

Reconciling Nature and Human Interests



Advice of the International Committee on the Management of
large herbivores in the Oostvaardersplassen (ICMO)

June 2006

Reconciling Nature and Human Interests

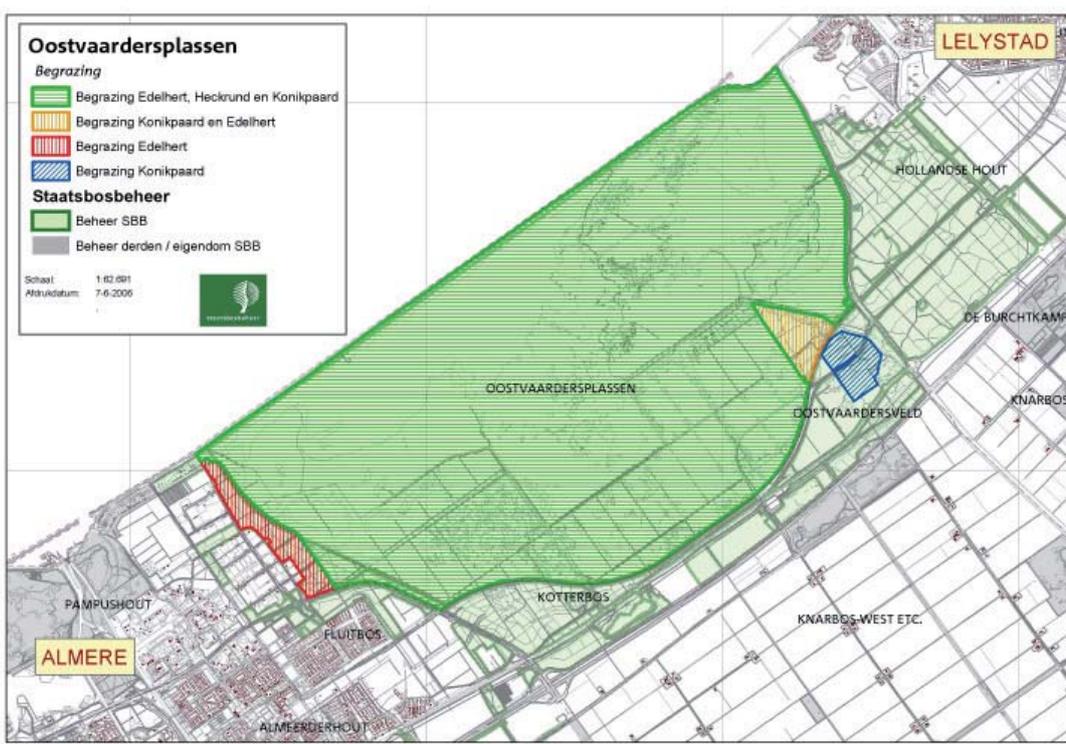
Advice of the International Committee on the Management of
large herbivores in the Oostvaardersplassen (ICMO)

Quotation of this report

ICMO, 2006. Reconciling Nature and human interests. Report of the International Committee on the Management of large herbivores in the Oostvaardersplassen (ICMO). The Hague/Wageningen, Netherlands. Wageningen UR - WING rapport 018. June 2006. ISBN 9032703528.

Table of contents

1	Introduction	5
2	Strategic framework.....	7
3	Recommendations	9
4	Answers to the Minister's questions	15
5	Summary of recommendations.....	19
6	References.....	21



1. Introduction

Reasons for establishing the Committee

For the past two decades, the Oostvaardersplassen nature reserve (OVP) has been managed as a minimum intervention ecosystem, where Red deer, Konik horses and Heck cattle live as semi-wild animals. At the moment animals in poor condition at the end of winter are culled according to a regime that is intended to simulate predation. No autumn culling is currently conducted.

However, mortality of large herbivores during the winter of 2004-2005 sparked off a debate on animal welfare and ecological management.

In autumn 2005 two contrasting advisory reports from the Council on Animal Affairs (RDA) and the Council for Rural Areas (RLG) (Raad voor Dieraangelegenheden, 2005; Raad voor het Landelijk gebied, 2005) urged the Minister of Agriculture, Nature, & Food Quality to establish a committee of international experts (ICMO) to advise on the future management of large herbivores in the Oostvaardersplassen.

Composition ICMO & secretariat

Consultation of several stakeholders involved in the discussion resulted in the following composition of ICMO.

