AGREEMENT ON THE CONSERVATION OF AFRICAN-EURASIAN MIGRATORY WATERBIRDS

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"Migratory waterbirds and people - sharing wetlands"

DRAFT REVISED CONSERVATION GUIDELINE NO. 10: GUIDELINES ON AVOIDANCE OF INTRODUCTIONS OF NON-NATIVE WATERBIRD SPECIES

Introduction

Article IV.4 of the Agreement requires a set of Conservation Guidelines to be prepared and regularly reviewed. Paragraph 7.3 of AEWA Annex 3 (Action Plan) further specifies that the development of Conservation Guidelines shall be coordinated by the Secretariat, in consultation with the Technical Committee and with the assistance of experts from Range States and paragraph 7.6 of the Action Plan also gives the Technical Committee the mandate to assess the guidelines prepared under paragraph 7.3 and formulate draft recommendations and resolutions relating to their development, content and implementation for consideration by the Meeting of the Parties (MOP). By MOP4, in September 2008, 12 different guidelines covering various aspects of conservation practice had been developed and adopted.

As part of its work plan for 2009-2012, the Technical Committee considered the need to review previously adopted guidelines and produced, in cooperation with the Secretariat, revised versions of three Conservation Guidelines, including Conservation Guidelines No.10 (CG10): *Guidelines on Avoidance of Introductions of Non-Native Waterbird Species*. CG10 were thoroughly reviewed and updated as well as revised in certain parts. All amendments and additions are presented in track- change mode in this document. The draft revised CG10 were approved by the Technical Committee at its 10th Meeting in September 2011 and by the Standing Committee at its 7th Meeting in November 2011, for submission to MOP5.

Action requested from the Meeting of the Parties

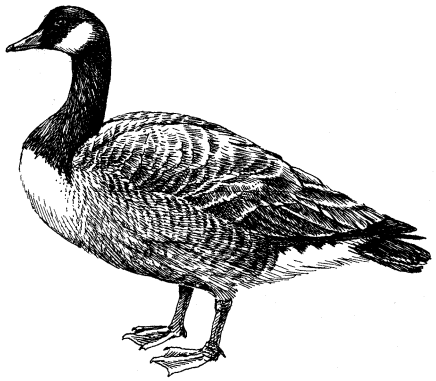
The Meeting of the Parties is invited to review and adopt these revised Conservation Guidelines (draft Resolution AEWA/MOP5 DR10 *Revision and Adoption of Conservation Guidelines*).

Agreement on the Conservation of
African-Eurasian Migratory Waterbirds (AEWA)

AEWA Conservation Guidelines No. 10

Guidelines on Avoidance of Introductions of Non-Native Waterbird Species

Revised version – September 2011



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Compiled by: Myrfyn Owen, Des Callaghan & Jeff Kirby
Just Ecology, Woodend House, Woodend, Wootton-under-Edge, Gloucestershire, GL12 8AA, United Kingdom
E-mail: *enquiries@justecology.co.uk*

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Final draft: approved by the 2nd Session of the Meeting of Parties to AEWA in September 2002
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Picture on the cover: Ruddy Duck *Oxyura jamaicensis*, © Mike Lane / www.nhpa.co.uk
Drawing on the inner cover: Canada Goose *Branta canadensis*

CONTENTS

Rationale

Article III to the African-Eurasian Migratory Waterbird Agreement includes the following:

Parties to the agreement shall:

> *"prohibit the deliberate introduction of non-native waterbird species into the environment and take all appropriate measures to prevent the unintentional release of such species if this introduction or release would prejudice the conservation status of wild flora and fauna; when non-native waterbird species have already been introduced, the Parties shall take all appropriate measures to prevent these species from becoming a potential threat to indigenous species."*

Many of the states within the agreement area have also made commitments under their domestic legislation and other international conventions that strengthen their intention to maintain biodiversity and control invasive and non-native species that threaten that biodiversity, be it habitats or individual species.

The quality of the legislation dealing with non-native species in the Agreement area was assessed using a questionnaire by Blair *et. al.* (2000~~1999~~) and their assessment is summarised in *Table 1*.

Table 1. The number of states (of the 36 legislative units within the Agreement Area) with different quality and effectiveness of domestic legislation dealing with non-native waterbird species (summarised from Table 7 in Blair et. al. 2000~~1999~~).

	None	**Low**	**Mixed/Partial**	**Good/High**	**Not Known**
Legislation Quality	2	1	9	22	2
Legislation Effectiveness	-	2	20	8	4

In general, the coverage by high quality legislation in the area is good, though it is noticeable that the effectiveness of that legislation is generally mixed, even in countries with a long history of conservation achievement. This is mainly because of the difficulty of policing such legislation in countries where the keeping of exotic waterbirds in captivity, in zoos and private collections, is commonplace and the deliberate and accidental release of full-winged birds is not uncommon.

The main international instruments include the Convention on Biological Diversity (Rio de Janeiro 1992) and the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention, Bern 1979).

Contracting parties to the Convention on Biological Diversity are committed under Article 8 to take action to:

> *"(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species;*
>
> *(k) develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species or populations;*
>
> *(l) Where a significant adverse effect on biological diversity has been determined….regulate or manage the relevant process and categories of activities…"*

Further, Article 13 of the convention commits contracting parties to:

"(a) Promote and encourage understanding of the importance of, and the measures required for, the conservation of biological diversity, as well as its propagation through media, and the inclusion of these topics in education programmes…"

Article 11(2) of the Bern Convention states that Contracting Parties undertake:

"(b) to strictly control the introduction of non-native species."

Although this convention refers to the conservation of European wildlife, states outside Europe that have an influence on European wildlife (e.g. through the protection of migratory species), may be full parties and thus participate in the implementation of the convention.

It appears that there is a wide range of relevant national and international statutes, as well as the Agreement itself, to which many countries in the Agreement area subscribe.

Introduction

We will define a non-native taxon as a species, sub-species or discrete geographical population that would not occur in an area without interference by man. This includes:

- A taxon introduced as a breeding bird to a region where it normally only occurred in the non-breeding season;
- A taxon introduced entirely outside of its previous known range;
- A taxon imported and taken into captivity at a location outside of its normal range;
- Domesticated taxa that have established in the wild, including domestic-type strains that have arisen by hybridisation between wild and domesticated individuals.

Problems with introductions occur because of the:
(a) Import of non-native species; and
(b) Deliberate or accidental release of these species, either in the past or today.

Most likely problems with non-native waterbirds arise from hybridisation with closely related species, previously separated by geographical barriers. Outside the Agreement area a number of waterbirds, such as the New Zealand Grey Duck *Anas superciliosa* are threatened by hybridisation with the Mallard *Anas platyrhynchos* (only 17% of Grey Ducks can now be regarded as 'pure'; Williams 1994). The North American Black Duck *Anas rubripes* is under threat and the Mexican Duck *Anas platyrhynchos diazi* has all but disappeared as recognisable taxon from North America because of hybridisation with the Mallard, a species which is able to expand its range in North America only because of interference by man by way of release of reared birds for hunting and the provision of food on artificial habitats (Callaghan & Kirby 1996). Examples of introductions within the Agreement area are given in *Boxes 1-~~3~~4*.

Box 1: The ~~African Yellow-billed Duck and the~~ Mallard

■ The African Yellow-billed Duck *Anas undulata undulata* occurs throughout southern Africa and is relatively common. The Mallard has been deliberately and accidentally introduced into the Cape provinces of South Africa and has become naturalised, especially in urban and peri-urban areas. The two species easily hybridise and the progeny are fertile, so the Mallard represents a threat to the integrity of the Yellow-billed Duck. Also other exotic ducks than the Mallard may associate with the Yellow-billed Duck (e.g. Laysan Teal at Gauteng Province).

There have been efforts to control the Mallard over a number of years, but there were still some at liberty in the South-western and Eastern Cape in the 1990s and escapes from unauthorised keeping are also considered to be a problem (Cape Nature Conservation 1994). The species is still considered to be a major problem, especially in the Western Cape Province and illegal keeping is common (K.A. Shaw pers. comm.). BirdLife South Africa supports an eradication programme (Berruti 1992).

■ The Meller's Duck *Anas melleri* is endemic to Madagascar. This species is listed as Endangered because it is believed to have a very small, although widely dispersed, population, all in one subpopulation, which is undergoing a continuing decline owing to intensive hunting, habitat loss and degradation, and disturbance. There are concerns in Madagascar that hybridisation could occur between introduced Mallards and the endangered Meller's Duck *Anas melleri*, as Mallards are kept by indigenous people on Lac Alaotra, an important site for Meller's Duck (Birdlife, 2009). Hybridisation between these two species has occurred in Mauritius, where both are introduced. No particular action has been taken up to now to prevent this risk in Madagascar.

Other potential causes of these problems include predation, disease spread, competition, and disruption of nutrient dynamics. These become a particular problem when the cause exerts a particular controlling influence on community structure. In these cases the non-native species becomes a 'keystone species', causing ecological processes to be severely disrupted and reducing or extirpating populations of many native

species, particularly those that require very specific ecological conditions (i.e. 'niche specialists') (Williamson 1996). However, problems are often difficult or impossible to foresee and the extent of impacts very difficult to assess.

Box 2: The North American Ruddy Duck and the White-headed Duck

The greatest long-term threat to the globally Endangered White-headed Duck *Oxyura leucocephala* is thought to be hybridisation with the North American Ruddy Duck *Oxyura jamaicensis* (Hughes *et al*. 2006). Conservation efforts in Spain have increased the number of White-headed Ducks there from only 22 birds in 1977 to around 2,500 birds in 2008.

The Ruddy Duck was brought into the United Kingdom in 1948 as part of the wildfowl collection at Slimbridge, Gloucestershire. About 70 juveniles escaped into the wild between 1956 and 1960, and soon afterwards became established as breeding birds (Hudson 1976). Numbers increased rapidly and reached about 6,000 birds by January 2000 (Kershaw & Hughes 2002).

Birds, presumably from Britain, soon reached the European mainland, the first record being in Sweden in 1965 (Hughes *et al*. 1999). Ruddy Ducks then reached Spain in 1984, and hybrids (which are known to be fertile to at least the second generation) were first seen in 1991. Since then, Spain has had a dedicated eradication programme with a total of 178 Ruddy Ducks and 68 hybrids shot by 2008. From 1995 onwards, a control programme was also launched in France where 650 Ruddy Ducks were shot in about 10 years.

