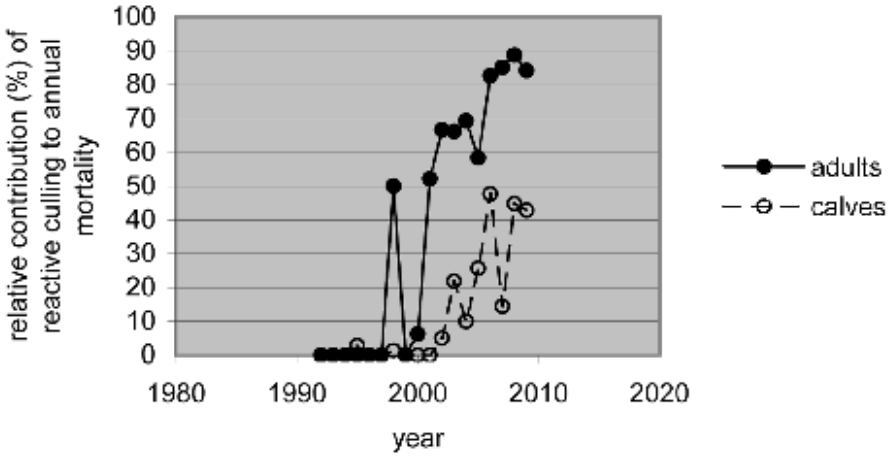



Fig. 4c red deer



# Appendix IV

## Analysis of possible measures related to five issues in the OVP

Most recommendation in the main text of this report are based on an integrated analysis of alternative scenarios around five main topics, that ICMO2 identified as the basis of most of the discussion on the area during the last years, and the basal points of discussion that needed to be answered in order to answer questions 10 and 11 by the minister. These topics are:

A. Large herbivore population management and avoidance of prolonged unnessasary suffering due to food limitation.
B. Animal welfare concerns related to lack of shelter by woody vegetation for large herbivores during some winters.
C. Animal welfare concerns related to food shortage in winter, with supplementary feeding as the main direction of solutions.
D. Concerns about effects on endangered birds and habitat homogenization.
E: Governance issues related to communication, involvement of stakeholders, societal acceptance, and relation between research management.

For each of these five topics, we provide realistic scenario's, and list the advantages (pros) and disadvantages (cons) of each of them. We assessed only scenario's that we considered to be realistic options under the current ecological, legal and societal constraints. The pros and cons for each scenario have formed the bases for our discussions which led to our main recommendations. The scenario's are identified by a letter and number, so A2 is the second scenario to address topic A. The spatial position and total area in ha of the different adjacent nature areas mentioned in the tables below are explained in a map and table at the end of this Appendix (Figure 1).

### Topic A. Large herbivore population management and avoidance of prolonged unnessasary suffering due to food limitation

| A. Scenario | Pros | Cons |
|---|---|---|
| A1. Late reactive culling: Maintain the current situation: no interference except shooting animals that are likely to die during the next weeks of all three species, mostly during the late winter. Same management for all three species | No or little interference with the social and genetic structure of the herds ecological, physiological and behavioural processes determine which individuals will die | Low societal support. Mortality due to food limitation viewed by many as ethically not acceptable for free-ranging populations of introduced, previously domesticated large herbivores in an enclosed area |
| | Specific, unique ecological processes in the grasslands associated with herbivore abundances at very high density, e.g. in relation to soil fauna and indirect effects on grassland birds | Inaccessibility of the area during the later winter (February/March) for people due to shooting activities |

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| | Strong facilitation during the winter for the greyleg geese that switch over to the marshland in the summer and maintain it open - maintenance of this functional connection within the ecosystem | Has proven to be not adequate in isolation to prevent long-term unneccessary suffering |
| | Positive effects of the carcases on ecological processes and biodiversity, specifically for species that feed on carrion | |
| | Strong facilitation during the winter for the greyleg geese that switch over to the marshland in the summer and maintain it open - maintenance of this functional connection within the ecosystem | |
| | Educational/philosophical values of the persistance and development of an ecosystem with minimal interference | |
| A2. Early reactive culling: cull animals that are visibly in poor condition, and with deviant behaviour, that have lower chance of survival, before clear unecessary suffering would happen, mostly in late winter. Same management for all three species | More complete prevention of unnescessary suffering due to food limitation in late winter | Possibly some risk of interference with social structure of the population, and of short term stress |
| | Positive effects of the carcases on ecological processes and biodiversity, specifically for species that feed on carrion | |
| | Less societal resistance in relation to welfare issues | |
| | Specific, unique ecological processes in the grasslands associated with herbivore abundances at very high density, e.g. in relation to soil fauna and indirect effects on grassland birds | |