Drs. Dzsingisz Gabor - Chairman	-	The Netherlands
Prof. Tim Clutton-Brock	-	United Kingdom
Dr. Michael Coughenour	-	United States of America
Dr. David Cumming	-	Zimbabwe
Dr. Patrick Duncan	-	France
Prof. Rory Putman	-	United Kingdom
Dr. Debby Reynolds/ Mr. John Montague	-	United Kingdom
Dr. Ramón Soriguer	-	Spain

The Committee was supported by an independent secretariat

Dr.ir. Henk Smit WING *Proces Consultancy* (Wageningen UR)

Drs. Rob Messelink Seconded to ICMO from the Ministry of LNV

The secretariat organized and supported the working process.



Remit

The Committee was formed on December 2005 and agreed to attempt to answer three questions identified by the Minister.

1. Is it possible to maintain a resilient, self sustaining ecosystem including large herbivores in the Oostvaardersplassen nature reserve, which is acceptable in terms of animal welfare?
2. If so, what conditions would have to be in place?
3. What impact would an ecological corridor between the Oostvaardersplassen and the Veluwe nature reserves have on the Oostvaardersplassen ecosystem and, in particular, on the populations of Konik horses, Heck cattle and Red deer?

Stakeholder consultations

The chairman of the committee, assisted by the secretariat, consulted stakeholders with the Oostvaarderplassen and informed the ICMO members about their views. Stakeholders consulted included:

- the Society for the Protection of Animals;
- several veterinarian experts;
- the Society for the Conservation of the Veluwe Deer;
- the State Forest Service;
- the Society for Nature Monuments;
- a member of the Provincial Executive of Flevoland;
- the Mayor, an alderman and staff of the city of Almere.



Procedure of ICMO

The Committee met on 9 & 10 February and 19 & 20 May 2006 and visited the Oostvaardersplassen (OVP) and its surroundings. Several members visited the OVP separately during March and April. During both meetings a range of views was presented to the Committee by prof. Dr. Elsbeth Stassen of Wageningen University & Research Centre and by dr. Frans Vera



of the State Forest Service. The relevant Dutch documents (including the legal framework and scientific papers) were translated and made available to the ICMO members. Several background documents were presented by ICMO members and discussed during the seven meetings held. A Sharepoint facility provided a permanent basis of mutual exchange and communication. All parts of this advice were unanimously agreed by all members of the Committee.

2. Strategic Framework

2.1 Guiding principles

- a) ICMO understands that the main objective of managing the OVP is the maintenance of suitable habitats for a diversity of wintering and breeding populations of birds of international importance, using a grazing system involving deer, cattle and horses in which intervention is minimal.
- b) ICMO supports the principle that populations of herbivores in the OVP should be treated as wild animals as far as is possible, and that human intervention should be minimized.
- c) ICMO is aware of several different value systems for animal welfare in The Netherlands (Stassen, 2006) and accepts that the management of large herbivores must meet animal welfare criteria acceptable to the Dutch people. ICMO has worked within the framework of Dutch legislation (Animal Health and Welfare Act (Gezondheids- en welzijnswet voor dieren) and the Flora and Fauna Act (Flora- en faunawet)) and values, rather than the personal views of the committee members.
- d) ICMO is aware that there is a public preference for avoiding OVP management policies that involve the routine culling of substantial numbers of healthy animals.
- e) ICMO considers that the present management practice does not realistically simulate predation, and should not be referred to as a predator model.



2.2 Alternatives examined

ICMO has considered four alternative approaches to managing herbivore populations in the OVP, though it recognizes that elements of different approaches could be combined.

- a) **No intervention:** a minimum management strategy where herbivore populations are allowed to self regulate and animals are neither killed nor removed whatever their body condition.
- b) **Proactive culling or removal** with the aim of minimizing starvation and winter mortality. Annual culls of this kind might be spread throughout the year or focused in particular periods (e.g. autumn). Such culls might attempt to mimic natural processes:
 - i) by simulating the impact of natural predation within the system, or by simulating a pattern of episodic mortality, similar to that observed in other herbivore populations,
 - ii) by maintaining herbivore populations at a fixed level by the removal of annual recruitment. Within such a system, population sizes could be set at a range of levels in relation to ecological carrying capacity and management objectives,
 - iii) by removing a variable number of animals each year in response to estimates of body condition and range condition (or both) at the beginning of winter.Under any of these alternatives, welfare requirements might require additional reactive culling.
- c) **Reactive culling:** a management policy where individuals that are below condition thresholds determined by clear and publicly accepted welfare criteria are culled on a daily basis to minimize suffering. Condition thresholds could be adapted upwards to simulate the behaviour and impact of predators.
- d) **Contraception:** controlling the reproductive rate of the population by artificial means.

3. Recommendations

Unanimously agreed by all members of the Committee

1. *General management and strategy*

ICMO believes that there is a need for a well defined management structure and strong direction for the management of the OVP. An early objective of the management team should be to produce an improved statement of the management objectives, that outlines and justifies the specific aims of management and describes the factors that affect them.