In the early 1990s, the UK Government instigated research into control and undertook intensive public awareness programmes. Control was stepped up in 1999 (despite considerable controversy) to assess whether the eradication of the species was a feasible option. A three-year trial, which killed over 2,600 birds, concluded that the UK Ruddy Duck population could be reduced to fewer than 175 birds in between four and six years.

In September 2005, a five year 3.77 million € Ruddy Duck eradication programme began, funded by LIFE-Nature and the UK Department for the Environment, Food and Rural Affairs. This reduced the population on only a few hundred birds by 2009.

However, there were still significant numbers of Ruddy Ducks also breeding in other European countries too, in particular in the Netherlands , Belgium and France and there are perceived movements of birds between the UK and the continental European countries concerned. Coordination between all European countries where the species still occurred in the wild was therefore badly needed.

In 2009, a pan-European project to control the remaining populations in Europe was launched under the aegis of the Berne Convention aiming at developing a coordinated strategy to eradicate the last populations. This project was followed up by a Recommendation N°149 (2010) of the Berne Convention on the eradication of the Ruddy Duck in the Western Palearctic urging Belgium, France, The Netherlands Spain and the UK to implement without delay the "Action Plan for the Eradication of the Ruddy Duck in the Western Palearctic" by 2015, adopted by the Parties to the Convention.
~~It is known from studies in captivity that hybrids between the two species are fertile, and a number of hybrids occurred in Spain in the early 1990s despite strenuous efforts being made to control the Ruddy Duck and hybrids (Hughes 1996).~~

The impact of non-native species through ecological competition with native species is difficult to quantify, though closely related species are inevitably likely to compete for resources. For example, the Mallard is said to threaten the New Zealand Grey Duck (Williams 1994) and the North American Black Duck *Anas rubripes* (Meredino *et. al.* 1994) because of competition for habitat as well as hybridisation. No doubt closely related species or those using the same resources (such as nest cavities) are very likely to be in competition (see *Appendix 1*).

Apart from hybridisation, the effects of invasive non-native species on native flora and fauna in the Agreement area are not well studied. However, evidence from other areas and circumstantial evidence here suggest that they do exist and there is a general consensus that, according to the *precautionary principle*, wherever possible, such species should be controlled (see e.g. SSC 2000).

Box 3: The Canada Goose

The Canada Goose *Branta canadensis* was introduced into England in the 17th century, primarily as an ornamental bird, but was later dispersed throughout Britain, primarily to provide hunting opportunities and to lessen the effects of high densities on agriculture. It was introduced to Sweden in 1933 and to other parts of Europe in later years (Callaghan & Kirby 1996). There are well-documented cases of the effects of these geese on agricultural habitats, but the effects on native fauna and flora are less well understood, though are likely to exist (Madsen & Andersson 1990). The geese winter and breed with closely related species such as the Greylag Goose *Anser anser* and a considerable amount of territorial aggression between the two species came to light in a Swedish study (Fabricuus *et.al.* 1974). However, no effect on the number of breeding pairs of the native species was detected, although this may well occur if the density of both species together exceeds the carrying capacity of the habitat.

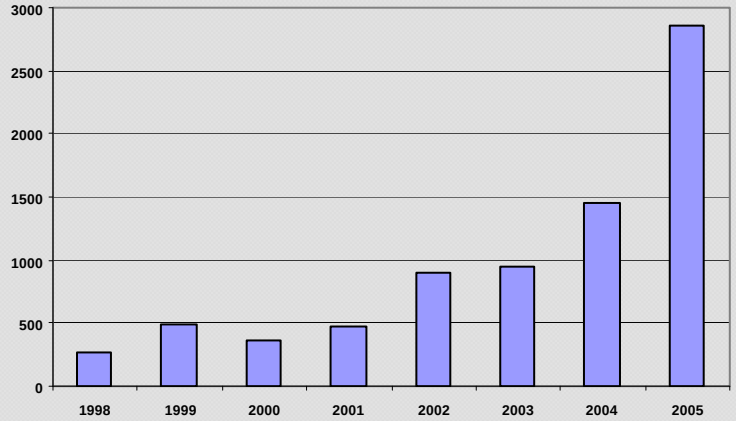
There are reports that the species has a damaging effect on reedbeds in England, a rare habitat there, (English Nature pers. comm.) by grazing and trampling. There may also be an effect on water bodies from the deposition of nutrients by roosting geese. This has not been investigated thoroughly but there is considerable circumstantial evidence that nutrients from roosting waterbirds cause damaging eutrophication of lakes (Callaghan & Kirby 1996, Watola *et. al.* 1996).

The species has other impacts on man, such as damage to amenity areas (which may also affect native species), threats to public health in parks and water areas, and threats to air safety (a number of collisions with aircraft have been recorded) (Watola *et. al.* 1996).

Box 4: The Sacred Ibis

The Sacred Ibis *Threskiornis aethiopicus* recently spread locally in Europe by escaping from zoos and collections, mainly in France, The Netherlands, Italy and Spain. The previous version of AEWA Conservation guidelines n°10 (2006) considered the biodiversity risk as low but warned out that , "if large populations become established it may become a problem through, perhaps, competition for tree nest sites with colonial nesting birds such as herons".

Following the impressive increase in numbers of the species, especially in France, (see figure below), its presence was recorded close to colonies of AEWA column A bird species (terns, herons, spoonbills, etc.). Cases of predation on chicks and eggs in such colonies were reported and AEWA MOP4 recommended to control the species especially in France and the Netherlands (res. 4.5).



Recent Numbers of Sacred Ibis counted in mid-January (Source: Delany et al. 2008) Nota: 99% of these birds have been counted in N-W France on average, where the populations has been estimated at 5 000 ind. in 2006.)

Culling has began in western France in 2007 on a trial basis and has been carried out on a large scale in 2008, 2009 and 2010 by the way of shooting flying birds both near the colonies (only at monospecific colonies) and at feeding places (mostly at controlled refuse tips). About 3 000 birds have been killed in 2008, over 1 000 in 2009 and 887 (+ 11 in Gironde) in 2010 (In addition to 2393 eggs destroyed in 2010). The breeding population has thus decreased from cca 1700 pairs to less that cca 900 pairs. In 2009, most breeding pairs have concentrated in a nature reserve where they breed with herons and egrets and a few Spoonbills, thus shooting is avoided there and the regional state representative has ordered the reserve staff to sterilize the eggs, which has been efficiently done on c150 nests (the others already had chicks when the sterilization was ordered). In southern France, the zoo from which the birds originated no longer holds any free-flying ibises, and has been particularly helpful in recapturing nearly 100 individuals. There are still a few tens of birds in the wild in southern France (17 specimens were counted in 2010), but a network has been set up in order to localise the remaining birds and control them (P. Yésou in litt. & J-B Mouronval pers. Comm.).

Most Sacred Ibises observed recently in the Netherlands are probably originating from a bird zoo in Alphen aan de Rijn (Avifauna) where they (illegally) keep freeflying birds. However, the possibility that some birds derive from the French population cannot be excluded. The bird Zoo Avifauna Alphen has recently recaptured 25 individuals and placed them in other zoos and further escapes seem to be prevented. The risk assessment undertaken for the Netherlands recently concluded to a "moderate to serious" risk. This species is protected in the Netherlands and research to clarify its legal status is currently being undertaken (T. van der Have in litt.).

In Italy, few pairs are breeding, mainly in Piedmont (Vercelli and Novara provinces), where the birds almost regularly breed starting from 1989. One case of hybridisation with an African Spoonbill (*Platalea alba)* has been recorded. Up to now, there are no indications of possible negative impact by that species on the environment and nothing has been done to limit its expansion. (Camilla Gotti in litt.). In Spain a feral population established in Barcelona has been culled in 2001 (Clergeau & Yésou 2006).

Step Chart

Step 1: Establish baseline information on imports, holdings and established populations of non-native waterbird species

Step 2: Introduce or maintain monitoring programmes to periodically revise the baseline information

Step 3: Establish levels of potential threat posed by each non-native waterbird species, so as to prioritise action

Step 4: Establish or improve legislation to prevent the deliberate introduction of non-native waterbird species and allow their control where established populations exist

Step 5: Introduce measures to prevent escapes of non-native waterbird species from captive collections

Step 6: Introduce measures to prevent the import of high risk waterbird species, where the risk is ascertained by the risk assessment proposed under step 3

Step 7: Design control strategies to limit or remove high risk non-native waterbird species, test and report on their feasibility

7.1 Educate and raise awareness amongst key stakeholders

7.2 Obtain public support for any control strategies to be implemented

7.3 Carry out eradication or control programme

7.4 Monitor the success of the control programme

Step 1: Establish baseline information on imports, holdings and established populations of non-native waterbird species

Non-native species in the wild

The UK Government environment department commissioned a study on behalf of AEWA to establish what information was available on the status of non-native waterbirds in the Agreement area (Blair *et. al.* 1999). The research indicates that a large number of non-native species are at liberty in the Agreement area, some in self-sustaining populations. A total of 113~~2~~ species (including 2 hybrid populations) was recorded as having escaped into the wild and survived at least one year. Banks *et al.* (2008) updated this information through a questionnaire sent to the AEWA R~~r~~ange S~~s~~tates and an extensive literature review.

Table 2. Summary information on the 16 species which Blair et. al. (~~1999~~2000) considered to present a potential problem to native species in the AEWA region and 2 species pointed by WAZA (but see Appendix 1 & 2)[1] and an additional 1 pointed by Banks et al. 2008.

