Scientific Council of the Bonn Convention
13th Meeting, 18 November 2005

BRIEFING DOCUMENTS

1. Background document for Science Council consideration

New Action Plan for the Lesser White-fronted Goose, *Anser erythropus;* **issues unresolved for which advice is being asked from the Scientific Council of the Bonn Convention**

Introduction and background

The Lesser White-fronted Goose *Anser erythropus* is one the smallest of the 'true geese' in the genera *Anser* and *Branta*. The species is globally threatened, being recognised as Vulnerable by IUCN – The World Conservation Union (IUCN, 2004), and ranked by BirdLife International as 'SPEC 1' within Europe, denoting a European species of global conservation concern (BirdLife International, 2004). It is listed on Annex 1 of the European Union Birds Directive (79/409/EEC), in Appendix I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), in Column A of the Action Plan under the African-Eurasian Migratory Waterbird Agreement (AEWA) and in Annex II 'Strictly protected species' of the Bern Convention.
Lesser White-fronted Geese are long-distance Palearctic migrants, currently breeding discontinuously in the sub-arctic zone from northern Fennoscandia to eastern Siberia. The wintering/staging areas and migration routes are only partially known (see map in draft Action Plan)

Four subpopulations can be recognised, three of which are considered to be surviving components of the species' formerly more extensive breeding range. The fourth subpopulation, in Sweden, has been developed by the release of captive-bred birds and establishment of a human-modified flyway to the Netherlands. The three wild subpopulations have all shown dramatic declines in recent decades and continue to decrease rapidly, due primarily to hunting pressure and habitat loss. The reintroduced Swedish population is increasing slowly and shows high adult survival rates, but expert views differ markedly in relation to the ethical and particularly scientific merits of captive breeding, reintroduction and flyway manipulation as conservation tools.

The 1996 International Action Plan prepared for BirdLife International on behalf of the European Commission (Madsen 1996) is outdated. Under the auspices of AEWA a revision process has started on a contractual basis with BirdLife International in co-operation with some independent experts (Mr. Tim Jones and Dr. Gerard C. Boere).
It was known that within the group of experts involved in the activities related to the conservation of the species, strong differences in view exist on various activities planned to be undertaken in the near future. These differences concern in particular the genetic aspects of captive and released birds, further modifying flyways and further re-stocking and re-introduction of birds and are geographically in fact restricted to the wild Fennoscandian subpopulation and reintroduced Swedish subpopulation.

International meetings focusing on the conservation of the species have been held regularly, most recently in Odessa, Ukraine (March 2004), Edinburgh, UK (April 2004) and most importantly the recent meeting in Lammi, Finland (April 2005) with all relevant people present (over 50 participants). The technical presentations and discussions at these meetings have been drawn on in preparing the new draft Action Plan.

The discussions in Lammi made clear that probably no consensus can be reached on some important issues to be dealt with in the new Action Plan. Also the amount of comments by the

Lammi workshop participants on the new draft Action Plan, circulated soon after the workshop, did not lead to a consensus position on most of the controversial issues in relation to specifically the Fennoscandian population.

To avoid misunderstanding it must be stated that there is a very high degree of consensus on the causes of the decline and it is the wide spread unsustainable (and often illegal) hunting during migration and in the wintering areas that is the most critical threat factor. This was the main reason for the Swedish initiative in the eighties (Mr. Lambert von Essen c.s.) to establish a new safe flyway to Western Europe, notably the Netherlands; where the species is not hunted during migration and wintering.

At the Lammi workshop, (Finland, 1-2 April 2005), at the suggestion by BirdLife c.s., participants agreed to request the opinion of the Scientific Council of the Bonn Convention on these controversial issues and seriously take into account the advice of the Scientific Council in guiding their future actions.

The Scientific Council has previously been involved in the matter during its session in September 2002 in Germany, on the basis of an overview report from WCMC and oral presentations.
Pending the advice of the Scientific Council, the Action Plan has not been finalised but the issues on which no consensus could be reached have been placed in square brackets.

With this cover note formulating the precise questions, we also submit the new draft Action Plan which includes further comments and information from the participants of the Lammi workshop as appropriate and a number of publications and scientific papers focussing on the controversial issues.
An interesting element in the discussion is a recent ruling by the Council of State of the Netherlands (which includes the Highest Administrative Court; their ruling is binding for everybody including the Government) of March and December 2004, obliging the Dutch Minister of Agriculture, Nature and Food Quality to issue a study for the establishment of NATURA 2000 sites for the Swedish re-introduced population which winters in the Netherlands. The Council of State considers the birds as Lesser White-fronted Geese and sees their protection as part of the binding EU Bird Directive, regardless of their origin or genetic profile of which the Council of State was aware. Their ruling is also based on a case decided by the EU Court in Luxembourg as is clear from the following citation:
"It follows from the case law of the Court referred to above that Article 4(1) of the Birds Directive does not allow the Member States to make a policy decision to the effect that no Special Protection Areas should be designated for the lesser white-fronted goose. That provision does not allow for a distinction to be made according to the level of genetic purity of the birds concerned. Nor can the alteration by human intervention of the migratory route of the lesser white-fronted goose constitute a reason not to designate an SPA for that species".

However, they did not consider the possible implications of genetic contamination of the reintroduced population. It is there were the advice of the Scientific Council could also be helpful.

The synthesis report on the Lesser White fronted Goose as prepared for the Scientific Council of the Convention on Migratory Species (UNEP/WCMC 2002/final version 2003) is still a valuable background document. An extremely well documented internet portal www.piskulka.net provides regularly updated news, links and literature references (with down-loadable PDF files) for all matters concerning Lesser White-fronted Geese.