ICMO recommends that a detailed statement of management objectives is developed and published during 2006. One component of this should be the outline of the specific objectives of management for important bird populations and their habitats, including upper and lower limits to change for each species identified in the Natura2000 document.

2. *Herbivore management strategies*

2.1 ICMO recognizes that a management policy involving *no intervention* would meet some of the objectives outlined above, but is of the opinion that some form of intervention is necessary to fulfill animal welfare standards.

2.2 ICMO considers that the *proactive culling* of herbivores (either in autumn or throughout the year) would be a feasible approach to population management and that it could be adjusted to simulate natural processes. In a situation where culled animals were to be used for human consumption, this would be the appropriate strategy. However, in context of the OVP, it has the disadvantage that 1) it represents a substantial intervention in the natural processes of population regulation and natural selection and 2) it would involve killing or removing a substantial number of young and healthy animals.

2.3 ICMO considers that a *reactive culling strategy* (involving the culling on a daily basis of all animals whose physical condition has declined to a set level defined by established welfare criteria) represents a feasible method of managing herbivores in the OVP. A management policy that fulfills an acceptable standard of animal welfare would need to include the culling or removal of animals while they are still standing. It considers that this approach has the advantage that it allows natural processes to determine the number of individuals that need to be culled or removed and minimizes the offtake of healthy individuals. Additional individuals above the condition threshold could be culled to simulate predation, if desired.

2.4 ICMO considers that *artificial control of reproduction* would involve substantial intervention, and that it would be difficult to treat enough individuals to achieve significant reduction in recruitment. There are also significant welfare problems related to the risk of traumatic injuries during handling and treatment as well as to the modification of natural cycles of reproduction and fat deposition and utilization (Putman, 1997).

As a result, ICMO does not support attempts to control population numbers through artificial control of reproductive rate.

While ICMO considers that either a proactive or a reactive approach to managing herbivore populations could fulfill the criteria for managing the OVP, it accepts that a reactive policy has some advantages and believes that this strategy most closely accords with public opinion (Dierenbescherming, 2006; Stassen, 2006; Stichting Recreatie, Kennis en Innovatiecentrum, 2005; Vereniging Natuurmonumenten, 2000; Wouters, 2006).

ICMO recommends that a reactive policy is 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. Since these situations are most likely to occur during winter months (February – mid April), ICMO recommends that the entire population is monitored on a daily basis during this period and that the State Forest Service should aim to cull 90% of the animals requiring culling while they are still capable of standing. This will require culling to be earlier than is the current practice.



3. *Heck cattle* appear to be most susceptible to competition from other grazers and thus to loss of condition, requiring a higher proportion of cattle to be culled on welfare grounds.

ICMO recommends that 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.

4. *Additional measures.*

In addition to the reactive culling of individual animals on welfare grounds, ICMO considers that there are additional measures which may improve animal welfare and reduce winter mortality:

- the establishment of enclosures within OVP to increase cover/shelter;
- the provision of additional reserve areas;
- development of an ecological corridor linking OVP to other reserve areas;
- supplementary winter feeding.

- 4.1 *Enclosures.* ICMO considers that the lack of shelter in the OVP represents a welfare problem for all species and particularly cattle and

recommends that woody vegetation be encouraged in permanent enclosures on the periphery of the reserve to provide wind breaks for the animals.



4.2 *Additional reserve area.* ICMO considers that inclusion of the Hollandse Hout into the OVP would increase the carrying capacity of the reserve, as it would increase its size considerably. However there are potential problems implicit in significantly changing the balance between available area of winter and summer habitat within the OVP. Increasing the area of winter habitat might also lead to increased herbivore populations and might impose greater pressure on areas of summer habitat (wetlands), potentially causing potential conflicts with delivery of OVP's wetland bird objectives.

In view of the complexity of the ecological and welfare issues, ICMO proposes that the Director of the State Forest Service conduct a thorough investigation of the likely effects of inclusion of the Hollandse Hout on a permanent basis. Meanwhile the Hollandse Hout should be used as a reserve pasture and shelter area for all three species during bad winters or at other critical times when the animals would benefit from extra forage or shelter.

- 4.3 *Ecological corridor.* In ICMO's view, the linkage between OVP and Horsterwold is the first step to the corridor linking OVP to the Veluwe. Opening the corridor will provide the herbivores with additional resources and shelter (and also the possibility for further migration) and is likely to lead to reduced mortality in the immediate future.

ICMO recommends that the ecological corridor to the Horsterwold is accomplished as soon as possible and opened to *all three species*.