Species	Status
Sacred Ibis *Threskiornis aethiopicus*	Established in France (increasing), Italy and UAE. Potential threat (not serious) to colonial nesting species (Herons, Egrets).
Greater Flamingo *Phoenicopterus ruber*	Occurs in Germany, the Netherlands, UK and South Africa, but no breeding so unlikely to be a major threat.
Chilean Flamingo *Phoenicopterus chilensis*	Has occurred in most countries of northwest Europe; breeding colony in Germany. May be a problem of competition if it reaches Greater Flamingo breeding range (*see Appendix 1*).
Mute Swan *Cygnus olor*	Introduced to many countries in Europe and to South Africa and reported to trample nest of Black Terns *Childonias niger* in France (*but see Appendix 1*).
Black Swan *Cygnus atratus*	Occurs in many countries in Europe (breeding in the Netherlands and UK). If numbers increase, it could threaten native species.
Snow Goose *Anser caerulescens*	Occurs in Switzerland according to the World Association of Zoos and Aquariums (WAZA).
Greylag Goose *Anser anser* (incl. hybrid)	Introduced and re-established in many European countries (including some non-native subspecies). Danger of erosion of purity of races.
Bar-headed Goose *Anser indicus*	Occurs in most European countries, with a few breeding pairs. Few at present, but could threaten native species if it increases (*Appendix 1*).
Hawaiian Goose *Branta sandvicensis*	Occurs in Switzerland according to the World Association of Zoos and Aquariums (WAZA).
Canada Goose *Branta canadensis*	Increasing in UK (80,000 birds) and north-west Europe (60,000+), causes widespread agricultural conflicts and other threats (*see Box 3*).
Barnacle Goose *Branta leucopsis*	Breeds in UK (900 birds), the Netherlands (300) and Germany (500), few elsewhere. May pose similar problems to Canada Goose if it increases.

[1] The world Association of Zoos and Aquariums (WAZA) questioned if it necessary to consider all listed taxa in this context. It is proposed to set a question mark regarding species that occur naturally in parts of Europe, because WAZA has experienced tremendous shifts of distribution occurring naturally, e.g. the expansion of the range of the Cattle Egret, the Red-crested Pochard, the Collared Dove, the White-backed Woodpecker, or the Scarlet Rosefinch. Escaped birds may thus only accelerate a process, which is taking place anyway and are rather not a problem for the ecosystem. WAZA noted also that climate change may have a much bigger impact than occasional escapees. They gave the example of a flock of Greater Flamingos migrating between the Camargue and the Lake of Neuchâtel. These wild birds arrive regularly in August and leave in October/November.

Some of these "subregionally alien" species risk to become hybridized with really alien species, e.g. the European Ruddy Shelduck (*Tadorna ferruginea*) at the Klingnau Dam in Northern Switzerland got hybridized with South African Shelduck (*Tadorna cana*), and WAZA assumes that there are considerably more than just the three hybrid broods reported by Kestenholz et al. in 2000.

Species	Status
Upland Goose *Chloephaga picta*	Small (30-45 birds) self-sustaining population in Belgium, with both the population size and range increasing. Few pairs in Britain and the Netherlands (not self sustaining populations)
Egyptian Goose *Alopochen aegyptiacus*	Populations in UK (1,000), Belgium (600), the Netherlands (6,000) and Germany (3,000). No major threat (no closely related native species).
Ruddy Shelduck *Tadorna ferruginea*	Small numbers in western Europe, very few breeding (but increasing). Could compete for nest holes with native species if it increases.
Muscovy Duck *Cairina moschata*	Domesticated strain has escaped in many countries in small numbers. No current problems but could dominate other breeding species.
Mandarin Duck *Aix galericulata*	Occurs in the UK (7,000 birds), Germany (1,000), a few elsewhere. Increasing, though no problem reported with native species (none closely related or using same niche). May compete for nest cavities with other hole-nesting species.
Mallard *Anas platyrhynchos*	Introduced to many countries, hybridises freely with some native taxa. Causes considerable problems in many areas and hybrids/domestic hybrids are common. See also *Box 1*.
Red-crested Pochard *Netta rufina*	Breeds in UK (150 birds) and the Netherlands in small numbers. Can hybridise with native species but unlikely to present major threat.
Ruddy Duck *Oxyura jamaicensis*	Increasing and spreading its range. Serious threat to the existence of the White-headed Duck unless controlled (*see Box 2 and ~~6~~7*).

Sixteen of these (including the hybrid populations) were considered to represent a potential threat to indigenous AEWA waterbirds; the remainder appeared not to be a problem. *Table 2* provides a summary of the available information for the ~~16~~ 19 potential problem species according to Blair *et. al.* (2000) and Bank *et al.* (see also *Appendix 2*, which updates the information provided by Blair *et. al.* (2000) and Bank *et al.* (2008)).
~~(see also *Appendix 1*, which updates the information provided by Blair *et. al.* (1999)).~~

The problem of non-native species is prevalent in countries where the keeping of exotic waterbirds is a common hobby. Notable for the number of non-native species recorded are the UK (79), Switzerland (34), United Arab Emirates (25), Germany (24), South Africa (24) and the Netherlands (20). Another four countries (all in Europe) have recorded more than 10 non-native species at liberty. The high number in the UK probably reflects the good knowledge base there (Hughes *et. al.* 1995).

The extent of our knowledge of the numbers of non-native species in the wild is mixed. In Blair *et. al*'(2000)~~s~~ survey, information was lacking from 46 out of the 125 states that were sent questionnaires and in most others the information was fragmentary. Even in areas well covered by waterbird counting networks, non-native species are often not recorded because observers do not deem them to be worthy of note. Clearly, since many non-native species are increasing and widening their range, it is essential that better systems of monitoring their numbers, distribution and interactions with native wildlife should be put in place (*Step 2*). International waterbird counters are soon to be encouraged to monitor these in the future (D. A. Scott, pers. comm.).

Non-native species in captivity

Waterbirds are very commonly kept in captivity because they are attractive and relatively easy to keep. There is a very long history of the keeping and breeding of waterbirds especially wildfowl (*Anseriformes*) stretching back at least to the 16th century (Kear 1990). The birds are generally not held in aviaries but housed in open enclosures and grounded by clipping the feathers of one wing or pinioning (the removal of the distal joint of one wing). Since many species breed freely, keepers must exercise considerable vigilance in ensuring that the progeny of non-native species are pinioned before they are capable of flight. In some cases birds are kept full-winged because they are attractive, and there have been some deliberate introductions in the past (*see also Step 4*).

Table 3. A summary of records held in the ISIS database for some important groups of waterbirds in captivity in Europe and Africa. The taxa include species and subspecies.

Group	No of Taxa listed	Taxa in captivity	Collections per taxon (holding species)	Total Birds
Grebes	5	2	1.0	13
Pelicans	8	5	22.0	916
Cormorants/Shags	14	5	9.0	377
Storks	18	14	17.5	1158
Ibis/Spoonbills	23	15	17.0	1790
Flamingos	6	6	31.5	4279
Whistling Ducks	8	8	15.5	848
Swans	8	8	25.0	779
True Geese	30	30	14.5	3764
Sheldgeese/ducks	13	12	19.1	1377
Dabbling Ducks	52	50	12.4	4109
Diving Ducks	14	14	20.5	2092
Sea Ducks/Sawbills	22	15	12.4	904
Stiff-tailed Ducks	6	6	6.2	287
Other Wildfowl	26	21	17.9	2950
Cranes	18	16	23.3	1192
Totals/Mean	**271**	**227(84%)**	**16.4**	**26835**

Because waterbird keeping and trading is such a common occurrence and because it is not strictly controlled in most countries, finding out how many and what birds are kept is very difficult, though there are some organisations and membership groups that enable us to obtain some clues as to the extent of keeping and the variety of birds kept and bred in captivity.

Most established zoos have representative collections of waterbirds and records of these are kept in a system known as the International Species Information System (ISIS), which holds information on ~~1,8~~2 million specimens of about 15,000 vertebrate taxa held in more than ~~5~~800 collections in 7~~6~~0 different countries worldwide. The data are available on line at the public site www.isis.org. A summary of the records in the database for some of the more important groups of waterbirds is shown in *Table 3*. Of the taxa listed in the database, no fewer than 84% are at present in captivity in the region, and many of these in substantial numbers. Most of the taxa are not native to the country where they are being held.

A large number of private breeders and dealers keep waterbirds as a hobby or a business. For example, the ISIS database records North American Ruddy Ducks in only four registered collections in Germany. An independent survey of the species found that there were 200 collections, mostly held by private individuals, holding Ruddy Ducks in the same country. The same survey found that there were more than 50 collections, together holding more than 200 Ruddy Ducks, in the Flanders region of Belgium (B. Hughes, pers. comm.).

Laar *et. al.* (1994) reported on a survey carried out by Aviornis International Nederland of the number of geese and swans in captivity in the Netherlands in 1991. The number of birds reported was over 36,000, of which nearly 24,000 were young birds, indicating that they had been bred in captivity in that year. Since the respondents represented only a third of Aviornis members, the authors suggested that the totals should be multiplied by three to obtain a more realistic estimate. Moreover, the survey was incomplete in relation to captive waterbirds because huntable species were not included and a number of others omitted. It seems likely that the number of captive waterbird in the Netherlands alone exceeds 100,000, of which two thirds are reared in the year and are presumably largely bred for sale (*see below*). The last inventory search, held in 2003 has shown that members of Aviornis are keeping more than 625 bird species and in numbers of a few hundred thousand in the Benelux only.

An independent survey of waterbirds kept by breeders is carried out in the UK. In the latest survey, covering 2001, census forms were sent to 323 collectors and 210 responses (65%) received (Hughes 2002). A total of nearly 18,000 birds was held by the responders. If these are representative in terms of numbers held, then the total number of birds must be nearer 30,000. This is in itself a minimum since birds kept purely for ornament are not included and there are a large number of keepers who do not participate in the survey. It seems likely that the number of waterbirds held in the UK may approach the Netherlands total.

It is clear from these figures that there are very large numbers of waterbirds of a wide variety of species in captivity in the Agreement area, mainly in north-west Europe.

Movements of non-native species between countries

There is no strict monitoring of the import and export of waterbirds in any co-ordinated way, except for those listed on the appendices of the Convention on International Trade in Endangered Species (CITES). However, this represents a very small proportion of the taxa available. ~~Within the European Union, since there is no restriction of trade between the member states, movement of non-native birds across national borders is commonplace and is not monitored. Dealers in the Netherlands and Belgium regularly transport birds to other countries and the extent of the trade can be guessed at when we consider that 60,000 birds were available for sale from Dutch and Belgian dealers in a recent year (Anon 1998).~~ This means that most of the young birds reared in captivity are sold and it seems likely that these leave the country.