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| | Strong facilitation during the winter for the greyleg geese that switch over to the marshland in the summer and maintain it open - maintenance of this functional connection within the ecosystem | |
| | Possibility to regulate population density to some extent | |
| | Educational/philosophical values of the persistance and development of an ecosystem with low interference by humans | |
| A3. Birth control: active contraception of female individuals of all three species | Fewer animals will die from food shortage | Very high costs of implementation |
| | | Technically difficult to implement, as same individual has to be caught several times |
| | | Significant suffering associated with the capture procedure (stress, injuries) |
| | | Animal suffering still possible in animals that die of old age |
| | | Possible effects on natural behaviour (dependent on method used) |
| A4. Proactive culling: maintain the populations at significantly lower number than the current (fall 2010) (1000-2500 indiviudals > 1 year) numbers by active culling of partly healthy individuals in the late fall or throughout the year | Less density-dependent mortality during winter due to food limitation, therefore less critique from those societal groups that find this not acceptable | Strong interference with social and genetic structure of the population, and with behaviour |
| | | Criticism from those opposing large scale culling of healthy animals |

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| | More variation in vegetation structure in the dry part due to lower densities, promotion of bird, small mammal and insect species that depend on tall, rough vegetation of the dry parts of the OVP | Strong lowering of densities promotes reproduction and juvenile survival, and therefore creates the need for more culling in the future (population is kept in exponential growth phase) |
| | Ecological, 'wildlife meat' can be produced and sold, providing revenues and more support of the area by those who appreciate this | Less facilitation for greylag geese due to presence of less short grassland, cascading effect to the wet part of the ecosystem |
| | | Less suitable conditions for birds that are attractive to short, intensively grazed grassland, such as golden plovers and barnacle geese |
| | | Less species and abundances of carrion-feeding species |
| | | For Heck cattle and konik: need for assessment of the legal basis for regulating the numbers by pro- active culling, as this would be the first system where this is practised in the Netherlands |
| A5. Population crash: strongly reduce the population of one, two or all three species of large herbivores at irregular, multi-year intervals | Less density-dependent mortality during the following winters due to food limitation, less unnessasary suffering of animals, therefore less public debate on starvation of large herbivore from food limitation | Large scale culling of healthy animals needed - societal resistance expected due to ethical concerns |
| | More suitable conditions for birds that depend on tall, rough grasslands, especially predators of small mammals, and more opportunities for tree recruitment at periods of low herbivore numbers | For Heck cattle and Konik: need for assessment of the legal basis for regulating the numbers by pro- active culling, as this would be the first system where this is practised in the Netherlands |

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| A6. Predators: Introduce or accept colonisation of one or more predators of larger herbivores (e.g. lynx or wolves) | Possibility of regulating population of large herbivore by predators | Not much experience with this practice yet, unclear if the predators will regulate the population, unclear if the area is sufficient to hold healthy populations |
| | Educational / philosophical values of the persistance of an ecosystem with minimal interference | In case of lynx: only predation on juveniles, unclear if this will regulate populations |
| | | Large improvements in fencing needed with associated costs, high likelyhood of outbreaks from the area with associated public arousal (perceived risk to people, domestic animals) |
| A7. Full removal: removal of all large herbivores from the area | No societal concerns anymore on the welfare of large herbivores | No facilation effects for geese, no dung fauna, no fauna feeding on carrion, disappearance of species bound to short grassland, decline of greylag geese, closing up of reed beds in the wet part |
| | | Public opposition agains culling large number of healthy animals |
| | | Need for assessment of the legal basis for killing large numbers of wild large mammals |