Specific issues and questions

Background
Genetic studies have shown that some individuals within the captive breeding populations used for the Finnish and Swedish reintroduction/restocking programmes are carrying DNA of other goose species, notably Greater White-fronted Goose but probably also Greylag Goose. It is

concluded that this arose through hybridisation in captivity as so far no introgression has been found in the wild population. There is a risk that released birds in Sweden, carrying DNA from other goose species could pair and breed with birds from the wild Fennoscandian population and that, given the Fennoscandian and Central Asian populations partially overlap outside the breeding season, contamination of the Central Asian birds could also occur. There is not a full consensus among Lesser White-fronted Goose stakeholders concerning the significance of this risk in practice. Nevertheless, further releases in Sweden of captive-bred birds are formally suspended since 1999 (though a few Lesser White-fronts were released in Finland in 2004). The expert workshop held in Lammi, Finland in March/April 2005, agreed that any future releases, if at all, should only be based on a genetically 'clean' new stock derived from birds from the wild.

The Swedish authorities are currently negotiating with Russian counterparts to try to obtain wild birds to build up a new captive-bred population from which future releases can be made. Plans exist also in Germany on a similar project, including birds already held in captivity.
Some experts believe that the established free-flying, reintroduced Swedish population (reproducing now without any human interference) should be caught and taken back into captivity or eliminated in full. There is no consensus on this point and the Swedish authorities among others, argue that the free-flying reintroduced population should be maintained. This position is reinforced by a recent decision of the Council of State's High Administrative Court in The Netherlands, ruling that a survey should be undertaken to establish Special Protection Areas for wintering birds from the reintroduced Swedish population (see details in your documentation).

The IUCN Guidelines for Reintroductions, issued in 1995 by the IUCN Species Survival Commission (SSC), have no formal legal status but are generally regarded as the most authoritative internationally published guidance on species reintroductions. While conformity with the IUCN Guidelines has often been cited by both proponents and opponents of Lesser White-fronted Goose reintroduction initiatives, the guidance actually doesn't extend to the more controversial aspects of the Lesser White-front programmes, namely the possible intro-regression of alien DNA into the wild population and modification of flyways.
The guidelines provide guidance on genetic issues in general:

- *"An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct"*
- *Choice of release site and type: Site should be within the historic range of the species. For an initial re-enforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes.*
- *" It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population. (4th bullet point.). If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology".*

However the underlying case may be already too complicated to easily follow the guidelines. To mention:

- the wild population is now almost extinct in Finland and Sweden
- the remaining Norwegian population is extremely small and almost certainly too small to be the basis of a new captive stock.

- There is already a free-living population from a previous re-introduction (re-stocking may be if some wild birds may have still been around in Sweden) with genetic material causing concern on the one hand (pollution with genes from GWfG) but containing at the same time to a very large extend the original genetic material from the Fennoscandian population.

The activities under discussion relate directly to the following countries: Finland, Netherlands, Norway, Russian Federation (most likely source of any future wild-caught breeding stock), Sweden and Germany.

Key issues, options and alternatives to be decided on for the new Action Plan.
There are three key issues on which expert opinion is currently divided. Under each heading, three/four possible questions/options/alternatives are presented related to these key issues.
For each of them these roughly equate to (i) continuation with little or no change from the situation prior to the voluntary moratorium on releases; (ii) continuation subject to implementation of additional safeguards; (iii) permanent suspension.

Captive breeding options and alternatives

- Captive-breeding and reintroduction/restocking resumes, using the existing stocks in Finland and Sweden which have been tested on their genetic origin to avoid releasing birds with alien genes. This is challenged by some genetic experts mentioning that nuclear DNA from other species cannot be detected. Germany has not yet started its planned captive breeding program but there are many birds in captivity.
- Captive-breeding continues in a new way, but using only genetically 'pure' birds derived from wild-caught stock (adults young, eggs). Given the size of the existing wild population in Fennoscandia the birds for this programme have to be taken from the Russian populations. No decision has been taken who would be responsible, where it should take place and who pays for the costs.
- Reintroduction takes only place when the Fennoscandian population is gone extinct. A problem might be: who determines that moment given remoteness of the breeding areas and uncertainties of the presence of scattered wild breeding pairs in Sweden and Finland. No re-stocking as long as there are wild birds left in Fennoscandia.
- Captive-breeding and reintroduction/restocking is permanently suspended; also when the Fennoscandian population goes extinct.

Free-flying reintroduced population options and alternatives

- The existing reintroduced Swedish/Dutch population continues to be free-flying, and is allowed to evolve without further human intervention; but see the problem formulated below on a possible interbreeding with the existing very small wild Fennoscandian, presently mainly Norwegian, population.
- Possible additional releases from present captives stocks, only if released birds are proven to be genetically 'clean'. This is challenged as a possibility for reasons that alien genes in nuclear-DNA cannot be detected.
- Possible additional releases, only if released birds are genetically 'clean' and come from the new breeding stock derived from wild birds; this approach will take at least 5-8 years (not to mention costs involved..!) and as a consequence the moratorium for releases from the present stocks should continue.
- The existing reintroduced Swedish/Dutch population is captured, individuals are genetically screened and any birds deemed likely to pose a risk of introgression of alien DNA into the wild population are removed; the remaining birds are released again (though some genetics experts insist that the best-available technology still does not provide 100% guarantee that all genetically 'contaminated' birds can be identified.
- The existing reintroduced Swedish/Dutch population is removed from the wild in its entirety to avoid any risk on genetic aspects to the existing small wild population.