It seems unlikely that countries will undertake routine monitoring of imports and exports of non-native species, except, perhaps, for a few special cases where species are either threatened or known to be especially troublesome. The EU Wildlife Trade Regulations (WTR) (see Box 6) are regulating border, import and transit controls in relation to trade in protected species of wild fauna and flora and aim~~s~~ to ensure that trade will not have a negative impact on their conservation. Intra-EU movement and holding (e.g. for captive breeding and rearing) of import-banned species may also be regulated. Since 1997, four invasive alien animal species have been banned for import but there is no restriction on their intra-EU movement/holding: *Oxyura jamaicensis*, *Rana catesbeiana*, *Chrysemys picta* and *Trachemys scripta elegans*. ~~The European Union is currently reviewing its regulations on trade in species that pose an ecological threat to EU flora and fauna. Regulations are in place whereby species that are a major threat cannot be imported into the EU and there could also be a prohibition on holding such birds. The UK government has proposed to the EU that the Ruddy Duck be placed on the list of prohibited species. This could lead to a complete ban on keeping and trading in Ruddy Ducks in the EU, though what would become of existing stocks is not clear.~~

Range states should consider how they could ensure that the movement of species that pose a real threat to native fauna or flora can be controlled. At the very least, those species that are considered high risk (*see Step 3*) should be listed on a schedule that prohibits their import into a country and customs personnel should be alerted to this fact, as they are to CITES-listed taxa.

Step 2: Introduce or maintain monitoring programmes to periodically revise the baseline information

Waterbirds are generally found in open areas and are generally not difficult to find and count. In order to comply with the AEWA policy on non-native species, countries should have monitoring systems in place that assess regularly the status of these species. These monitoring data will form an essential part of the evaluation of the potential risk associated with non-natives (*Step 3*).

Recording of non-native species in the wild

Non-native species should always be covered in regular waterbird inventories such as the International Waterbird Census or national waterbird counting schemes. Many observers currently do not consider presumed escaped exotics as worthy of note. The totals given in the summary reports, at least in the UK, are underestimates, although attempts are made to improve these by using summed site maxima rather than the sum of monthly counts (Musgrove *et. al.* 2001).

Perhaps special surveys, targeted at particular species or groups would be more effective than regular counts in providing good estimates of numbers. For example, Delany (1993) reports on a survey of non-native geese in Great Britain, which found 14 non-native species in numbers ranging from 63,500 (Canada Goose) to 2 (Red-breasted Goose). At least 15 different hybrid geese were also found in small numbers. In a review of the status of the Ruddy Duck, Hughes *et. al.* (1999) documents the occurrence and numbers of this non-native species in Europe and Africa. ~~A review of all non-native species is underway in Belgium, in preparation for formulating a national policy on the management or control of non-native species (O. Beck, pers. comm.).~~

Although such surveys are time-consuming and depend on numerous amateur observers, waterbirds are popular with bird-watchers and monitoring is possible, at least occasionally, though this may not be very realistic for some parts of the AEWA range. Nevertheless, range states should ensure non-natives are always recorded and that the results are published in reports such as Waterbird Population Estimates.

Monitoring the status of non-native species in waterbird collections

As indicated under Step 1, assessing accurately the number of birds held in captivity is not easy since legislation on captive collections is lacking in most countries. In the Netherlands it has been compulsory to mark all captive birds with rings since 1995, but how well this is being policed is uncertain. If this were widely practiced, it would be possible to identify escaped birds and compel breeders to be very careful about the way their collections are managed.

It would require legislation to make it possible to control what birds are kept in private collections (some countries already have legislation covering authorised zoos open to the public) and all waterbird collections should be registered and licensed. A condition of a license should include compulsory ringing, regular censoring and reporting of any birds missing or definitely escaped into the wild. Only Norway (Blair *et. al.* 1999) and Iceland (*see Box ~~4~~5*) of the Agreement area states operates a system of regulation (any keeping of non-native species must be for authorised zoological reasons).[2]
The control of what non-native species are kept in captivity and the conditions under which they should be kept are clearly inadequate in most states in the Agreement area. More stringent conditions should be

[2] ~~The British Waterfowl Association annotated that the registering and licensing of all collections of waterbirds could lead ceasing smaller establishments and that only the large organisations, such as zoological departments, will continue. In such an event the inter-mixture of blood lines will be much more restricted and increasing infertility will become a major problem.~~ The British Waterfowl Association annotated that the registering and licensing of all collections of waterbirds could lead to the closure~~ceasing~~ of smaller establishments and that only the large organisations, such as zoological departments, will continue. In such an event the inter-mixture of blood lines will be much more restricted and increasing infertility will become a major problem.

applied that minimise the chances that non-native species kept in collections can be deliberately released or accidentally escape into the wild (*see Steps 4 and 5*).

Monitoring of imports and exports of non-native waterbird species

For any policy for assessing the potential impact of non-native species, their movement to and from the Agreement area, and between countries within it, must be regulated and monitored, though this is fraught with difficulty and would involve considerable administrative resources. However, the mechanisms exist within CITES and the EU Regulations implementing them (*see under Step 1 above and Step 6 below*). Both of these involve listing all the species concerned, though in reality, it is likely that such controls and monitoring will only be implemented for those species that are proven to be highly threatening to native fauna and flora.[3]

[3] It is assumed by WAZA that it is rather unlikely that intra-community trade can be efficiently monitored considering that a very high percentage of transactions is made without being registered in the ANIMO System.

Step 3: Establish levels of potential threat posed by each non-native waterbird species, so as to prioritise action

Clearly, some non-native waterbird species will pose a greater threat than others to biodiversity and this can be predicted to some extent based on current knowledge and a risk assessment.[4]

Ecological risk assessment

Ecological risk assessment calculates the probability of an impact to a specified feature over a defined period of time. Methods evaluate the interaction of three components: stressors released into the environment (e.g. non-native waterbird species); receptors living in and using that environment (e.g. native species); and the receptor response to the stressor. Measurement of exposure and effect quantify the degree of interaction between these components and statistical models are normally employed to analyse the data (Suter 1993; Landis 2004~~, in press~~).

Comprehensive assessment of the risk posed to biodiversity by non-native waterbird species requires an understanding of four main features (after Landis 2004~~, in press~~):

1. The probability of successful invasion by a non-native species, which is related to infection rates from source areas, the habitat specificity of the non-native species, the suitability of the new environment, the isolation of the receiving environment, the size of the receiving environment, the frequency of disturbance within the landscape and historical events which may preclude or enhance invasion;

2. The life history, population dynamics and ecology of the non-native species;

3. The mechanisms through which the non-native species can impact biodiversity, such as predation (including grazing), disease, competition, hybridisation and disruption of nutrient dynamics;

4. The ecological and evolutionary processes that govern (3).

Each of these features requires that a risk assessment for a particular species needs to be understood in the context of the regional landscape. Therefore, there is a need to undertake such assessments at a national and sub-national level in order to adequately understand the risks posed to biodiversity by non-native waterbird species in the AEWA region.

That accepted, *Appendix 1* provides a more basic and qualitative risk assessment for non-native waterbird species currently established within the AEWA region. The eleven species identified are mainly *Anatidae* (ducks, geese and swans) and are concentrated in north-west Europe. No doubt this taxonomic and geographic pattern has arisen from the long and popular history of keeping *Anatidae* in captivity in north-west Europe, leading to regular escapes and (in the past at least) deliberate introductions. The geographic bias may also be related to the highly disturbed landscapes in north-west Europe, which is a factor that has been shown to aid the establishment of non-native species (With 2004~~, in press~~).

[4] It was mentioned by WAZA that alien species are not only a problem in the case of waterbirds, but also in many other taxonomic groups, from plants to mammals. To monitor all non-native species seems therefore unrealistic, and they are of the view that such monitoring should be limited to highly threatening species.

The analysis shows that two non-native waterbird species in particular in the AEWA region are a high risk to biodiversity: (i) the Ruddy Duck (*Oxyura jamaicensis*) in western Europe and Morocco; and (ii) the Mallard (*Anas platyrhynchos*) in South Africa, and this latter species is still a problem in some provinces. Medium risk species include the Black Swan (*Cygnus atratus*), Canada Goose (*Branta canadensis*) and Egyptian Goose (*Alopochen aegyptiacus*) in north-west Europe. The other six species are considered low risk, though this is tentative.

The most serious threat posed by these species based on current knowledge arises from hybridisation with closely related native species, especially Eendangered ones. Grazing of natural vegetation, competition with native species and eutrophication of wetlands are also potential threats that have sometimes been documented at a local level, but they remain poorly understood and may prove to be only localised problems.

What should range states do?

Range states should therefore:

- Develop or adopt a standard methodology for Risk Assessments;
- Gather data required to apply the criteria;
- Apply criteria to determine degree of threat;
- Continue to gather data to improve above and regularly re-assess the assessments.

In the meantime, actions should be taken against non-native species according to the best available scientific knowledge and/or best practice in other range states or against similar species.

Step 4: Establish or improve legislation to prevent the deliberate introduction of non-native waterbird species and allow their control, to prevent establishment, and where established populations exist

Legislation to provide the framework for combating the problem of non-native waterbird species needs to address trade (*see next section*), release of birds and, where populations have become established in the wild and prove or risk to be a problem. In particular, preventing the arrival of new non-native species through strict rules of trade, aviculture and release into the wild is the most effective and least costly management strategy to reduce threats posed by biological invasions and should always be the first lines of defense.

~~In most Member States of AEWA, deliberate introductions are illegal without prior consent from the respective government. However, in some others it remains legal without the need of any permission. e.g. anybody can release Ruddy Ducks into the wild in Ireland, Italy, the Netherlands and Portugal, despite the extreme risk this poses to the future survival of the White-headed Duck (*Oxyura leucocephala*) (Hughes *et. al.* 1999).~~

A policy usually promoted with regard to intentional introductions of non-native species is to allow it only after an appropriate risk assessment procedure has proven the species to be low risk. However, with regard to waterbirds, our ability to predict impacts of non-native waterbirds on native biodiversity is very limited (*see previous section*). Hence, considering the precautionary principle the wisest policy is to prohibit any intentional releases into wild of non-native waterbirds.

Aside from the intentional release of non-native waterbirds, large numbers of native waterbirds are also reared in captivity and released for hunting purposes ('stocking programmes'). A number of species have been used in such programmes, but the vast majority of birds are Mallards (*Anas platyrhynchos*). Most programmes are in western Europe, where millions of Mallards are released each year. These captive-reared (or 'game farm') birds are genetically and ecologically different from wild Mallards, but inter-breed with them freely and thus threaten the genetic integrity of wild Mallard populations (Callaghan *et. al*. 1997a,b). However, this seems to be largely rhetoric given the scale and long history of releases of captive-reared Mallards throughout most of their native range in the AEWA region. Nonetheless, large-scale releases of captive Mallards probably also increases the incidence of disease in wild populations, such as Duck Virus Enteritis (DVE), although this is practically impossible to measure (Callaghan *et. al*. 1997a,b).