### Topic B. Animal welfare concerns related to lack of shelter by woody vegetation for large herbivores during some winters

| B. Scenario | Pros | Cons |
|---|---|---|
| B1. Maintain the 2010 situation: winter shelter for red deer in the Fluitbos, little shelter for Konik horses and Heck cattle | Shelter for the red deer | Hardly any winter shelter for the Konik horses and Heck cattle resulting in compromised animal welware and resulting in unnecessary suffering |
| | | Strong damage by the deer to the trees due to a high density in a relatively small areas, concerns about future tree regeneration |
| B2. Woody recruitment stimulation: establishment of temporary exclosures, combined with planting of saplings to promote establishment of woody vegetation on sufficiently large spatial scales at the margins of the area | Creation of more heterogeneity of vegetation structure and associated biodiversity effects inside the current OVP boundaries | Long duration for the measure to result in shelter to be of use to the animals |
| | | Fences conflict with 'wilderness' philosophy |
| | | A proportion of woody sapling will be killed by animals if fences are removed |
| | Fenced area's provide shelter | If fences are not removed there will be an increase in amount of fencing in the OVP |
| | | Cost of fencing, tree planting and fence maintenance |
| B3a. Open the adjacent Driehoek (75) and part of Oostvaardersbos (100ha) to all three herbivores during the winter,: Provide winter shelter for Konik horses and Heck cattle by connecting this part of these areas to the current grazing area | Advantages: see under Hollandse Hout<br><br>Measures can be already effective in winter 2010-2011, fencing already in place | Surface still limited (75 ha), therefore only first step. Restriction to the public: currently these areas are open for hiking and would need to be closed during the winter period Negative impact on trees: relatively small woodland part added relative to grassland component |

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| B3b. Opening of the Kotterbos to all three herbivores .A 5 m wide tunnel under the railway is already present, which means that the Kotterbos can be made directly available for the large herbivores, after fencing, preferably year round | Considerable amount of shelter is added<br><br>Measures possible in winter 2010-2011 if appropriate fencing can still be realized | Negative impact on trees: relatively small woodland part added relative to grassland component. Risk of reduced shelter in the future if Hollandse Hout (B4) would not be connected |
| B3c. Create shelter by forming ridges (2 m wide, 1 m tall) by digging up sand in the sandy part (“Het Stort”) of the current OVP fenced area. | Immediate availability of shelter for the large herbivores near the grazing areas<br>Effective and directly visible measure<br>Additional geomorphological heterogeneity in a relatively uniform area, expected positive effects on diversity of insects (eg solitary bees) and birds (eg sand martins) that potentially utilize sandy escarpments<br>Measures will be effective in winter 2010-2011 | Costs of creating shelter ridges |
| B4. Open about half of the Hollandse Hout (HH, a total of 947 ha) in Winter. Thus provide 500 ha of winter shelter for all three species by temporarily connecting/including part of the Hollandse Hout to the current grazing area. This means about 50% of the Hollandse Hout (947 ha in total) should be included in the grazing area but only during winters. | Large scale winter shelter (about 500 ha) available when needed | Cost of fencing the Hollandse Hout on short notice and creation of road crossing for animals across the Knardijk public road |
| | Additional short term emergency food resources provided during the following harsh winter when population numbers are still very high | Closure of part of the grazed part of the Hollandse Hout for the public recreation during the winters |
| | Possible improvement of vegetation heterogenetiy and biodiversity in the Hollandse Hout through large herbivore impacts | Practical difficulties of getting the animals out of the area again at the end of each winter., with associated risks for injury and stress |
| | More opportunities to view the animals along the boundary by people hiking in the open part of the Hollandse Hout,<br>improvement of public support by people living in Lelystad and surroundings | |

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| | short term relief from food limitation during the potentially harsh periods in the 2010/2011 winter | |
| | Stronger seasonal movements, choice of alternative options for large herbivores among habitats | |
| B5. Open Hollandse Hout (HH) on a year round basis (500 ha) | Large scale winter shelter (about 500 ha) available when needed | Roe deer will disappear from HH |
| | Additional short term emergency food resources provided during the following harsh winter when population numbers are still very high | No access for recreation year-round to the grazed part of the HH |
| | Stronger seasonal movements, choice of alternative options for large herbivores among habitats | Increases in population of herbivores will increase repeating previous problems and lead to higher numbers to be culled |
| | Vegetation variation increases | On the long term the shelter value might reduce |
| | More varied habitat for the animals | |
| | No practical difficulties in removing the animals again at the end of winter | |
| | Stronger seasonal movements, choice of alternative options for large herbivores among habitats | |
| B6. Light corridor. Connection by a 120 m wide pathway between OVP and Horsterwold: “the Oostvaarderswissel” see figure 3.2)<br>To start with red deer and to expand to konik horse and Heck cattle | Short to medium term realisation possible, with current available funds | Incomplete solution |