Flyway modifications options and alternatives

- Initiatives for the creation of new human-modified 'safe' flyways continue exactly as at present. This concerns the present Swedish population and plans for an additional flyway from northern Sweden/Finland to Germany, using ultra-light aircraft techniques to guide the birds. Finland, Norway and Sweden have so far rejected to support the German plans using ultra lights in the light of the present discussions on genetics etc. Sweden has, on the longer term, no objections however only from the point of view of the principle as such and is not against a pilot project; provided other countries along this route agree as well. The proposed new wintering area, the Lower Rhine Delta, is not regularly used by wild Lesser White-fronts, though the species stages annually in small numbers in the eastern part of the country.
- Initiatives for the creation of new human-modified 'safe' flyways continue, subject to the implementation of additional measures advised by the Bonn Scientific Council;
- Initiatives for the creation of additional flyways are completely abandoned.

Specific questions for the Scientific Council of the Bonn Convention

The above describes the various options and alternatives possible, presently most relevant for the Fennoscandian population but population elsewhere decline as well and may be faced in the near future with similar problems and discussions.

Below a number of more generic and fundamental questions which in fact needs to be answered before choices can be made from the options and alternatives for the three main issues under debate.

- Does each of the existing and planned reintroduction/restocking and flyway modification initiatives for Lesser White-fronted Goose fully implement current international best-practice standards and guidelines? Is there experience elsewhere in the world on similar cases?
- Although carriers of alien genes were screened in present captive stocks using best available techniques and scientific methods, some genetic experts argue that only female carriers can be identified through mtDNA analysis but carrier males not. What further measures are needed to certainly exclude carriers of alien genes from breeding stocks?
- Does the presence of genetic material from other goose species in the present captive-breeding stock, if still present in spite of the above cleaning process, represent a tangible threat to wild Lesser White-fronted Geese if birds are released and in what sense? If so, what measures must be taken?
- Does the highly likely presence of genetic material from other goose species in the present free-flying reintroduced population represent a tangible threat to wild Lesser White-fronted Geese? If so, what measures must be taken additional to the fact that no other birds have been released since 1999 and that the present population of about 100 birds wintering in the Netherlands, contains already birds born in the wild? This issue is a particular concern of the Norwegian Government that the remaining very small wild population may interbreed with the Swedish free flying population which probably still contains a number of birds with alien genes.
- Could reintroduction/restocking and flyway modification continue in the future as an integral element of the international conservation Action Plan for Lesser White-fronted Goose in particular as a pre-cautionary conservation measure for the almost extinct Fennoscandian population? This is only under the condition that all released birds are from a captive stock newly set up with birds taken from the wild and with the appropriate taxonomic status.
- If flyway modification continues what methods should be preferred: foster parents (as used in the Swedish project) or ultra-light airplanes as used e.g. in the USA and proposed for the German initiative?
- What is the opinion of the Scientific Council on the genetic consequences of restocking with birds from the western Russian population? Does the Fennoscandian population represent a

unique genetic characteristics or the difference in haplotype is only the result of recent isolation? Does the restocking with birds from Russia present any tangible risk to the existing population, notably the small Norwegian breeding population? Should it wait until the existing population goes extinct?

2. Comments Received

2.1 Summary of responses received on the International Single Species Action Plan (SSAP) for the LWfG, first draft [May 2005]

Date	Respondent
17.05.05	Luba Balyan, for Armenian Society for Protection of Birds
18.05.05	Seppo Vuolanto on behalf of Finnish Ministry of Environment
19.05.05	Baz Hughes on behalf of Wildfowl & Wetlands Trust, UK
22.05.05	Sergey Yerokhov/Kazakhstan
23.05.05	Åke Andersson, on behalf of Swedish reintroduction project
26.05.05	Torsten Larsson, on behalf of Swedish Nature Protection Agency
26.05.05	Marie Björkland, on behalf of County Administrative Board of Norrbotten, Sweden
29.05.05	Elena Kreuzberg/Uzbekistan
31.05.05	Juha Merilä (also on behalf of Petteri Tolvanen, Petri Lampila and Sami Timonen), Finnish LWfG Conservation Project
31.05.05	Lauri Kahanpää, Friends of LWfG, Finland (also including inputs from Anti Haapanen and Martti Soikkeli)
31.05.05	Doris Eberhardt for Friends of the Earth, Germany (comments compiled by Johan Mooij, Aktion Zwerggans; same document also sent through by Johan Mooij 31.05)
31.05.05	Szabolcs Lengyel/Hungary (Univ. of Debrecen)
31.05.05	Vladimir Morozov/Russia
31.05.05	Tomas Aarvak, LWfG Conservation Project Norway
01.06.05	Minna Ruokonen, University of Oulu, Finland
01.06.05	Morten Ekker, Directorate for Nature Management, Norway
01.06.05	Ingar Øien & Tomas Aarvak, on behalf of Norwegian LWfG project/BirdLife Norway
01.06.05	Per Hansson, on behalf of Regional Ornithological Society of Västerbotten, Sweden
01.06.05	Maire Toming, on behalf of LWfG Working Group Coordinator, Estonia
01.06.05	Teemu Lehtiniemi, on behalf of BirdLife Finland
01.06.05	Juha Markkola, Finland
02.06.05	Sergey Dereliev, AEWA Secretariat

2.2 List of comments and presentations received by the CMS Secretariat relevant to 'unresolved issues' from the SSAP

Comments from Dr. Johan H. Mooij on the Scientific Council paper ScC.13/ Doc.9

Comments from Prof. Dr. Juha Merila, Petteri Tolvanen, and Dr. Minna Ruokonen on the Scientific Council paper ScC.13/ Doc.9

Comments from Morten Ekker, Dr. Ingar J. Oien, and Tomas Aarvak on the Scientific Council paper ScC.13/ Doc.9

Information on the conservation genetics of the Lesser White-fronted Goose by Dr. Minna Ruokonen and Anna-Carin Andersson

Ruokonen, M., L. Kvist, H. Tegelgtrom & J. Lumme (2000). Goose hybrids, captive breeding and restocking of the Fennoscandian populations of the Lesser White-fronted Goose (*Anser erythropus*). Conservation Genetics 1: 277-283.