Box 45: Licensing of captive birds

An effective means of controlling captive populations of waterbirds is through a licensing scheme. Under such schemes aviculturists have to apply for a license to keep or trade certain species.

Since January 1995 it has been illegal to trade in Ruddy Ducks (*Oxyura jamaicensis*) in the UK without an individual licence and in recent years licenses have not been issued. In effect, this has ceased trade in the species and will probably lead to a major reduction, if not the elimination of the Ruddy Duck in captivity in the UK (B. Hughes, pers. comm.). Likewise, it is illegal to keep Ruddy Ducks in captivity in Norway without a permit and the government has declared that no permits will be granted (Hughes *et. al*. 1999). Lastly, the Wildlife Conservation and Hunting Act in Iceland states that it is prohibited to keep any wild bird species in captivity without a permit from the Ministry of Environment, and as yet no permits have been issued for keeping any waterbirds (O. Nielsen, pers. comm.).

Such licensing schemes are often more politically attractive than out-right bans of keeping certain captive animals and in effect allow for the eradication of species from captivity if needed.

~~As regards stocking programmes of other native waterbird species, there seems to be little activity in the AEWA region. But from a precautionary perspective, it seems wise to dissuade stocking programmes in general and where they are allowed to ensure birds that are used are 'wild-strain' individuals (i.e. less than two generations removed from the wild). An example of the former policy has been adopted in the~~

~~Netherlands, where the release of any birds (and their eggs) into the wild is forbidden under The Flora and Fauna Act.~~

Step 5: Introduce measures to prevent escapes of non-native waterbird species from captive collections

Along a 2 km stretch of the River Rhine near Wageningen, the Netherlands, nine non-native waterbird species have been recorded in recent years (Snow Goose *Anser caerulescens*, Bar-headed Goose *Anser indicus*, Black Swan *Cygnus atratus*, Mandarin Duck *Aix galericulata*, Wood Duck *Aix sponsa*, Egyptian Goose *Alopochen aegyptiacus*, Canada Goose *Branta canadensis*, Maned Duck *Chenonetta jubata* and Ringed Teal *Callonetta leucophrys*). All of these species are present in local captive breeding collections, both private and public, though not all have established self-sustaining wild populations in the area yet (D. Callaghan, pers. obs.; S. Delany, pers. comm.; N. Gilissen, pers. comm.).

Between 1990 and 1995, a review of only 26 County Bird Reports in the UK produced 421 records of 65 species of non-native waterbird (Hughes *et. al.* 1995).

Such unintentional releases ('escapes') of captive waterbirds are frequent in the AEWA region, especially in north-west Europe, and form the major pathway for the establishment of non-native waterbird species in the wild. *Anatidae* in particular represent such fugitives, since they are by far the most numerous waterbird group kept by aviculturists.

Combating such escapes is only possible through the strict application of rules governing aviculture, such as (after de Klemme 1996; Shine *et. al.*. 2000; DCCNH 2001)[5]:

- Strict standards of rendering birds flightless (wing-clipping or 'pinioning') when they are kept in roofless enclosures;
- Strict standards of security for roofed aviaries when birds are not rendered flightless;
- The requirement that all establishments keeping captive non-native waterbirds should be licensed;
- A register of and an appropriate system to mark birds (e.g. ringing) so that their origin can be identified in the event of their escape;
- Strict rules in the event of the avicultural establishment closing down to prevent organisms from being deliberately freed;
- An obligation for avicultural merchants to inform their customers of good practice, legal regulations and of the penalties for violation;
- Prohibiting the possession of waterbirds liable to pose a risk to native fauna and flora if non-native populations become established;
- Penal and administrative sanctions that could include the withdrawal of permits, the closing of the establishment and the confiscation of birds in the event of a violation of regulations.

Considering the particular risk of the Ruddy Duck (*Oxyura jamaicensis*) escaping from captivity in Europe, much interest been centered on controlling their captive management in recent years (Callaghan *et. al.* 1997a). Voluntary guidelines ('Codes of Practice') for their keeping in captivity have been developed in five European countries, though the impact of these is practically impossible to measure. More stringent legal measures have been adopted in some countries, with good success (Box ~~5~~6). On the whole, however, progress has been very limited in Europe with regard to the legal control of Ruddy Ducks in captivity and few governments have yet imposed rules to limit escapes of birds from captivity (Hughes *et. al*. 1999).

Escape of Mallards from captivity in South Africa has led to the establishment of wild populations that pose a risk to native Yellow-billed Ducks through hybridisation (*Box 1*). It is proposed that the keeping of species or subspecies in captivity in South Africa which are likely to hybridise with native taxa should they escape should be prohibited (Shaw 1999, quoted in Blair *et. al.* ~~1999~~2000). This does not seem to have been incorporated within national legislation as yet, though a ban on importation of Mallard is effectively imposed at provincial level, though policing of inter-province movement has proved difficult (K.A Shaw, pers. comm.).

[5] WAZA mentioned that Zoos, at least in Europe, are already subjected to a series of licensing procedures. It may be advisable to integrate rules governing aviculture into the existing procedure under the European Zoo Directive 1999/22 or comparable national legislation.

Any rules established for combating the release of non-native waterbirds into the wild need to be enforced and any breaches punished. Criminal penalties for unlawful introductions of non-native waterbirds should be as severe as for the most serious offences against legislation on protection of the environment, such as certain types of pollution. In addition, with reference to the polluter-pays principle, the person responsible for the offence should bear the cost of eradicating the species from the wild. Without enforcement, any rules are meaningless. For example, Blair *et. al.* (~~1999~~2000) highlighted some countries that have strong legislation preventing the introduction of non-native waterbirds into their territory, but where enforcement is weak and both intentional and unintentional release of non-native species from captivity is happening currently in some of these states (D. Simic, pers. comm.; S. Tyler, pers. comm.).

Strict controls of aviculture through national legislation in AEWA countries are infrequent and in general waterbirds, especially *Anatidae*, are kept under loose rules (if any). In addition, in those countries where strict rules are established in law, enforcement is often weak. This suggests that for some time yet, escapes from captivity will continue to be the major pathway for the establishment or supplementation of non-native waterbird populations in the wild.

These measures should relate to all non-native species, whether they are in the high-risk category or not. However, it is appropriate to recognise that measures to eliminate the chances of escape of non-native species from waterbird collections are likely to be very difficult to implement because of the number of such collections in existence, the extent of international trade in many species and the ease with which many waterbird species breed in captivity. In practice, only high-risk species are likely to be subject to such strict control, since the policing of a general regulation would be very difficult and collectors may well defy restrictions if they deemed them to be unnecessarily restrictive.

Step 6: Introduce measures to prevent the import of high risk waterbird species, where the risk is ascertained by the risk assessment proposed under step 3

Waterbirds, especially *Anatidae*, are popularly kept in captivity and their international trade has a long history (*see Step 2*). Whilst accepting the principle of free trade, adequate control is a key factor in preventing the establishment of invasive non-native waterbirds in the wild in the AEWA region. Such action has two elements: legislation and enforcement (*Box ~~5~~6*)[6].

Legislation

Legislation governing trade in wild fauna and flora should cover as a minimum (after Raymakers 2001):

- List of species;
- Specimens regulated, e.g. birds and their eggs;
- Administrative structures in place and their power;
- Procedures for the issuance of permits and certificates;
- Possession, transport, collection, export, etc. of specimens;
- Provisions for confiscation and sanctions; and
- Enforcement structures and their power, e.g. customs, police and federal services.

GISP (2001) proposed a 'pied list' for governing the trade of species, which contains:

- A 'black list': species whose importation is prohibited;
- A 'white list': species classified as beneficial or low risk, whose importation is allowed generally, under conditions restricting the use of the species to specific purposes (research, public education, others) or only after the holding facilities to contain the organism have been inspected and approved. 'White lists' may be developed at national or sub-national level and should only include species that have undergone risk assessment.

Any species not included on either list is part of a grey category and must be subject to a risk assessment process prior to importation. Any species not yet known to be harmful or harmless is included in the grey category. A potential option to reduce costs related to the lists system is to require anyone applying for an import authorisation for a non-native species to produce a risk assessment.

Individual States within AEWA have very variable legislation governing the trade of waterbird species, ranging from no measures at all to very strict legal instruments. The 'pied list' approach described above has developed, at least in part, within the national legislation of various AEWA Members States, but to very variable degrees. Comprehensive international legislation is not yet available in the AEWA region, although encouragingly 'black listing' of invasive species is possible through EU legislation (*see Box ~~5~~6*).

~~CITES regulates international trade in specimens of species of wild fauna and flora, based on a system of permits and certificates. However, although CITES could in theory be used for 'black listing' trade in invasive species, the convention is focused on controlling international trade in endangered species~~.

[6] WAZA proposed taking into account that the educational role zoos have to play may require the keeping of high risk waterbird species, they recommend to provide for exemptions (for licensed zoos in general rather than on a case by case basis) from prohibitions of import and possession under defined conditions (which may vary according to the species concerned).

Box ~~5~~6: Restricting trade of invasive species in the European Union

Legislative background

CITES is implemented in the EU through a set of Regulations known as the Wildlife Trade Regulations (WTR). Currently these are Council Regulation (EC) No. 338/97 on the protection of species of wild fauna and flora by regulating trade therein (the Basic Regulation) and Commission Regulation (EC) No 865/2006 laying down detailed rules concerning the implementation of Council Regulation (EC) No 338/97 (the Implementing Regulation). In addition, a specific Regulation is in place to suspend the introduction into the Community of certain species from certain countries (known as the Suspensions Regulation). In addition to this core legislation, a Commission Recommendation to the Member States (Commission Recommendation No 2007/425/EC identifying a set of actions for the enforcement of Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein) specifies further the measures that should be taken for the enforcement of the Wildlife Trade Regulations.

The Council Regulation (EC) No. 338/97 deals with the protection of species of wild fauna and flora by regulating the trade in these species. It lays down the provisions for import, export and re-export as well as internal EU trade in specimens of species listed in its four Annexes. It provides for procedures and documents required for such trade (import and export permits, re-export certificates, import notifications and internal trade certificates) and it regulates the movement of live specimens. It also sets out specific requirements for Member States to ensure compliance with the Regulation and to impose adequate sanctions for infringements.