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| | Uses land originally reserved for a road which was never realized. Requires no current agricultural land | |
| | Has never been agricultural land. Flexibility to add parcels of land to this backbone in future, making the realization of the Oostervaarderswold more modular rather realization at once of the whole plan, which is more suitable under the current budget constraints | Cost of fencing |
| | Access to shelter in the Horsterwold | Narrow strip that is less attractive for the animals to move through than a wider corridor (Oostvaarderswold) |
| | Facilitation of future possibilities for red deer to move to Veluwe | Practical obstruction by the temporary fences during realization of the Oostvaarderswold |
| B7. Full corridor: Oostvaarderswold. Provide additional habitat for red deer, Konik horses and Heck cattle by connecting the OVP to the Horsterwold through the Oostvaarderswold ecological corridor. For an overall evaluation of pros and cons of this scenario, see Structuurvisie Oostvaarderswold, Province of Flevoland, 2009 | Improvement of vegetation heterogenetiy and biodiversity in the corridor and Horstelwold | Reduction of agricultural land in the corridor |
| | More opportunities to view the animals along the boundary and corridor, combination with ecotourism | Cost for purchase of land and new infrastructure |
| | Stronger seasonal movements, choice of alternative options for large herbivores among habitats | |
| | Possibility of ecological connection for red deer to the Veluwe habitat | |
| | Large scale creation of outdoor recreation opportunities in Zuidelijk Flevoland, which are highly needed given the growing population of Almere, Lelystad and surroundings | |

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| B8. provision of topographical shelter by digging up levees within the current boundaries of the OVP | Some additional topographical shelter at low costs | Very limited improvement for the large herbivores |
| | | It is an extra human intervention |

### Topic C. Animal welfare concerns related to food shortage in winter, with supplementary feeding as the main direction of solutions

| **C. Scenario** | **Pros** | **Cons** |
|---|---|---|
| C1. Maintain ICMO I recommendation: no supplementary feeding | Educational/philosophical values of the persistance of a grazing ecosystem with minimal interference | Societal concerns on animal welfare and pressure to supplementary feed the animals in harsh winters |
| | Avoid risk of artificially sustaining populations above the capacity of the natural system | Animals appear to be hungry which some people find hard to accept |
| | Avoid extra unnecessary suffering due to higher population density | Animals cannot do anything to releave hunger |
| C2. Emergency feeding in the late winter, and only in winters when (too) many animals are in poor conditions | Creates the suggestions that “we are doing something about it` | Practical difficulties in getting the food to the right individuals at the right moment due to dominance relations / social structure |
| | | Much literature shows that emergency feeding has little effect in relieving suffering, or improvement in body condition |
| | | Effects are only short term, the long term effect is that, if effective, different large herbivore populations are increased, with the need for more and more feeding |

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| | | If effective, spatial distribution and activities of the individuals become driven by the areas of food supply, not by current spatial differences in vegetation and shelter |
| | | Additional nutrient inputs into the area with the hay, local eutrophication and heavy trampling effects arround the feeding sites |
| C3. Large scale preventive supplementary feeding in the fall of each year to prevent animals entering the winter in poor condition | Little suffering of the animal due to food shortage in the short run | Making the problem of food limitation worse in the long run - strong resultant population growth will require more and more supplementary feeding, with no clear end, possible need for large scale culling in the future |
| | | Also the con's of C2 |
| | | Conflicts among animals will increase |
| | | A number on extra negative effects due to competition for resources, local environmental damage around feed sites, increase of risks on diseases (Putman and Stains, 2005) |
| | | It leads to domestication |
| | | More human animal contacts and other import risks |

### Topic D. Concerns about effects on endangered birds and habitat homogenization

| D. Scenario | Pros | Cons |
|---|---|---|
| D1. No further interference: no future interference with the hydrology or geomorphology of the area, also if the levee breaks that now separates the wet and dry parts of the area, uncertain and uncontrolled future change in hydrological situation | Wetter conditions in the current dry part, with waterbirds profiting from those | Large risk of disappearance of characteristic ecosystem processes and target Natura 2000 species in the marshland |
| | Long-term readjustment of the hydrological situation due to the settling of the clay soil after the dry part falls dry, the initially lowest part of the polder (the wet area, which is now among the highest) becomes the lowest part again | Longterm persistance legacy of the man-made initial conditions (gulleys, levee) |
| | Educational/philosophical values of the persistance and spontaneous development of an ecosystem with minimal interference | |
| D2. Maintain the current situation: Active, permanent maintenance to ensure the continuation of the current internal hydrological situation, repair and enforce the levee that separates the wet and dry part, maintain the current hydrological differences | | Ongoing disappearance of characteristic ecosystem processes and target Natura 2000 species in the marshland due to successional processes, increasing water body area due to reed consumption of greylag geese at the lake margins |