Ruokonen, M., L. Kvist, T. Aarvak, J. Markkola, V. Morozov, I. J. Oien, E. Syroechkovsky Jr., P.

Tolvanen & J. Lumme (2004). Population genetic structure and conservation of the Lesser White-fronted Goose (*Anser erythropus*). Conservation Genetics 5: 501-512.

Ruokonen, M., A-C. Andersson & H. Tegelgtrom (manuscript). Using historical captive populations in conservation of currently threatened species. The case of the Lesser White-fronted Goose.

Report 2001/2002: Analyses of the captive populations of the Lesser White-fronted Goose, by Dr. Marina V. Kholodova

Review on the genetics of the Fennoscandian population of the Lesser White-fronted Goose, by Dr. Johan H. Mooij in cooperation with Prof. Dr. Allan Baker and Prof. Dr. Michael Wink

A new migration route for the Lesser White-fronted Goose, presentation by Dr. Johan H. Mooij at the workshop in Lammi, Finland, April 2005.

Protection of genetic biodiversity – conservation and management units with special reference to the Lesser White-fronted Goose, presentation by Prof. Dr. Juha Merila at the workshop in Lammi, Finland, April 2005.

Recommendations for a reintroduction program of Lesser White-fronted Geese *Anser erythropus*: A genetic perspective, information by Prof. Dr. Michael Wink

Comments on the genetic issues related to the new Action Plan for the Lesser White-fronted Goose, independent review by Dr. Robert C. Lacy*

***Additional independent comments by Dr Robert C. Lacy on the genetic issues related to the new Action Plan for the Lesser White-fronted Goose (LWfG), November 2005**

I will preface my remarks by stating that I have not before been involved in any of the discussions or analyses of the LWfG or any related species. My comments below are in response to the set of documents sent to me by Sergey Dereliev of the UNEP/AEWA Secretariat.

It is not clear to me if the primary disagreement about the genetic issues related to conservation actions for the LWfG are due to different opinions about the genetic data and analyses, or to different interpretations of the implications of those data for conservation, or to both the data and the conservation implications. With respect to the data themselves, it seems to me that with the most recent molecular genetic analyses, the genetic characterization of the LWfG is becoming clear (although I expect that some of those involved in the debates may still disagree with parts of my description of the information now available).

The mitochondrial DNA data show that two divergent clusters (each with a primary common type and a number of variants that differ only by one or two mutations of likely recent origin) of mtDNA haplotypes occur in the wild populations of LWfG, and an additional two general types occur in the birds in the captive breeding programs for the LWfG. The two general types (West and East) found in the wild LWfG both exist in all wild populations, but at different frequencies, although some sub-types (slight variants that would represent recent evolutionary changes) of the W and E types are unique to one region or the other. The other two general forms of mtDNA observed in the captive geese have been found to be typical of the Greater White-fronted Goose (GWfG) and the Greylag Goose. The sampling of LWfG from wild populations has been sufficiently extensive so that it is very unlikely that both the typical (E and W) LWfG and the typical GWfG forms of mtDNA are prevalent in the natural populations of LWfG (as could have occurred if both forms persisted in the LWfG from an ancestral population that preceded the evolutionary split between the LWfG and the GWfG). In addition, although the numbers of LWfG in the wild populations has been in decline, the numbers are not so low that it would have been possible that once common mtDNA haplotypes would have been lost from the wild populations but still persisted in non-hybridized captive flocks. Even if the wild populations had lost some mtDNA haplotypes that persisted in captive flocks, it is not plausible that all the types characteristic of the GWfG (and the Greylag Goose) would have been lost – loss of haplotypes from small wild populations would be expected to have been more random. Thus, the mtDNA data do show that the captive stocks of LWfG have been hybridized with two other species.

Mitochondrial DNA are inherited only from the maternal parent, so the data on mtDNA haplotypes can show that hybridization occurred, but not how much occurred. Birds labeled as LWfG would show mtDNA haplotypes characteristic of

other species only if their maternal lineage (mother, grand-mother, etc.) descended from the other species. Breeding between a male GWfG (or a hybrid) and a female LWfG would not be detectable by this method. Variants of nuclear genes can be used to detect ancestry through the paternal side, and can be used to quantify the average amount of genetic ancestry in a hybrid population that descends from each source species. The RAPD technique can reveal species-typical DNA patterns. However, the technique relies on non-specific DNA probes (i.e., sequences of DNA that bind, with uncertain fidelity, to unknown numbers of genes in each species), so that the repeatability and interpretation of those data are often uncertain. For these reasons, most geneticists are willing to use RAPD data to suggest possible patterns, but are unwilling to use them to provide rigorous quantitative estimates of population parameters – such as the degree of divergence between two populations or extent of hybridization in a possibly mixed population.