- 4.4 *Supplementary feeding.* ICMO has reviewed arguments for and against provision of artificial supplementary feeding over winter (Raad voor het Landelijk Gebied, 2005; Raad voor Dieraangelegenheden, 2005; Dierenbescherming, 2006) and considers that to be effective, supplementary feeding must be prophylactic and not reactive. If offered only when conditions are extreme, or when animal condition is already poor, feeding will have little beneficial effect on welfare. Effective prophylactic feeding would represent a significant intervention in the dynamics of the system and would lead to continued growth in herbivore populations which would conflict with nature conservation objectives for OVP.

ICMO therefore does not recommend artificial supplementary feeding.

5. *Monitoring and evaluation*

- 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.

- 5.2 ICMO recommends that an improved system of environmental monitoring is instigated, 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 modeling to identify current processes, predict future trends and set thresholds to acceptable change

(Rogers 2003, Biggs & Rogers 2003), see also recommendation 7. In order to achieve this it may be necessary to recruit additional scientific support or to organize contract with relevant institutions as well as provide the funds necessary to do this. The data collected need to be available to interested bodies. ICMO considers that the organization of an adequate monitoring system is outside its current remit and suggest that an expert group is convened to advice on its design, structure and implementation.

- 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.

6. *Communication with the public*

ICMO considers that improved communication is needed to inform the public about the management strategy and the rationale underlying it. Large herbivore management should be set in the context of current understanding of population dynamics in other wild animals.

ICMO recommends that a communication expert be assigned to plan and execute this objective.



7. *Scientific basis*

Given the great opportunities to deepen knowledge of ecological, behavioural and sociological interactions by research in the OVP,

ICMO recommends that the State Forest Service obtain scientific guidance with a view to identifying the key research opportunities presented by the OVP. ICMO recommends that previous modeling work (Groot Bruinderink et al., 1999) 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.

Models should also be used to assess the consequences of alternative management strategies, the possible effects of management efforts designed to add missing ecological components such as predation to the system, and the consequences of climate variability on its extent and frequency of population crashes in the herbivores.

8. *Implementation*

ICMO recommends that the Minister charges the Director of the State Forest Service 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.



4. Answers to the Minister's questions

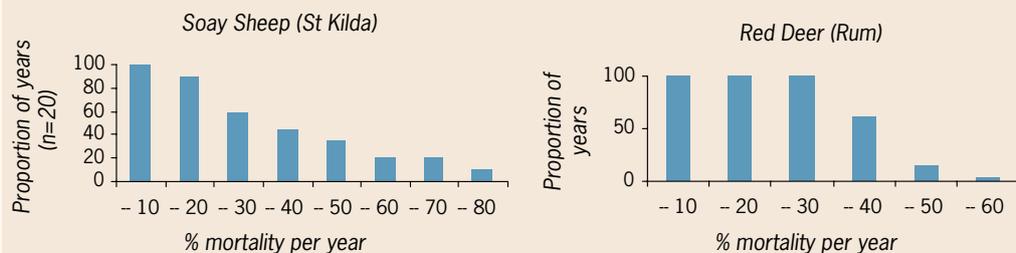
Question 1.

Is it possible to maintain a resilient, self sustaining ecosystem including large herbivores in the Oostvaardersplassen nature reserve, which is acceptable in terms of animal welfare?

ICMO concludes that it is possible to maintain a resilient self sustaining ecosystem within the present boundaries of the OVP. Populations of large herbivores will be regulated by the carrying capacity of the area (Gaillard et al., 1998, Coughenour and Singer 1995), their numbers fluctuating over time in relation to variation in resource availability and natural mortality. Spatial and temporal heterogeneity is likely to contribute to the stability of the system (Holling 1973, Holling and Meffe 1995, Rogers 2003, Biggs and Rogers 2003, Biggs 2003). In some years mortality of up to 50% can be expected. Systems of this kind currently exist on several islands similar in size to the OVP, e.g. Red deer on Rum, Scotland, Soay sheep on St Kilda, Scotland, reindeer on South Georgia and feral sheep on the Kerguelen Islands (Sub Antarctic) (Clutton-Brock et al., 1987, 1996, 2002, 2004). Analysis of mortality levels in these populations shows that mortality observed in OVP in 2005 was not exceptional (see text box).

Mortality levels in comparable systems

A number of ungulate populations are maintained with no predators and minimal management. Some of the best known examples include reindeer on South Georgia, some populations of white-tailed and mule deer, red deer on Rum (Scotland) and Soay sheep on St Kilda (Scotland).