| | | |
|---|---|---|
| D3. Drought simulation: Active, permanent maintenance to ensure the current internal hydrological situation, repair and enforce the levee that separates the wet and dry part. Irregular simulation of an extreme drought (e.g. once every 10 years) by dropping the water table in the wet part, which stimulates recolonization of reed beds | Resetting of vegetation succession by germination of reed and cattails on the dry lake beds. Proven experiment that is done before, strong positive but temporary effect on marshland birds | No clear ecological motivation for which year to choose, impression of a strongly managed ecosysystem in communication, education, maintenance of artificials, man-made boundaries in the area |
| D4. Simulated geomorphological & hydrological past and future: Large-scale one-time interference with the hydrological and geomorphological situation (simulated past), to create a situation where water bodies separate areas with different grazing intensities by large herbivores. Dynamic water management, where where additional water inflow tracks the regional rainfall: simulation of riverine floodplain conditions, or simulate droughts (simulated future). Combined with geomorphological variation, this makes some areas accessible for the herbivores during some years and not in others | Promotion of heterogeneity in vegetation structure and biodiversity of different species groups, recovery of endangered marshland birds, introduction of spatio-temporal mosaics in vegetation structure, access to food in periods with heavy frost over ice, breeding and foraging oppertunities opportunities of birds and mammalian predators in non-grazed areas | Cost of initial measures |
| | Compatible with the minimal interference philosophy, it can be viewed as undoing the current strong human interference in the regional hydrology, e.g., the prevention of floods that originate from outside the area. Also, it reduces the legacy of the initial human interference of drainage ditches and soil tillage | |
| D5. Strongly reduce large herbivore numbers through implementation of scenarios D2, D3, D4 | Promotion of heterogeneity in vegetation structure and biodiversity of different species groups but only in the dry grasslands, birds, small mammals and insects of rough grassland will profit. | Negative effects on the marshlands through lowering the numbers of mouling geese |
| | | See other cons of D2,D3, D4 or D5 with regard to biodiversity and animal welfare |

### Topic E: Governance issues related to communication, involvement of stakeholders, societal acceptance, and relation between research and management

| E. Scenario | Pros | Cons |
|---|---|---|
| E1. Maintain the 2010 situation, where management is not strongly driven by research and monitoring outcomes, little stakeholder involvement takes place in decision making, little openness of the management on ongoing practices, all resulting in strong opposition of some societal groups against the current management strategy of the area | Support by some societal groups which agree with the current management strategy (wilderness approach, existing natural values with respect to biodiversity)<br>Inspirational/philosophical value of a area with little intervention, 'wilderness feeling'<br>Value for ecotourism (bird watching, deer rut, walking etc) | Strong opposition by several societal groups<br>Lack of understanding and connection with societal opinions by the management authority |
| E2. Task force implementation: Installation of a taskforce to oversee the immediate implementation of the key aspects of the winter package that ICMO2 formulated (Hollandse Hout inclusion, connection to the Horsterwold) | Improves chance of successful implementation of the winter 201/11 recommendations and reduces risk of unnecessary suffering during the next winter | |
| E3. Stakeholder forum Develop appropriate long-term stakeholder involvement through installation of a formal stakeholder forum | Realization of broad societal acceptance and support for the area and its management strategy<br>Transparent approach improves public trust and accountability | Time investment by SBB, risk of disappointment with some groups since not all wishes can be fulfilled |
| E4. Scientific Advisory board Installation of a scientific advisory board, that together with SBB develops a research priorities agenda for the area, evaluates results of the ongoing research, approve which research should commence, should have priority based on research proposals, guards against negative (disturbance) effects of research, stimulates the implementation/funding of the research agenda | Available resources in scientific community are mobilized for the benefit of the OVP.<br>Diverse scientific interests and views are connected to the OVP<br>Opportunities for basic research in this unique area are utilized with radiation to conservation areas, also internationally | |