Microsatellite DNA markers (sections of repeated short sequences of DNA) provide more repeatable and precise estimates of population differences, because – if proper precautions are taken – we can confirm that the variants at each scored locus are simple alleles that follow Mendelian inheritance. The recent work by Ruokonen et al. assessed 10 microsatellite loci – sufficient to document that a number of captive LWfG (including some that had a mtDNA haplotype typical of LWfG) contain evidence of GWfG ancestry. Considering both types of genetic evidence, at least 36% of the captive LWfG that were analyzed were shown to have some hybrid ancestry. The close evolutionary relationship and consequent overlap of nuclear genetic alleles prevented the researchers from quantifying the proportion of GWfG ancestry in the captive stocks, but the above numbers support the view of Ruokonen et al that the present captive stocks are “unsuitable for further reintroductions or supplementation.” Rigorous testing of the mtDNA and microsatellite DNA of captive birds (with, preferably, an increase in the number of microsatellite loci scored) could allow selection of birds in the captive stocks that have low probability of hybrid ancestry, but without at least 3-4 diagnostic nuclear loci (none are yet known) or good pedigree records (apparently not available for the captive stocks), it would not be possible to select a subset of captive birds that exclude all hybrid ancestry.

The combination of mtDNA and nuclear DNA data are now showing a clear pattern of moderate but not strong genetic divergence among wild populations of LWfG. The lack of sharp discontinuities in the allele frequencies and the estimated numbers of migrants that would result in the observed differences in allele frequencies indicate that there is (or recently has been) enough movement of LWfG between eastern, central, and western parts of the species range to have prevented evolutionary divergence and also to have prevented extreme loss of genetic diversity and accumulated inbreeding within any population segment. Thus, the populations do not appear to be genetically isolated to the extent that they would be considered to be evolutionarily significant units or subspecies. The populations may have diverged partially with respect to traits adapted to local conditions, but the genetic mixing makes it unlikely that important adaptive differences have become “fixed” in (i.e., unique to) segments of the species range. Thus, dispersing or translocated *individuals* may have lower fitness because they may more often have genotypes best suited for a different habitat, but each *population* probably still contains the range of genetic variability necessary to adapt to local conditions.

The populations in Fennoscandia appear to have some reduction in genetic variation relative to more eastern populations, but there is not yet evidence of problems arising from inbreeding, and such problems would not be likely to accumulate rapidly, given the evidence for some genetic connections to the larger populations to the east. Thus, it does not seem to me that it is necessary at this time to release individuals in Fennoscandia in order to “rescue” the population from a lack of genetic diversity.

Although I do not think that the evidence suggests a current need to provide genetic rescue of the Fennoscandian population of LWfG, I do not agree with the suggestion that restoration of genetic variation should wait until the Fennoscandian population is extinct. Release of birds from other sources (whether from captive flocks of documented origin or translocations from other wild populations) may shift allele frequencies, but given the genetic closeness of the LWfG populations in different regions it is hard to see how such releases could disrupt local adaptations to the extent that it would damage the prospects for the population. Instead, the effects of such releases would be to restore genetic variants that could have been lost from the small population and to reverse local inbreeding. Moreover, the extent of disruption of any local adaptations would be greatest if the remnant population is allowed to become nearly extinct before genetic management was resumed. Waiting until the local population is extinct would actually ensure that any local adaptations that did exist would be lost, instead of remaining within a more variable gene pool that could continue to adapt to local conditions.

In contrast to the lack of evidence of notable genetic *isolation* of the Fennoscandia population, the extent of divergence of *frequencies* of genetic alleles does indicate that inter-populational dispersal is rare enough that the populations are demographically independent (or nearly so) and should be considered to be separate conservation “management units.”

Thus, the movement of individuals into the Fennoscandia population is not sufficient to provide significant demographic reinforcement of a declining population nor reestablishment of a population following regional extirpation. This is especially so if, as suggested from the mtDNA patterns, most dispersal between regions is by males, with females being more philopatric. Dispersing males are as useful as are females for preventing genetic isolation and inbreeding, but they have little demographic impact. The fact that the population in Fennoscandia continues to decline is evidence that natural dispersal among regions is not sufficient to support that population if it is not protected as an independently vulnerable management unit.

There is a difference of opinion among the experts regarding whether the small and declining wild population in Fennoscandia is doomed to extinction if it is not supplemented. I have been involved with developing and assessing population viability models for a number of endangered species (but not for the LWfG). The probability of population recovery – after the causes of decline are removed – is a function of the population size, with very small populations being more likely to experience inbreeding depression, locally imbalanced sex ratios and other difficulties in finding mates, vulnerability to disease epidemics or other local catastrophes, and other problems intrinsic to small populations. The size of population below which extinction becomes likely varies among species, based on life history, habitat characteristics, evolutionary history, and other factors. It is perhaps misleading to consider any given number to be a “critical” population size, as smaller populations are at greater risk, but there is no size below which a certainty of persistence changes to a certainty of extinction. However, for any given species and environment, the relationship between population size and extinction probability is amenable to analysis.

For relatively long-lived vertebrates (such as geese and most birds), I do not believe that the numbers that currently exist in the wild population of LWfG in Fennoscandia would allow classification of the population as either “doomed” or “safe”. (I.e., both sides of the debate seem to have overstated their case.) Many populations have recovered from even lower numbers, such as the whooping crane recovering steadily from a low of only N=15, after protective measures were implemented. However, the whooping cranes did suffer a significant loss of genetic diversity, and this is likely a cause of the observed high rate of genetic anomalies of development and high susceptibility to some diseases. If the current population of about 20-30 breeding pairs of LWfG is so low as to make damaging genetic impoverishment inevitable, then almost all captive populations of wildlife species would have to be considered to have no conservation value, as rarely are the captive stocks founded with more than 25-30 breeders. Fortunately, not very much genetic diversity is lost when a population goes through a bottleneck of about 20 pairs for one or a few generations. For example, 25 randomly breeding pairs would lose about 1% of its gene diversity (heterozygosity) per generation, allowing it to persist for 10 generations before it lost the 10% of gene diversity that has often been considered to be level of concern for stocks of wildlife or domesticated species. (Often, however, some pairs are much more productive than others, rather than there being a random distribution of breeding success, so actual losses of genetic diversity might be about twice this rate.)