The attached plots show the proportion of years when mortality of Soay sheep on St Kilda and red deer on Rum reached different levels. Mortality is measured for all individuals from September to September so does not include neonatal mortality. These plots show that the mortality levels observed in OVP in 2005 are not exceptional: annual mortality exceeding 30% occurs in over 40% of years in both populations. In Soay sheep, mortality levels exceeding 50% occur in one year in five while in the deer they occur around one year in six. Comparison with mortality figures for a wider range of herbivore populations compiled by Young (1994) and Erb and Boyce (1999) shows that the distribution of mortality over 11 years in the OVP (Fig. 2) is at the lower end of the observed levels of die-offs in natural plant-herbivore systems. Their records show that 25% of the observed annual die-offs (Fig.1) were greater than 50% of the population, and 48% of the observed annual declines exceeded 30% of the population (Fig. 1d). Only one annual die-off of the 33 recorded in OVP was greater than 30% (for Heck Cattle in 2005). However, populations in the OVP were below carrying capacity of much of this time, which means that higher mortalities may occur more frequently in the years to come.

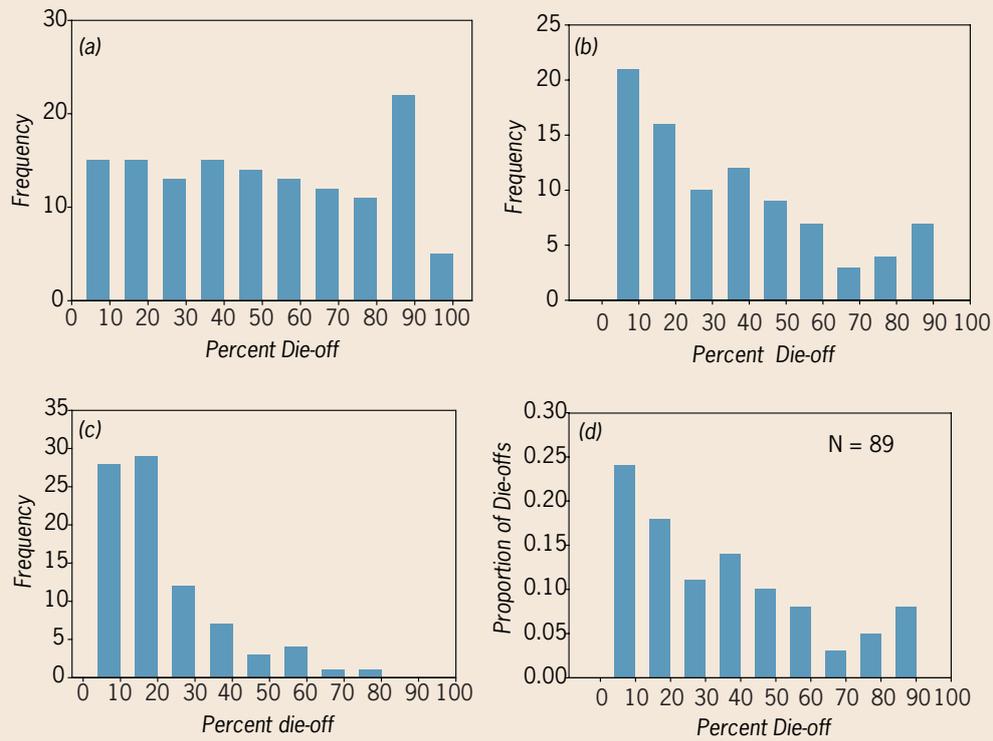


Fig. 1. Distributions of reported die-offs, (a) Distributions reported by Young (1994) corrected by Erb and Boyce (1999) and including die-offs of less than 25%, (b) Distribution of annual die-offs (Erb and Boyce 1999), (c) Distribution of annual declines of large mammals from six time series of abundances, (d) Proportion of die-offs calculated from data in (b) showing that 24% of recorded die-offs exceeded 50%. Data include primates (9 populations), carnivores (17 populations), and 27 species of large herbivores (66 populations) on four continents ranging from African elephants, zebras, warthogs and antelope, to bison, bighorn sheep, musk oxen, and kangaroos".

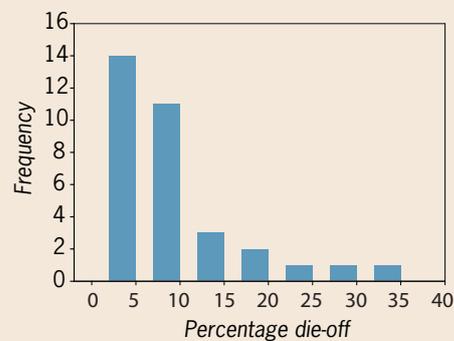


Fig. 2. Distribution of annual die-offs of Red Deer, Konik Horses, and Heck Cattle in Oostvaardersplassen from 1995 to 2005. (N =33)

Question 2.