~~The European Union (EU) represents one of the largest markets for international wildlife trade and 75% of the global trade in birds (Raymakers 2001). For many years, legislation to govern this trade has been a conservation priority in the region. The EU adopted Council Regulation 338/97 on the 'Protection of the Species of Wild Fauna and Flora by Regulating Trade Therein' in December 1997. Rules concerning the implementation of this Regulation are detailed in the Commission Regulation 1808/01. Together, these Regulations fully implement the provisions of CITES and go beyond.~~

Best practice feature

The WTR provides a legal basis to suspend the import into the EU of 'live specimens of species for which it has been established that their introduction into the natural environment of the Community presents an ecological threat to wild species of fauna and flora indigenous to the Community' ('ecological threat' species). Intra-EU movement and holding (e.g. for captive breeding and rearing) of import-banned species may also be regulated. Since 1997, four invasive alien animal species have been banned for import, but there is no restriction on their intra-EU movement/holding: *Oxyura jamaicensis*, *Rana catesbeiana*, *Chrysemys picta* and *Trachemys*

Based on the analysis in the previous section the most obvious candidates to be included in a 'black list' of trade in the AEWA region are (in order of priority):

- ~~Ruddy Duck (*Oxyura jamaicensis*) - throughout the AEWA region;~~
- Mallard (*Anas platyrhynchos*) - in regions outside its natural range in the AEWA region where it poses real threat (i.e. South Africa, Madagascar and Mauritius);
- ~~(i.e. most of Africa and the Middle East);~~
- Canada Goose (*Branta canadensis*) - throughout the AEWA region;
- Sacred Ibis (*Threskiornis aethiopicus*) - in regions outside its natural range in the AEWA region.
- ~~Egyptian Goose (*Alopochen aegyptiacus*) - in regions outside its natural range in the AEWA region (i.e. northern Africa, Europe and the Middle East).~~

Enforcement[7]

With adequate legislation in place, enforcement is the next step to preventing importation of invasive waterbirds species. The main bodies involved are customs, police, prosecutors, judges and lawyers (Yeater 2001). Although still relatively uncommon, court cases and challenges in the prosecution of crime related to wildlife trade are becoming more frequent and penalties are becoming more severe (Anton 2001). However, since invasive non-native waterbird species have not been dealt with in trade legislation to any significant degree, examples of law enforcement in this context have yet to arise.

The most frequent problem regarding enforcement of wildlife trade regulations is lack of, or insufficient, border control. Aside from the obvious need of adequate human and financial resources in this regard, identification of specimens is also a basic problem. Identification of adult waterbirds traded in the AEWA region is generally straightforward given an adequate identification guide. However, the identification of eggs of many species, especially *Anatidae*, is practically impossible without costly molecular analysis, and so trade in eggs should not be allowed unless the owners can prove their identification.

Nonetheless, custom officials are often unskilled in the identification of adult waterbirds and it is feared that many species pass through customs under mistaken identity. It seems the best general approach to combat this problem is to issue simple identification guides and, where identification is problematic, ensure specialists are consulted before specimens are released from quarantine (G. Elliott, pers. comm.).

An on-line Global Invasive Species Database (http://www.issg.org/database) is being developed that includes specimen identification information, although as yet few species are in the database and descriptions of specimens are only textual (and hence is inadequate for use by customs officials). Another initiative is the Global Compendium on Invasive Species (http://www.cabi.org/isc/default.aspx?site=144&page=2241) At a regional level (Europe) also see http://www.nobanis.org/ and http://www.europe-aliens.org/index.jsp both are well used and generating more interest. To aid implementation of CITES various identification guides have been produced for species listed in the CITES appendices, including an on-line bird guide (http://www.cws-scf.ec.gc.ca/enforce/pdf/Bird/BIRD_GUIDE_complete.pdf). ~~To aid implementation of CITES various identification guides have been produced for species listed in the CITES appendices, including an on-line bird guide (http://www.cws-scf.ec.gc.ca/enforce/pdf/Bird/BIRD_GUIDE_complete.pdf).~~ Meanwhile, some national schemes have been undertaken to help customs officials identify birds listed on CITES, such as 'Green Parrot' in the UK. This is a computerised identification database, which includes:

- Visual keys for identification;
- Colour images of CITES and non-CITES species;
- An analytical system that assesses the identification characteristics entered to provide the species of best fit;
- CITES-listing information;
- Source country;
- Information and notes.

The system is developed so far to cover nearly all parrots, the majority of raptors, many reptiles and amphibians, a large selection of butterflies, corals, and traditional Chinese medicines and derivatives. The process of adding data and images is ongoing. The resulting database will be made available online for all UK H.M. Customs & Excise CITES officers nationally and may be offered to Customs in other countries. Products such as identification manuals based upon the database are in preparation.

Currently, it seems few custom offices in the AEWA region can ensure correct identification of all adult waterbirds in trade, which is a major problem when trying to prevent the import of invasive species. There is no on-line system that provides a complete aid to identification, and the only printed material is that produced for bird watchers, such as Madge & Burn (1988). It would seem the production of a guide (electronic and printed) or software to the identification of waterbirds traded in the AEWA region aimed at

[7] WAZA mentioned that it is questionable at least in Europe context whether border controls can still serve as a main tool for the enforcement of conservation legislation Note that "imports" do no longer exist between 25 European countries, that the ANIMO system does not work properly for monitoring intra-community trade, and that almost every potentially invasive species one can think of is already kept within the European Community/Economic Area.

custom officers would be a very useful tool, similar to the 'Green Parrot' example above and paying particular attention to invasive species.

Step 7: Design control strategies to limit or remove high risk non-native waterbird species, test and report on their feasibility

If an invasive species is non-native~~non-native species has been non-native~~, early detection and rapid action are crucial to prevent its establishment. The preferred response is often to eradicate the organisms as soon as possible. In the event that eradication is not feasible or resources are not available for its eradication, containment and long-term control measures should be implemented.

Paradoxically, non-native species can be automatically protected by legislation when the law protects all species belonging to a particular taxonomic group or when protection is afforded to all species by so-called 'reverse listing' other than those listed as huntable (usually during an open season) or as pests (which can generally be killed at all times). Hence, in order to allow the control of Ruddy Ducks (*Oxyura jamaicensis*) in the Netherlands the species had to be listed on Article 54 of the Dutch Hunting Law (Hughes *et. al.* 1999), while in the UK the control is permitted under general license (J. Knot, pers. comm.). ~~the species is still protected and only controllable through special license (B. Hughes, pers. comm.).~~ In some cases, such bureaucracy can seriously delay control/eradication strategies. It has been proposed that this can be avoided if legislation makes express reference to "indigenous" species in lists of protected species, thus leaving non-native species unprotected and hence freely controllable (DCCNH 2001). However, allowing uncontrolled killing of invasive species is perhaps not wise owing in particular to the threat of disturbance to native fauna. It seems the best approach is to make reference to specific non-native species within legislation and sanction their eradication/control under license. The design and implementation of control strategies should involve hunters' organisations.
~~As yet, however, there does not seem to be any examples of such a method in the AEWA region.~~

In some countries, depending on the land and hunting rights, a major problem regarding legislation and control/eradication of non-native species could be access to private land. ~~A major problem regarding legislation and control/eradication of non-native species is access to private land.~~ For example, a questionnaire survey in the UK showed that only about 50% of landowners would allow access to their land for the control of Ruddy Ducks. Special land access rights would be required to ensure eradication (B. Hughes, pers. comm.). Rapid access to all land is of course vital to the success of any eradication programme and needs to be stipulated in legislation, empowering eradication teams with special land access rights. ~~As yet, such an approach does not seem to have been taken in the AEWA region.~~

There is a presumption among the public in many countries against the killing of animals and many people have difficulty in understanding the conservation arguments for such control where these are considered purist or where their effects may be felt in countries other than that where the control is exercised. Convincing a public of the need to control invasive species is very difficult where they are generally ignorant of scientific or ecological principles and more aware of welfare concerns than of conservation needs.

Any control programme must be carefully planned and must include Cost Benefit Analysis (Appendix 4) and the following four elements:

7.1 Educate and raise awareness amongst key stakeholders

It is very important at the outset to identify the most important stakeholders in the species to be controlled – those organisations and individuals who perceive that they would be affected if control was exercised. In our view educating and raising awareness amongst stakeholders is the key issue for preventing new introductions. No doubt the most important group are the people who deal with non-native species issues on a professional basis – if professional managers are not convinced about the need for and the probable effectiveness of a control programme, it will not succeed. Voluntary organisations concerned with animal welfare and groups that may have a particular interest in the species are also very important. Such groups should be brought in to the discussions at a very early stage or they may cause problems or even thwart the control programmes later.

7.2 Obtain public support for any control strategies to be implemented

It is also important to improve understanding of the issues amongst the general public. In order to achieve this a sympathetic media coverage is extremely beneficial, so it is very important to identify press sources that are particularly concerned which such issues and which might give positive coverage. Unfortunately some media are apt to sensationalise control programmes and generate hostility among the public. This should be avoided where possible.

Before any control of the Ruddy Duck was carried out, there was a substantial public relations campaign, which attempted to explain to each target group and to the public at large, the importance of the programme and details of steps being taken to minimise the likely cruelty involved and the effects on other species (the two most common complaints about control of troublesome animals). Despite this there was a substantial amount of adverse comment, but the extent of negative actions (e.g. resignations from membership of organisations such as the RSPB and Wildfowl & Wetlands Trust that were supporting control) was not great, and the public relations effort was generally successful.

7.3 Carry out eradication or control programme

The practical problems of eradication are likely to be considerable after a species has become established, since many non-native species are widespread and prolific breeders. They are often found on private land or in areas where control is difficult because of public sensitivities. For example, the Canada Goose in Europe lives in close proximity to Man and is considered by many to be an attractive animal that enhances people's experience, especially in city parks. A number of organisations in the UK have been deterred from taking action against the species despite considerable agricultural damage ~~threat to habitats and perhaps human health~~ because of real or perceived public pressure in favour of the birds. Many of the species concerned are long-lived and control of reproduction alone is unlikely to be successful, so control measures are likely to be contentious. In many cases any control of non-native species is likely to have a deleterious effect (e.g. through disturbance or the killing of non-target animals) on native fauna and flora.

The measures that can be taken to control non-native species are given in Appendix ~~2~~3. Many of these methods are fraught with difficulty, either because of practical or political problems. However, given the will and with the support of voluntary organisations, the example of the Ruddy Duck (*Box ~~7~~6*) indicates that control programmes can be publicly acceptable and meet with success.