On the other hand, we should not have confidence that the population of LWfG in Fennoscandia can recover without assistance. First, the current steady decline must be stopped, or else all other conservation actions will provide at best only temporary assistance. After stopping the decline due apparently to hunting mortality, the existing population may or may not be able to recover without supplementation. The persistence to today of apparently a single remnant male ivory-billed woodpecker and other examples of presumed species losses that have been avoided (or delayed) should not be taken to be evidence that that species or any species can recover from very low numbers. Florida panthers declined to perhaps only 10-20 breeding individuals for several generations, and the severe inbreeding effects were reversed only after intercrossing with another population. Black-footed ferrets had been presumed to have been rescued after a decline to only about 10 unrelated animals (and their offspring), but they are now showing declining reproductive success that most likely results from the inbreeding that occurred in the population bottleneck. The wild population of LWfG is approaching the level at which we might soon see dangerous effects of inbreeding, but the population should still be recoverable, especially if occasional natural or manipulated immigration from central and eastern populations occurs.

If a captive stock is used for supplementation of the wild LWfG, it would be wise (in light of the data discussed above) to initiate that stock with birds that are “pure” LWfG. Starting new stocks from birds captured in Fennoscandia or more eastern populations might be costly, but perhaps no more so than the extensive genetic testing that would be needed to derive a pure or largely pure population from existing captive stocks. In addition, existing captive stocks have not been managed to minimize genetic changes, so they may have adapted genetically to captivity in ways that include loss of species-typical breeding preferences that serve as isolating mechanisms. After a population is established, monitoring and genetic management of a captive population is not much more difficult or costly than maintaining a population without attention to

the pedigree, and can increase the genetic effectiveness of a breeding population several-fold relative to a stock that is not managed genetically. (I.e., a stock managed with the methods used for wildlife species in well managed breeding programs can lose genetic diversity as slowly as would an unmanaged population that is two or three times larger.)

Perhaps the most difficult issue facing the conservation and management authorities is to decide what to do with already released birds (and their descendants) that carry non-LWfG genes. It may not be possible to remove these birds or the hybridized genomes from the wild, especially if they have already further interbred with the remnant wild population. It is possible that species-isolating mechanisms have broken down in the hybrids, so that the released birds and their descendants might now provide a path for continued introgression of genes from GWfG into LWfG populations. Otherwise, the extent of introgression of non-LWfG genes into Fennoscandian populations is probably not so great that it will do long-term damage to the ecological and evolutionary future of LWfG in Fennoscandia. Very small amounts of gene flow from closely related species is not an uncommon occurrence in natural populations. Future releases of documented LWfG, occasional immigration from central and eastern populations, and natural selection could all serve to slowly reduce the level of genetic contamination of the LWfG and restore the species to a genetically more natural condition.

3. LWfG-related discussions from the Report of the 13 Meeting (Extract)

Concerted actions for selected Appendix I species and groups, according to resolutions 3.2, 4.2, 5.1, 6.1 and 7.1

31. Under the item, the Council considered unresolved issues related to the new draft action plan for the lesser white-fronted goose (*Anser erythropus*). Introducing the item, Dr. Barbieri said that BirdLife International and a group of experts, under the auspices of the African-Eurasian Migratory Waterbird Agreement (AEWA), had been undertaking a revision of the 1996 International Action Plan for the conservation of this threatened species. The experts involved in the activity had been unable to reach consensus on certain issues, however, particularly those concerning the genetic aspects of captive and released birds, and had sought the advice of the Scientific Council.

32. Elaborating on the issue, Mr. Sergey Dereliev, Technical Officer of AEWA, explained that the lesser white-fronted goose was a long-distance Palearctic migrant breeding in four disjunct subarctic populations and wintering in southern Europe and Asia. The free-flying Swedish population, reintroduced from captive stock, has been found to contain hybrid birds. At an expert workshop held in Lammi, Finland, in April 2005, no consensus had emerged on how to deal with that population, or on the process by which further reintroductions might take place. There was still controversy over the accuracy of methods used to detect alien DNA, and the extent to which the presence of minute quantities of genetic material from other goose species represented a risk to the wild population. The Council was being asked to offer its advice on a number of options related to three key issues: captive breeding policy; the status of the free-flying reintroduced population; and modification of flyways.

33. In the ensuing discussion, some councillors drew attention to the political issues involved. It was strongly felt, however, that the Council should address itself to scientific considerations only. The time factor was also mentioned, and one councillor suggested that an authoritative update of the status of the wild populations would help inform the timescale for any future interventions. One councillor thought that the issue should not be dealt with by the Council, because of the lack of full updated information, and its highly technical nature, on which even experts had been unable to reach agreement.

34. The Chair suggested that a small independent working group, led by Mr. John O'Sullivan, the Conference-appointed councillor for birds, be convened to review the clarity of the scientific issues and the questions being referred to the Council, with a view to assessing whether the information presented was sufficient for the Council to make any informed observations.

35. In its subsequent report (contained in annex III to the present report), the working group took into consideration the Council paper CMS/ScC13/Doc.9 summarizing the issues related to conservation of the lesser white-fronted goose, and the numerous representations received by CMS from interested parties, including an independent review obtained by the CMS Secretariat from a renowned population geneticist. A cautious approach had been taken, given the unresolved scientific issues.