If so (a self sustaining ecosystem including large herbivores is possible and acceptable in terms of animal welfare: red), what conditions would have to be in place?

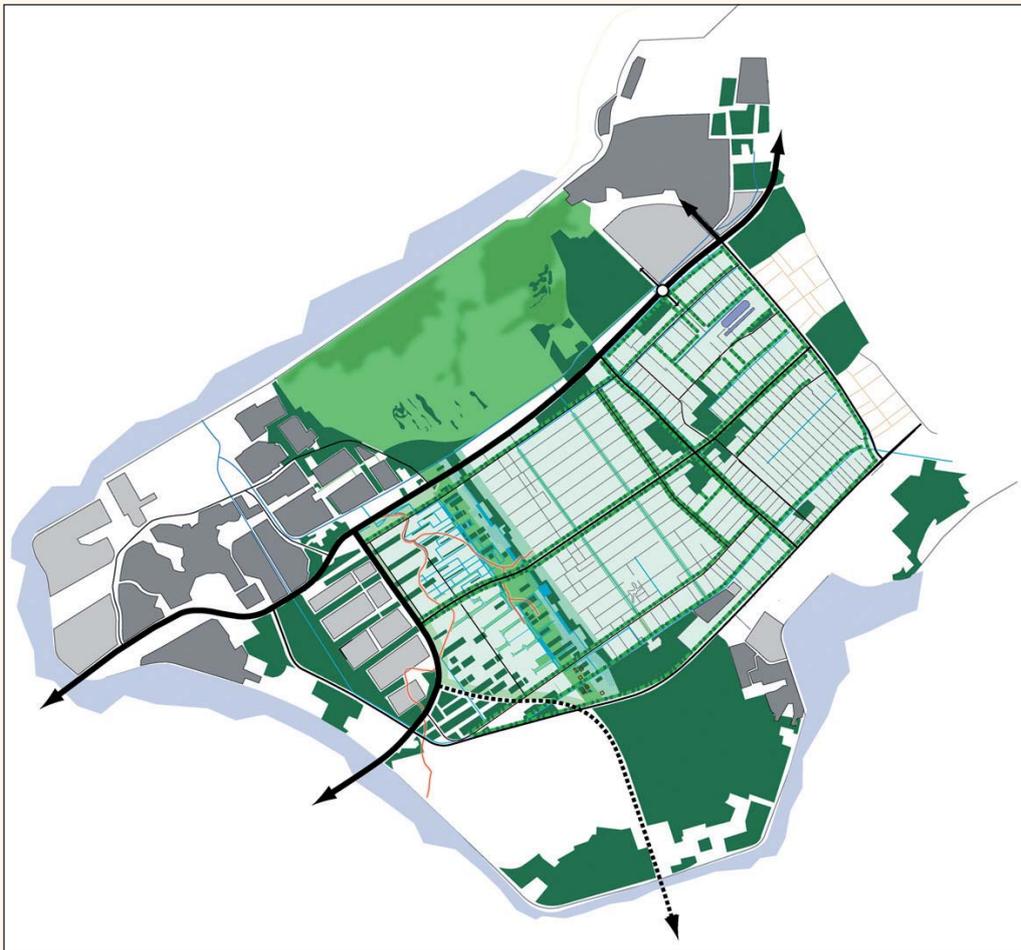
To meet acceptable welfare criteria and minimize the number of individuals dying from starvation, there either needs to be proactive cull that aims to reduce autumn numbers to within the winter carrying capacity of the OVP, or individual animals falling below an established condition threshold in late winter need to be culled while they are still standing on a daily basis. Additional measures to ensure adequate welfare criteria are met are needed (recommendation 4). These include permanent exclosures to provide windbreaks and access to the Hollandse Hout in critical periods.



Question 3.

What impact would an ecological corridor between the Oostvaardersplassen and the Veluwe nature reserves have on the Oostvaardersplassen ecosystem and, in particular, on the populations of Konik horses, Heck cattle and Red deer?

Creation of an ecological corridor will have benefits for all three herbivore species, and will also increase the diversity of habitat with potential benefits to the stability of the system. In ICMO's view the linkage between OVP and Horsterwold is the first step in the establishment of a corridor linking OVP to the Veluwe. The link to the Horsterwold needs to be accomplished as soon as possible. ICMO recommends that the ecological corridor is opened to all three species. Opening the corridor will provide them with additional resources and shelter (and also the possibility for further emigration) and is likely to lead to reduced mortality.