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| | Ensures management is based on scientific insights as well as on management philosophy<br>Quality filter for proposed research, to ensure that only high quality work is proposed, direct impact in the field of research is minimised, and relevant questions are addressed | |
| E5. Establish an internal PR committee with links to scientific advisory board and stakeholder groups | Open communication | Time investment by SBB |
| E6. Independent full evaluation in 2015<br>Full independent review of the OVP management in 2015 | An ongoing 5 year evaluation ensures sufficient time to implement and concrete deadlines to have milestones met. | Resources needed |


| Area name | Surface area (ha) |
|---|---|
| Current area (2010) fenced for Heck cattle, koniks and red deer | |
| Grasslands and roughage drained part OVP | 1714 |
| Marshlands undrained part OVP | 2145 |
| Shallow water OVP | 1627 |
| Total | 5486 |
| | |
| Additional areas that the red deed can currently enter and could be added as shelter for Koniks and Heck cattle | |
| Oostvaardersbos woodlands | 173 |
| Driehoek woodlands | 75 |
| | |
| Potential other areas to be added as winter shelter | |
| Kotterbos woodlands (property of Province of Flevoland) | 372 |
| Woodlands Hollandse Hout (property SBB) | 947 |
| Woodlands and grasslands Praambos | 267 |
| Oostvaarderswissel connection to Horsterwold | 134 |
| Horsterwold (property of SBB) | 2519 |
| Oostvaarderswold: currently (Nov 2010) planned acquisition of agricultural land | 2545 |

Figure 1. Location and surface area of main habitats within the fenced Oostvaardersplassen, of adjacent woodland areas that potentially could be added, of two corridor options and the Horsterwold that could be connected by these.

# Appendix V

## Interim report of ICMO2 to Minister Verburg on September 24

The Minister of Agriculture, Nature and Food quality
Mrs. Gerda Verburg
Postbus 20401
2500 EK DEN HAAG
The Netherlands

ICMO-2: Commission on the Evaluation of Management of large herbivores in the Oostvaarderplassen

Secretariat
Dr. Henk Smit,
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6706 KN Wageningen,
Netherlands

T 0031 317 465200

Date 24 september 2010
Concerns Progress of work of ICMO2: the Commission on the Evaluation of Management of large herbivores in the Oostvaardersplassen

Dear Minister,

I am pleased to inform you on the progress of work of the Commission on the Evaluation of Management of large herbivores in the Oostvaardersplassen (ICMO2).
ICMO2 started its activities directly after its initialization on July 12. Over the last two months data collection has taken place, several interviews have been done and an audit was performed by two ICMO2 members regarding the reliability of existing data on herbivores. The nature of the full set of questions and the underpinning dilemmas require ICMO2 to follow a working process with two multi-day meetings as a minimum, in order to be able to deliver a report with sufficient quality to be of substantial use.

The first meeting took on September 17-19. During this meeting we addressed the questions you asked us to consider. We also dealt with your additional question on the preferable methodology for counting the large herbivores. I further promised that ICMO2 would provide you with (preliminary) answers as far as possible, including the question on the counting methodology, by the end of September.

During the first meeting the question on the counting methodology was answered and agreed upon amongst its members. In addition ICMO2 was able to give its judgment on the reliability of existing data on the monitoring of the large herbivores (Red deer, Heck cattle and Konik horses).

The other questions need more fundamental elaboration and hence more time. For example, the term carrying capacity, a static single species concept, needs to be reinterpreted in accordance with current

scientific insights, and the question how we merge ethical considerations (how to deal with suffering) with ecological judgments (benefits of management system) also needs further elaboration.

Further clarification of the strategic management goals by SBB is also needed to be able to evaluate the present ecological qualities of the area and thus the effectiveness of current management approaches in delivering ecological goals. The important issue of the provision of shelter needs dialogue with parties involved.
In addition, one of the members was unable to attend the first meeting, so most issues need further discussion during the second meeting to reach unanimity.

However, ICMO2 is able to provide you with some preliminary answers from those present during the first meeting on ecosystem functioning and the culling protocol (see Appendix I). ICMO2 conclusions on existing data and counting methods are given below.