36. The group had concluded that the wild Fennoscandian population, breeding in Norway, should not be interfered with, unless or until such interference might become inevitable. Every effort should be made to conserve these birds along their traditional flyways. A captive breeding population of birds from this source should be established as a priority. It was also recommended, given the possible risk to the genetic make-up of the wild Fennoscandian population posed by existing free-flying birds released from captive stock, that the latter be removed from the wild. The group did not support the introduction of lesser white-fronted geese into flyways where they did not occur naturally.

37. Some councillors expressed the opinion that some of the arguments in the paper were couched in nonscientific language. Mr. O'Sullivan, who led the working group, explained that a number of those who had made representations were heavily involved in conservation of the lesser white-fronted goose and were not specialist scientists, and this had been taken into account. The Chair advised that a clear scientific perspective be taken on the issue. The need for a continuing review of the situation was also stressed.

38. The report was welcomed by the Council. A councillor suggested that the Council should recommend an evaluation of the feasibility of capture of the free-flying population originally released from captivity, rather than recommending capture only. Others felt that the recommendation of capture should be retained; the Chair suggested that the Council recommend capture of the existing free flying population, preceded by a rapid feasibility study.

39. ***Summary***. Summarizing, the Chair noted the Scientific Council's approval of the report of the working group. He also noted the need to undertake a feasibility study into the techniques contained in the working group's report.

40. The taxonomic working groups for aquatic mammals and large fishes, terrestrial mammals, birds and marine turtles considered Concerted Actions for selected Appendix I species and groups, according to resolutions 3.2, 4.2, 5.1, 6.1 and 7.1.

41. In its report (contained in annex IV to the present report) the working group on birds proposed two new species for Concerted Action: *Puffinus mauretanicus* and *Calidris canutus rufa*, subject to their inclusion on Appendix I by the Conference of the Parties at its eighth meeting. In its review of existing Concerted Actions, the working group reported that it had received updates on Concerted Action species: Siberian crane (*Grus leucogeranus*), Andean flamingos (*Phoenicopterus andinus* and *Ph. Jamesi*), ruddy-headed goose (*Chloephaga rubidiceps)*, great bustard (*Otis tarda*), slender-billed curlew (*Numenius tenuirostris*), lesser kestrel (*Falco naumanni*), aquatic warbler (*Acrocephalus paludicola*), white-headed duck (*Oxyura leucocephala*), lesser whitefronted goose (*Anser erythropus*), ferruginous duck (*Aythya nyroca*) and Humboldt penguin (*Spheniscus humboldti*). The councillor for Spain was the new focal point for the white-headed duck (*Oxyura leucocephala*). Three species added to the list of Concerted Action species at the seventh meeting of the Conference of the Parties were the subject of action plans currently in preparation, for which project funding had been allocated by the CMS: *Platalea minor*, *Eurynorhynchus pygmeus* and *Sterna bernsteini*. The working group noted the value of the birds section of the draft rapid review of concerted action species, but felt that an update was necessary to accommodate more recent data.

4. Science Council Recommendation

Recommendation from the Scientific Council

As noted in paper ScC.13/ Doc.9, produced for the Scientific Council, a workshop was held in Lammi, Finland, in April 2005 at which participants with a deep interest and involvement in the conservation of the Lesser Whitefront agreed to request the opinion of the Council on a number of issues, which have for some time seriously divided conservationists interested in a better future for this species.

In addition to the Council paper, also needing to be taken into account are the numerous representations that have been received by the CMS Secretariat from interested bodies and individuals as well as an independent review obtained by the CMS Secretariat from a professional population geneticist. (A list of these is given in Annex 1.)

At the 13th Meeting of the Scientific Council, consideration of this issue began with an introduction to the background by the CMS Secretariat. The Technical Officer of the African-Eurasian Waterbird Agreement then gave more detail of the history of efforts to conserve the species, including the introduction into the wild of birds of captive-bred origin. Further comments were then made by Scientific Councillors, some from the Range States directly involved, others not. In order for the Scientific Council to make progress and attempt to comment meaningfully on the key issues, the Chairman of the Scientific Council requested that the Appointed Councillor for Birds should make a review, concentrating in particular on drawing out the views of Councillors from Range States other than those involved in the intense discussions which have been going on surrounding this bird. Sweden was one of the Range States in the latter category.

The Councillor for Birds spoke to several Councillors, and was approached by others. A small working group assisted with identifying the key issues and determining the possible position of the Scientific Council. It should be stated from the outset that some difficult and complex issues are involved in the conservation of the species. In some cases, a clear and undisputed scientific answer to a particular question does not appear possible, at least currently. Where such is the case, it has seemed appropriate to take a cautious approach, however always bearing in mind that the passage of time is an important consideration in the conservation of this particular species.

There is no doubt of the genuine intentions of the individuals on all sides of the argument. Indeed, it is the deeply held concern for the conservation of the species that has made for much of the controversy in the case. Nor is the scientific and professional integrity of those involved doubted. However, opinions of those involved do differ, and the Scientific Council is being asked to make decisions among them: this we do in good faith.

Our first conclusion is that it is desirable to have a wide genetic diversity among wild Lesser Whitefronts. We have read the arguments, and taken into consideration the known wintering ranges of the populations, and there appears to be no undisputed answer at present to the question of whether the Fennoscandian population (as represented by the birds breeding in Norway) is genetically distinct from the nearest breeding birds to the east, in northern Russia. Given the uncertainty, we take the cautious approach that there might be a potentially valuable genetic distinction, and that we should not deliberately interfere with it (for instance, by boosting the Fennoscandian population with wild birds from elsewhere), unless or until such interference may become inevitable. Our second conclusion is that given the small size of the wild Fennoscandian population, if possible, a captive breeding population of birds from this source should be established and maintained as a priority. We recognise that there are risks involved in taking eggs and/or young birds from the wild population, but that careful use of a known surplus (that is, those birds that would have died or been killed in their first winter) may be a practical conservation option.