5. Summary of recommendations

1. ICMO recommends that a detailed statement of management objectives in the OVP is developed and published during 2006. This should include the specific objectives of management for important bird populations, and their habitats including upper and lower limits of numbers for each species, identified in the Natura2000 document.
2. ICMO recommends that a reactive policy is 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. Since these situations are most likely to occur during winter months (February – mid April), ICMO recommends that the entire population is monitored on a daily basis during this period and that the State Forest Service should aim to cull 90% of the animals requiring culling while they are still capable of standing. This will require culling to be earlier than is the current practice.
3. ICMO recommends that if resource competition between horses, deer and cattle eventually leads to a reduction in the number of cattle, or even the loss of all cattle from the OVP system, this should be accepted as a natural outcome.
4. *Additional measures.*
 - 4.1 ICMO considers that the lack of shelter in the OVP represents a welfare problem for all species and recommends that woody vegetation be encouraged in permanent enclosures on the periphery of the reserve to provide wind breaks for the animals.
 - 4.2 In view of the complexity of the ecological and welfare issues, ICMO proposes that the Director of the State Forest Service conduct a thorough investigation of the likely effects of inclusion of the Hollandse Hout on a permanent basis. Meanwhile the Hollandse Hout should be used as a reserve pasture and shelter area for all three species during bad winters or at other critical times when the animals would benefit from extra forage or shelter.
 - 4.3 ICMO recommends that the ecological corridor to the Horsterwold is accomplished as soon as possible and opened to *all three species*.
 - 4.4 ICMO does not recommend artificial control of reproduction or artificial supplementary feeding for herbivore populations.

5. *Monitoring and evaluation*

- 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.
 - 5.2 ICMO recommends that an improved system of environmental monitoring is instigated, 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 modeling to identify current processes, predict future trends and set thresholds to acceptable change.
 - 5.3 The committee 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.
6. ICMO recommends that a communication expert be assigned to plan and execute the objective to inform the public about the management strategy and the rationale underlying it.
 7. ICMO recommends that the State Forest Service obtain scientific guidance with a view to identifying the key research opportunities presented by the OVP. ICMO recommends that previous modelling work 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.
 8. ICMO recommends that the Minister charges the Director of the State Forest Service with personal responsibility to implement the recommendations above. This will include definition of strategic goals, provision of resources, development of a formal management plan, and publication of yearly progress reports against defined targets.

References

- Biggs, H. C. (2003) Integration of science: successes, challenges, and the future. Pp. 469-487, In: Du Toit, J. T., Rogers K. H. and Biggs, H. C. *The Kruger Experience: Ecology and management of savanna heterogeneity*. Island Press, Washington D.C.
- Biggs, H. C., Rogers K. H. (2003) An adaptive system to link science, monitoring and management. Pp. 59-80, In: Du Toit, J. T., Rogers K. H. and Biggs, H. C. *The Kruger Experience: Ecology and management of savanna heterogeneity*. Island Press Washington D.C.
- Caughley, G. (1994) Directions in conservation biology. *Journal of Animal Ecology* 63:215-244.
- Clutton-Brock, T. H., Major, M., Albon, S. D. & Guinness, F. E. (1987) Early development and population dynamics in red deer: I. Density-dependent effects on juvenile survival. *Journal of Animal Ecology* 56: 53-67.
- Clutton-Brock, T. H., Stevenson, I. R., Marrow, P., McColl, A. D. C., Houston, A. I. & McNamara, J. M. (1996) Population fluctuations, reproductive costs and life-history tactics in female Soay sheep. *Journal of Animal Ecology* 65: 675-689.
- Clutton-Brock, T. H., Coulson, T. N., Milner Gulland, E. J., Thomson, D. & Armstrong, H. M. (2002) Sex differences in emigration and mortality affect optimal management of deer populations. *Nature* 415: 633-637.
- Clutton-Brock, T. H. & Pemberton, J. M. (2004) *Soay sheep : dynamics and selection in an island population*. Cambridge University Press, Cambridge.
- Cumming, D. (2004) Performance of parks in a century of change. pp. 105-124, In Child, B. A. (ed.) *Parks in transition: biodiversity, rural development and the bottom line*. Earthscan, London.
- Cumming, D. (2005) Elephantine dilemmas. *Quest* 1(4): 14-17.
- Cumming, D. Jones, B. (2005) *Elephants in southern Africa: management issues and options*. WWF-SARPO Occasional Paper No. 11. 100 pp. WWF-Southern African Regional Programme Office, Harare.
- Dierenbescherming (2006). Statement on wild animals. In: website www.dierenbescherming.nl, May 2006.
- Erb, J. D. and Boyce, M. S. (1999) Distribution of population declines in large mammals. *Conservation Biology* 13:199-201.
- Fraser, D., D.M. Weary, E.A. Pajor and B.W. Milligan (1997) A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare* 6(3): 187-205.
- Gaillard, J. M., Festa-Bianchet, M. & Yoccoz, N. G. (1998) Population dynamics of large herbivores: variable recruitment with constant adult survival. *Trends in Ecology and Evolution* 13: 58-63.
- Gill, E.L. (1991) Factors affecting Body condition in Free-ranging ponies. Technical Report, Royal Society for the Prevention of Cruelty to Animals. as summarised in: Putman R.J. (1996) *Competition and Resource Partitioning in Temperate Ungulate Assemblies*. Chapman and Hall, London.
- Groot Bruinderink, G.W.T.A.; Baveco, J.M.; Kramer, K.; Kuiters, A.T.; Lammertsma, D.R.; Wijdeven, S.; Cornelissen, P.; Vulink, J.T.; Prins, H.H.T.; Wieren, S.E. van; Roder, F. and Wigbels, V. (1999) *Dynamische interacties tussen hoefdieren en vegetatie in de Oostvaardersplassen*. Wageningen : IBN-DLO, 1999 - p. 132.