7.4 Monitor the success of the control programme

Should a control or eradication scheme be undertaken, the success of this should be monitored by careful recording of control methods and their effectiveness, and assessing the impact of control on the size of the remaining population. It is likely that targeted surveys will be needed, aimed at the species controlled and the sites where control took place, as well as the routine monitoring programmes that are in place in most countries (*see Step 2*).

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Box ~~6~~7: The eradication of the North American Ruddy Duck in the United Kingdom~~The control of the North American Ruddy Duck in Europe~~

The threat posed by this species was recognised in the 1980s and late in that decade The Wildfowl & Wetlands Trust, which was involved in conservation and research programmes to safeguard the White-headed Duck, decided that the potential threat should be examined in detail. All the steps outlined in 7.1 to 7.4 above were followed, as described in detail in Hughes *et. al.* (1999).

The first step was to hold a meeting involving national organisations that were likely to have an interest in the problem, including governmental and voluntary groups. A consensus was soon reached that the problem was potentially serious and deserved attention. When hybrids between the two species were discovered in Spain in 1991, the feeling grew among conservation organisations that action had to be taken to control the Ruddy Duck in Britain. An international conference was held in 1993, bringing 50 delegates from 10 countries to discuss the issue. There was general agreement that control was necessary on an international scale.

Before any action was taken, a campaign, organised by the RSPB and The Wildfowl & Wetlands Trust, was undertaken to inform the public at large of the situation, both through the membership publications of the organisations and by transmitting information to national and local press, radio and television. This met with considerable success, though a number of groups and individuals were vociferous in their condemnation and some members resigned from organisations supporting control.

The Ruddy Duck Working Group was formed in 1992, including statutory and voluntary organisations, to consider how a control programme should be carried out. The first stage was to carry out research into the feasibility of control and this was done between 1992 and 1996. It demonstrated that shooting females during the breeding season was likely to prove effective. In 1998 it was decided to move to the second stage – a regional control trial, which began in 1999 and lasted for three years. The aim of the project was to assess the feasibility of eliminating the species within 10 years. By early 2002 more than 2,500 Ruddy Ducks had been shot from a UK population of about ~~5~~6,000 birds.

The status of the species is monitored annually by the Wetland Bird Survey, and there were~~have also been~~ special surveys conducted to assess numbers in the regions and sites where control had taken place. The regional trial in the UK resulted in reductions of 66% in regional populations in an area in the west midlands of England and 93% on an island in Wales. The study concluded that shooting was the most effective method of control and that the Ruddy Duck could be reduced nationally to less than 175 birds ~~(5% of the 1999 population)~~ over four to six years at a cost of £~~GBPounds~~ 3.6 million (then equivalent to $4.4m or €4.4m).~~(USDollars 4.4m, Euros 4.4m).~~

In September 2005, a five year 3.77 million € Ruddy Duck eradication programme began funded by LIFE-Nature and the UK Department for the Environment, Food and Rural Affairs. Conducted by the Food and Environment Research Agency (formerly the Central Science Laboratory), this had reduced the population to only a few hundred birds by 2009.

Initially, t~~T~~his programme had a very difficult task in the public relations field since the Ruddy Duck is an attractive and endearing species and since the benefits of control would not be seen in the host country. Some also doubted whether the evidence that Spanish birds originated from Britain did exist. It is a credit to the planning and structure of the programme that control continued and proved effective on a regional level. The Ruddy Duck research and control programme could serve as a model for future control operations for waterbirds.

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Appendix 1

Assessment of risk posed to biodiversity by non-native waterbird species within the AEWA region

This analysis is restricted to those waterbird species with populations currently established outside their natural range within the AEWA region. 'Currently established' is defined as breeding in the wild for at least the last 10 consecutive years. 'Natural range' is defined as the range of a taxon excluding any portion that is the result of introduction.

For each risk assessment below a species is categorised as 'Very High', 'High', 'Medium' or 'Low' (according to Banks et al. 2008). ~~.~~ This reflects an assessment based on current knowledge of the risk of negative impacts on biodiversity after considering possible effects through predation (including grazing), disease, competition, hybridisation and/or disruption of nutrient dynamics. Since our understanding of such impacts posed by each species is often poor, the categorisation of most species is provisional. Such provisional understanding is a hallmark of biological invasions in general (Williamson 1996).

Taxonomy follows Sibley & Monroe (1990).

Sacred Ibis (*Threskiornis aethiopicus*)

Biodiversity risk: Low

Small non-native population established in France (Snow & Perrins 1998), United Arab Emirates (Richardson & Aspinall 1998) and Italy (U. Gallo Orsi, pers. comm.; M. Gustin pers. comm.). In the UAE, free-flying collections are kept in Al Ain Zoo and Sir Bani Yas Island, where the species sometimes nests ferally (Richardson and Aspinall 1998). The species is recorded singly or in flocks elsewhere, though the absence of recent records from the UAE birders' newsletter indicates that they are not numerous outside these few locations (D.A. Scott pers. comm.).

Large populations recently became established in Western France and cases of predation on chicks and eggs in colonies of terns, herons and spoonbills were reported (Kayser & al. 2005; Yésou & Clérgeau 2006). It may also become a problem through competition for food resources and for tree nest sites with colonial nesting birds such as herons and spoonbills. The control of this population started in France in 2007.

~~Negative impacts on biodiversity have not been recorded and the species seems unlikely to become numerous outside its natural range. However, if large populations become established it may become a problem through, perhaps, competition for tree nest sites with colonial nesting birds such as herons.~~

Chilean flamingo (*Phoenicopterus chilensis*)

Biodiversity risk:Low-Medium

A very small and apparently stable population (5-8 breeding pairs) is established in Germany. There are no apparent adverse effects on native species and habitats. However, this species can hybridise with Greater Flamingos and further introductions of Chilean Flamingos could potentially lead to problems with hybridisation (Banks *et al.* 2008).

Mute Swan (*Cygnus olor*)

Biodiversity risk:

- Canada : ***High***
- Mauritius : ***Medium***

In Canada, Mute Swans were introduced during the late 1800s and have since increased to around 8,000 pairs in the Great Lakes of Ontario. The population continues to increase at around 9-11% per year. They are causing many problems to native waterbirds and their habitats, but implementation of a control scheme has been hindered by the fact that Mute Swans are protected under the Migratory Birds Treaty Act. Mute Swans have bred with threatened Trumpeter Swans *Cygnus buccinator*, producing hybrid offspring. They are also causing a wide range of negative effects on native species and habitats (aggressiveness, competition for food, habitat degradation, etc.

In Mauritius Mute Swans breed in the western part of the country around hotels and a bird park where they were introduced in the last 20-30 years and despite a lack of data is thought to be increasing (Banks *et al.* 2008).

Black Swan (*Cygnus atratus*)

Biodiversity risk: Medium

Long history of regular escapes from captivity but as yet only very small populations established in Slovenia and the Netherlands (Snow & Perrins 1998; Bijlsma *et. al.* 2001). Negative impacts on biodiversity have generally not been recorded within AEWA region, but the large non-native population in New Zealand is known to have negative impacts on biodiversity through grazing of macrophyte communities (Scott 1972). In the UK, Black Swans nest in winter and are observed to be very aggressive in the company of wild swans, such as Whooper and Bewick Swans (M. Smart, pers. comm.), which may prove serious should the numbers of this non-native species increase.

Banks *et al.* (2008) mentioned that the species is widespread and increasing, with about 155-225 breeding pairs reported by 11 countries, the Netherlands, Belgium and UK being the most important resorts for this species. However, the risk assessment is still assessed as medium.

Greylag Goose (*Anser anser*)

Biodiversity risk: Medium

In Europe, introduced Greylag Geese are widespread and increasing rapidly in a number of countries where this species also occurs naturally, making estimates difficult. Introduced Greylag Geese are thought to displace native species although there is no real data to confirm it. This species hybridises fairly regularly with Greater Canada Goose, domestic goose varieties and other introduced goose species. Hybrids are particularly common in Germany and The Netherlands, where there are established populations of hybrid domestic-type geese, but have also been recorded frequently in Ireland and the UK (Banks *et al.* 2008).

Bar-headed Goose (*Anser indicus*)

Biodiversity risk: Low

Long history of regular escapes from captivity but as yet only very small population established in the Netherlands (Snow & Perrins 1998; Bijlsma *et. al.* 2001). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through grazing and, perhaps, competition. The species is widespread and increasing slowly but the population remains at a low level (about 15 pairs) (Banks *et al.* 2008).

Greater Canada Goose (*Branta canadensis*) **& Cackling Goose** (*Branta hutchinsii*)

Biodiversity risk: High (Banks *et al.* 2008)
~~***Medium***~~

Long history of introductions from 17th century up to recent times for aesthetic and hunting reasons has led to large established populations in the UK, Ireland, Norway, Sweden, Denmark, Belgium, France, Germany, Russia and Finland (Callaghan *et. al.* 1997b; Snow & Perrins 1998). Negative impacts on biodiversity little understood, but some evidence of local problems through grazing, competition and eutrophication of wetlands (Allan *et. al*. 1995; Allan 1999, Hagermeier & Blair 1997; Callaghan *et. al.* 1997b, Wattola *et. al.* 1996).

These widespread species are increasing rapidly and show a wide range of negative effects on native species and habitats: competition and aggressiveness towards other species, hybridisation with Barnacle and Greylag geese, water eutrophication, damage to natural habitats and agriculture etc. A total of 48,500 to 73,750 breeding pairs were recently estimated in a dozen of countries belonging to the AEWA range (Banks *et al.* 2008).

Barnacle goose (*Branta leucopsis*)

Biodiversity risk : Low-Medium

Increasing populations of introduced Barnacle Geese in the AEWA area are recorded mainly in UK, the Netherlands, Germany and amount to 1,620 to 2,550 breeding pairs. Introduced Barnacle Geese have been shown to damage small ponds or shallow mesotrophic waterbodies by faecal deposition and by overgrazing of aquatic vegetation in Belgium. They have been known to breed with other introduced goose species, but not with native species (Banks *et al.* 2008).