Reliability of existing data on changes in the large herbivore populations
After it became clear that new total counts (done from the ground) yielded a population size that is different from the numbers so far published by SBB, the question rose why these numbers differ, and whether the data as collected are sufficiently reliable to use for answering the question on dynamics of the population

Conclusions
1. The identified difference between the calculated and the counted number of Heck cattle in 2010 is probably the result of the sum of errors in the birth and mortality figures over a period of 14 years: in 1996 the population was counted for the last time. After this point only the birth and mortality figures have been registered, and the likely population size was calculated from that. Because of this methodology the estimation errors in birth and mortality (for example, dead animals that were not found or double counting of newborn individuals) will have accumulated over the years, as a result of which the estimated population size gradually drifted away from the real numbers.
2. The annual figures of birth and mortality are based on many hours in the field and seem to be of sufficient quality to be used to estimate trends in population size, even if this methodology has led to a different estimation of the total population size.
3. The members of the Commission conclude that a more professional approach of the population counting, which is also better embedded institutionally, is urgently needed. The new approach should also include estimations of the errors.

Counting methodology
Your question: what methodology for counting of herbivores which is as reliable as possible and generally accepted do you recommend?

Conclusion: A reliable and commonly used method to assess numbers of large ungulates in open landscapes such as the Oostvaardersplassen, is to perform aerial surveys from a helicopter. Animals are either counted at the time of observation or counted later from aerial photographs in the case of big herds. The advantages and disadvantages of such methodology when compared to other available methods are reviewed by for example Mayle and Staines, 1998; Daniels 2006; Putman et al, 2011; Morellet et al, 2011.
The counting should be done both at the end of winter (March) and in autumn (October), to have an independent measurement for offspring and mortality. Such timing means that counts can be outside the breeding season, hence avoiding disturbance. Other Natura 2000 areas are monitored in the same way. The helicopter is not required to fly lower than 100 to 200m. The disturbance to birds and other animals

that results from this is thus expected to be low.
At least in Scotland large herbivores in all Natura 2000 areas, where significant impacts have been recorded from these animals, and thus some monitoring is required of animal numbers, are counted in this way by helicopter.
In order to have insight into the accuracy of the counting method, ICMO-2 recommends to start with a triple count with independent counters that do not know each other's results, preferably three days at a row, and develop a monitoring protocol from the first results.

Meanwhile ICMO2 continues its work to provide you with conclusive answers as soon as possible.

Yours sincerely

Dzsingisz Gabor
Chairman

## Appendix Interim report to Minister Verburg

Preliminary answers to questions on ecology and animal welfare

Ecology
Question 2. Does the Oostvaardersplassen area, with its herbivore management system, operate as a predominantly naturally functioning ecosystem?

Preliminary answer. We reviewed three main aspects determining the characteristics of the ecosystem: its initial conditions, its boundary conditions and its internal processes.
We conclude that while the initial stages and some of the current boundary conditions are manmade or managed, most of the internal processes occur spontaneously, and hence can be considered as "naturally functioning".

Animal Welfare
Question 4. Could you give your opinion on the culling policy operated by SBB to prevent unnecessary suffering in sick and weak animals?
Question 5. What is the commission's opinion on tightening culling criteria to raise the welfare standards of individual animals?

Preliminary answers
The commission judges, that the wardens of SBB do a good job within the framework of the protocol. However, the protocol is still a compromise between the objectives of non-intervention and minimizing unnecessary suffering. Unnecessary suffering is understood here as prolonged suffering when it is likely that the animal will not survive the next few weeks.

The commission recommends to change the protocol to further minimize unnecessary suffering. There are several possibilities to do this within the framework of current management.

a. The functioning of the animal in its environment should be the primary criterion, rather than simply considering single behaviours (such as passive behaviour while being approached by the warden) or single environmental circumstances such as time of the year, temperature. It has to be considered that animals will show certain behaviour like fleeing until it is really not able to move anymore.
b. The wardens should be allowed to be more pro-active in their final decision. Changes in the formal protocol could for example include a larger distance of approaching the animals (10-15 m instead of 3 m). Moreover, an environmental score, taking into account all environmental factors (e.g. time of the year, recent period, weather forecast of the coming period) could be combined with the condition score already used. This would lead to a more straight-forward protocol.
c. The circumstances for culling during winter could be improved for example by closing parts of the Oostvaardersplassen accessible to the public during the morning to enable culling without danger for human beings.

However, ICMO-2 recommends to implement changes systematically. The developing protocol should be evaluated systematically on the basis of the experience of the wardens in consultation with other experts.

We wish to emphasise at this point, however, that giving our opinion on how to improve the present protocol does not imply that ICMO-2 already has qualified the present method of reactive culling as the best possible method. This needs further consideration and will be concluded in the second meeting.

## Colofon


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|---|---|
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