- Holling, C. S. (1973) Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4: 1-23.
- Holling C. S. & Meffe, G. K. (1996) Command and control and the pathology of natural resource management. *Conservation Biology* 10: 328-337.
- Putman R.J. and Langbein J. (1990) Factors affecting performance of deer in parks. Contract Report PECD 7/2/65 to Department of Environment. 86pp. 40 figs/tabs.
- Putman, R.J., and Langbein, J. (1992) Effects of disturbance on behaviour and performance of red and fallow deer in recreational areas. *Animal Welfare* 1: 19-38.
- Putman R.J. and Langbein J. (1992) Effects of stocking density, feeding and herd management on mortality of park deer. Pp 180-188 in, Brown, R. (ed.) *Biology of Deer*, Springer-Verlag; New York.
- Putman, R.J. (1997) Chemical and Immunological Methods in the Control of Reproduction in Deer and other Wildlife: Potential for Population Control and Welfare Implications, RSPCA Technical Bulletin Royal Society for the Prevention of Cruelty to Animals, Horsham, 50 p.
- Putman, R.J. and Staines, B.W. (2004) Supplementary winter feeding of wild red deer *Cervus elaphus* in Europe and North America: justifications, feeding practice and effectiveness. *Mammal Review* 34: 285-3.
- Putman R.J. (2004) *The Deer Manager's Companion: A Guide to Deer Management in the wild and in parks*. Swan Hill Press ISBN 1-904057-03-9.
- Raad voor Dierenaangelegenheden (2005) Advies over de wintersterfte 2004-2005 van grote grazers in de Oostvaardersplassen. Briefadvies van 18 augustus 2005 van de Raad voor Dieraangelegenheden.
- Raad voor het Landelijk Gebied (2005) De wintersterfte 2004-2005 van grote grazers in de Oostvaardersplassen. Briefadvies van 14 juni 2005 van de Raad voor Dierenaangelegenheden en de Raad voor het Landelijk Gebied.
- Rogers, K. H. (2003) Adopting a heterogeneity paradigm: implications for management of protected areas. Pp. 41-58, In: Du Toit, J. T., Rogers K. H. and Biggs, H. C. *The Kruger Experience: Ecology and management of savanna heterogeneity*. Island Press, Washington D.C.
- Stassen, E. (2006) Van bruikbaar tot dierbaar; over de relatie mens-dier. Oratie, Wageningen Universiteit, 8 juni 2006.
- Stichting Recreatie, Kennis en Innovatiecentrum (2005) *Recreatie in de Oostvaardersplassen – Aanbod, gebruik, waardering en beleving*. Report, Den Haag, 92p.
- Vereniging Natuurmonumenten (2000) *De omgang met dieren. Richtlijnen voor het verantwoord omgaan met dieren*. Nota, 24p. 's-Graveland.
- Young, T. P. (1994) Natural die-offs of large mammals: implications for conservation. *Conservation Biology* 8:410-418.
- Wouters, M. (2006) *Beheer Oostvaardersplassen*. Nota Gemeente Almere, Stafdienst Bestuurs- en Beleidscoördinatie, 10p.

Colofon

Date:	June 2006
Authors:	International Committee on the Management of large herbivores in the Oostvaardersplassen
Production:	WING Proces Consultancy P.O. box 47, 6700 AA Wageningen
Assigned by:	Dutch Ministry of Agriculture, Nature and Food Quality
Design:	Communication Services, Lelystad
Photography:	Martijn de Jonge Vincent L. Wigbels Rob Messelink Dzsingisz Gabor
Cartography:	Staatsbosbeheer
Print:	Drukkerij Cabri Lelystad
ISSN 1572 - 4611	WING rapport 018
ISBN	9032703528

The digital version of this report and further information are available at <http://www.wing.wur.nl/icmo>.