We consider that every effort should be made to conserve the Fennoscandian birds down their traditional migration routes into southeastern Europe and the Caspian/Central Asian region. We recognise that this is a major challenge. We endorse the current LIFE project that aims to safeguard the birds and their habitats along the western route. It is our opinion that all appropriate efforts should also be made to conserve the wild populations of the species in its other flyways.

We also consider that doubts do remain about the genetic make-up of the existing free-flying birds, originally introduced into the wild in Fennoscandia, and which winter in the Netherlands. It does seem to us that not all, but a large part, of the scientific community will never be completely satisfied concerning the level of genetic contamination from the Greater White-fronted Goose *Anser albifrons* and other species, which many will regard as impossible to eliminate. Despite genuine efforts to improve the genetic purity of existing captive flocks, we consider that these flocks are not to be regarded as potential sources for release to the wild.

Given the possibility that the above mentioned free-flying birds, or their descendants, may pose a risk to the genetic make-up of the wild Fennoscandian population, the Scientific Council is of the opinion that these birds should be caught or otherwise removed from the wild. We do not say this lightly, nor underestimate the practical and other difficulties involved. We recommend that a feasibility study be undertaken as a matter of urgency. We believe that there is nothing against establishing a group in captivity of purebred Lesser Whitefronts from the wild, western Russian stock, and it may well prove valuable to have such a group in the future. However, we do not believe that it is appropriate to release such birds to the wild now or in the immediate future.

For the present, we do not support the introduction of Lesser Whitefronts into flyways where they do not occur naturally. We have borne in mind the powerful argument concerning the improved safety of birds in these flyways, as well as practical considerations, such as current proposals that could quickly be put into effect. However, we consider that modifying the natural behaviour of Lesser Whitefronts in this respect, as well as unknown ecological effects in the chosen new flyways, and other such considerations, make this technique inappropriate until such time as it may become essential, particularly when major disruption or destruction occurs of key components of the natural flyways. We do not believe that to be the case at present.

We give due weight to arguments about the continuing decline of the very small Fennoscandian population, and to the estimates of how long it may continue to be viable, but we are not persuaded that such a fact alone is enough to justify radical action.

We consider that it would be appropriate to re-examine the issues once more in five years. The conclusions set out above were approved by consensus at the Scientific Council meeting, on Friday 18th November 2005. The Chairman of the Scientific Council undertook to transmit them to those who had raised the matter with the Council.

Summary of Conclusions

1. It is desirable to have a wide genetic diversity among wild Lesser Whitefronts.

2. There appears to be no undisputed answer at present to the question of whether the Fennoscandian population (as represented by the birds breeding in Norway) is genetically distinct from the nearest breeding birds to the east, in northern Russia. Given the uncertainty, we take the cautious approach that there might be a potentially valuable genetic distinction, and that we should not deliberately interfere with it (for instance, by boosting the Fennoscandian population with wild birds from elsewhere), unless or until such interference may become inevitable.

3. Given the small size of the wild Fennoscandian population, if possible, a captive breeding population of birds from this source should be established and maintained as a priority. We recognise that there are risks involved in taking eggs and/or young birds from the wild population, but that careful use of a known surplus (that is, those birds that would have died or been killed in their first winter) may be a practical conservation option.

4. We consider that every effort should be made to conserve the Fennoscandian birds down their traditional migration routes into southeastern Europe and the Caspian/Central Asian region. We recognise that this is a major challenge. We endorse the current LIFE project that aims to safeguard the birds and their habitats along the western route. It is our opinion that all appropriate efforts should also be made to conserve the wild populations of the species in its other flyways.

5. We consider that doubts do remain about the genetic make-up of the existing free-flying birds, originally introduced into the wild in Fennoscandia, and which winter in the Netherlands. It does seem to us that not all, but a large part, of the scientific community will never be completely satisfied concerning the level of genetic contamination from the Greater White-fronted Goose *Anser albifrons* and other species, which many will regard as impossible to eliminate. Despite genuine efforts to improve the genetic purity of existing captive flocks we consider that these flocks are not to be regarded as potential sources for release to the wild.

6. Given the possibility that the above-mentioned free-flying birds, or their descendants, may pose a risk to the genetic make-up of the wild Fennoscandian population, the Scientific Council is of the opinion that these birds should be caught or otherwise removed from the wild. We do not say this lightly, nor underestimate the practical and other difficulties involved. We recommend that a feasibility study be undertaken as a matter of urgency.

7. We believe that there is nothing against establishing a group in captivity of purebred Lesser Whitefronts from the wild, western Russian stock, and it may well prove valuable to have such a group in the future. However, we do not believe that it is appropriate to release such birds to the wild now or in the immediate future.

8. For the present, we do not support the introduction of Lesser Whitefronts into flyways where they do not occur naturally. We have borne in mind the powerful argument concerning the improved safety of birds in these flyways, as well as practical considerations, such as current proposals that could quickly be put into effect. However, we consider that modifying the natural behaviour of Lesser Whitefronts in this respect, as well as unknown ecological effects in the chosen new flyways, and other such considerations, make this technique inappropriate until such time as it may become essential, particularly when major disruption or destruction occurs of key components of the natural flyways. We do not believe that to be the case at present. We give due weight to arguments about the continuing decline of the very small Fennoscandian population, and to the estimates of how long it may continue to be viable, but we are not persuaded that such a fact alone is enough to justify radical action.

9. We consider it would be appropriate to re-examine the issues once more in 5 years.