Upland Goose (*Chloephaga picta*)

Biodiversity risk : Low-Medium

The largest numbers of introduced Upland Geese in the AEWA area occur in Belgium, where there are at least 30-45 individuals and an estimated 4-7 pairs breed annually. The population is thought to be self-sustaining in Belgium, with both the population size and range increasing. Small numbers of escaped birds are also present in The Netherlands, but breeding is recorded only occasionally here.
Upland Goose is aggressive towards other bird species and is thought to displace native waterbirds in Belgium. It may also contribute towards habitat damage and eutrophication caused by introduced geese in Belgium. Increasing population. This species is not known to hybridise with natives.
Control (if deemed necessary) would be very cheap and easy but will be more difficult and costly in the future (Banks *et al.* 2008).

Egyptian Goose (*Alopochen aegyptiacus*)

Biodiversity risk: Medium
Substantial populations have become established in the UK and the Netherlands and Germany, with smaller numbers in the UK, Belgium and France (Hagermeier & Blair 1997; Snow & Perrins 1998). Population in the Netherlands is expanding rapidly throughout the country and spreading to neighboring regions (Bijlsma *et. al.* 2001). Negative impacts on biodiversity little understood, but may be significant locally through competition and, perhaps, grazing. The species is now widespread, increasing rapidly, and that its range is expanding in Europe (about 10.000 pairs). Negative effects on native species and habitats are also reported, as well as hybridisation with Canada goose, Greylag goose and Mallard (Banks *et al.* 2008).

Ruddy Shelduck (*Tadorna ferruginea*)

Biodiversity risk: Medium-High~~Low~~

Long history of escapes from captivity but as yet only very small population established in the Netherlands and Ukraine (Askania Nova), which may include some wild birds (Snow & Perrins 1998; Bijlsma *et. al.* 2001). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through competition.

The largest introduced population of Ruddy Shelducks in the AEWA area is in Switzerland where the late-summer population in 2004 was around 450 individuals (Banks *et al.* 2008). The species was showing signs of establishing a self-sustaining naturalised population, and the birds breeding in Switzerland were thought to be the source of a feral population in Europe. There were also signs of nest-site competition with other hole-nesting species such as Barn Owl and Kestrel. Because of this control measures were introduced for this species in 2004, and over 400 individuals have been shot since this time (Banks *et al.* 2008).

Carolina Wood Duck (*Aix sponsa*)

Biodiversity risk: Low

Long history of escapes from captivity but as yet only small population established in the UK (Snow & Perrins 1998). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through competition for tree-hole nest sites. Although increasing within the AEWA territory (50 to 100 pairs), this species is still localized (Banks *et al.* 2008)

Mandarin Duck (*Aix galericulata*)

Biodiversity risk: Medium-High (Banks *et al.* 2008)
~~Low~~

Escapes and deliberate releases from captivity have led to a large established population in the UK and much smaller populations in the Netherlands and Switzerland, with populations apparently becoming established also in Belgium and Germany (Snow & Perrins 1998; Bijlsma *et. al.* 2001). Negative impacts on biodiversity not recorded, but a localised problem may be competition for tree-hole nest sites. The species is widespread and increasing, with an estimate of 850-3,000 breeding pairs (Banks *et al.* 2008).

Mallard (*Anas platyrhynchos*)
– South Africa population

Biodiversity risk: High

Small non-native populations have become established in South Africa where they are increasing and beginning to hybridise with the native Yellow-billed Duck *Anas undulata* (Harrison *et. al*. 1997). As yet this remains a very localised problem and the Yellow-billed Duck remains common and widespread in southern Africa (Young 2005~~, in press~~). It is still considered a major problem in Western Cape Province (K.A. Shaw, pers. comm.) and if the non-native populations of Mallard in South Africa increase and spread substantially, the future of the Yellow-billed Duck will be threatened.

- Madagascar population:

Biodiversity risk: Very High (Banks *et al.* 2008)

There are concerns in Madagascar that hybridisation could occur between introduced Mallards and the endangered endemic Meller's Duck *Anas melleri*, as Mallards are kept by indigenous people on Lac Alaotra, an important site for Meller's Duck (Birdlife, 2009). Hybridisation between these two species has occurred in Mauritius, where both are introduced.

Red-crested Pochard (*Netta rufina*)

Biodiversity risk: Low

Small and apparently stable population introduced in southern UK (Snow & Perrins 1998). Negative impacts on biodiversity not recorded and, seemingly, unlikely to arise from current population. Due to potential hybridization with native species, it is now prohibited to introduce this species in South Africa (*Banks et al.* 2008).

Ruddy Duck (*Oxyura jamaicensis*)

Biodiversity risk: High

Large non-native population in southern UK and a small population in Ireland, with annual breeding of very small numbers also in seven other European countries and Morocco. Numbers increasing and southward spread into Spain has brought it into contact with the globally threatened White-headed Duck (*Oxyura leucocephala*), which has resulted in hybridisation. This poses the most significant threat to the future survival of this latter species (Green & Hughes 2001; Hughes 1998). Also, if the spread of the Ruddy Duck continues southward into east and southern Africa it may come to pose a serious threat through hybridisation to the future survival of the Maccoa Duck (*Oxyura maccoa*). Following an eradication programme (2005-2010) co-financed by the EC and UK through a € 3.7 millions Life-Project, numbers have now been reduced to few hundred (see box 7).

Appendix 2

List of introduced waterbird species in order of risk status in the AEWA region (from Banks et al. 2008)

Appended is Table 7.2.1.1 from *Banks et al. 2008* with the list of introduced waterbird species in order of "risk status" (high risk – low risk) in the AEWA region. The geographic area in which each species is introduced is given, and for some species introduced populations are divided into different geographic areas with different risk statuses. The "risk status" is categorised from Very High – High – Medium – Low – Very Low. These assessments are subjective, but are based on the evidence gathered as part of this review. "Resource requirement" describes the amount of resources that would be required to conduct further research on each species or to implement control programmes, if control is deemed necessary, and the assessment of resource requirement is again subjective but is based on the size and distribution of the introduced population, as well as certain behavioural characteristics (for example, colonial nesting easily detected species such as Sacred Ibis might be easier to study or control than dispersed and secretive species such as Mandarin).

English Name	Scientific Name	Geographic Area	Risk Status	Resource Requirement	Notes
Ruddy Duck	*Oxyura jamaicensis*	Western Europe	Very High	High	Ongoing international control scheme.
Mallard	*Anas platyrhynchos*	Madagascar, Mauritius, South Africa	Very High	Very High	
		Other parts of AEWA region	Medium	Very High	
Canada Goose	*Branta canadensis*	Europe	High	Very High	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Sacred Ibis	*Threskiornis aethiopicus*	South and west Europe, UAE	High	Low - Medium	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Mute Swan	*Cygnus olor*	Canada	High	High	
		Mauritius	Medium	Medium	
		Europe	Very Low	Very High	
Egyptian Goose	*Alopochen aegyptiaca*	Western Europe, Mauritius, UAE	Medium - High	High	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Ruddy Shelduck	*Tadorna ferruginea*	Western Europe	Medium - High	Medium	Control in Switzerland ongoing.
Greylag Goose	*Anser anser*	Europe	Medium	Very High	Re-established in many areas.
Black	*Cygnus atratus*	Europe, Mauritius	Medium	Medium	

Swan					
Mandarin	*Aix galericulata*	Europe	Low - Medium	High	
Barnacle Goose	*Branta leucopsis*	Western Europe	Low - Medium	High	More research is needed on the ecological effects of this species.
Upland Goose	*Chloephaga picta*	Belgium, Netherlands, UK	Low - Medium	Very Low	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Chilean Flamingo	*Phoenicopterus chilensis*	Germany/Netherlands, France	Low - Medium	Low	
Swan Goose	*Anser cygnoides*	Europe	Low	Low - Medium	
Bar-headed Goose	*Anser indicus*	Western Europe	Low	Medium	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Wood Duck	*Aix sponsa*	Western Europe	Low	Medium	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Muscovy Duck	*Cairina moschata*	Europe & Africa	Low	Very High	
Snow Goose	*Chen caerulescens*	Germany, Netherlands, UK	Low	Low	
Emperor Goose	*Chen canagicus*	Netherlands, UK	Low	Very Low	
Purple Swamphen	*Porphyrio porphyrio*	Italy, UAE	Low	Very Low	
Caribbean Flamingo	*Phoenicopterus ruber*	Germany/Netherlands	Low	Very Low	
White-faced Whistling Duck	*Dendrocygna viduata*	Mauritius	Low	Low - Medium	
Greater Flamingo	*Phoenicopterus roseus*	Germany/Netherlands & UAE	Very Low	Low	
Red-crested Pochard	*Netta rufina*	UK	Very Low	Medium	Increasing population. Control (if deemed necessary) will be more difficult and costly in the future.
Whooper Swan	*Cygnus cygnus*	Germany, UK	Very Low	Low	
Gadwall	*Anas strepera*	UK	Very Low	High	

Bean Goose	*Anser fabalis*	Belgium, Netherlands, UK	Very Low	Very Low	
Pink-footed Goose	*Anser brachyrhynchus*	France, Germany, UK	Very Low	Very Low	
Greater White-fronted Goose	*Anser albifrons*	Germany, Netherlands, UK	Very Low	Low	
Eurasian Wigeon	*Anas penelope*	UK	Very Low	Low	
Lesser White-fronted Goose	*Anser erythropus*	Finland / Sweden, UK			
Meller's Duck	*Anas melleri*	Mauritius	Very Low	Low - Medium	At present this species is not known to affect native biodiversity in Mauritius. The wild population in Madagascar is critically endangered, therefore control should not be recommended for the introduced population as it could be vital to the conservation of the species.

Appendix 32

Methods that could be employed to control high-risk, non-native species

Control of nests and eggs

This is considered acceptable to most people because it does not involve killing of adult birds. However, most species of waterbirds are long-lived and need to breed successfully in only one of several years to maintain their populations, so nest and egg control would need to be intensive and continuing, which would be very difficult if not impossible to achieve for more widespread species. Since many species nest in cover and their nests are difficult to find, there would also be considerable practical problems and resource implications.

Shooting of full-grown individuals in the hunting season

This is likely to be an acceptable control method because hunting is legitimate and considered to be an acceptable part of rural life in the region. However, shooting seasons are generally set so as to preserve the breeding potential of a population (e.g. spring shooting is banned in most countries) which is contrary to the aim of control. Because of this, placing a species on the quarry list is unlikely, by itself, to be effective in eliminating a non-native species. Hunters are in any case reluctant by nature to shoot such numbers of a quarry species as would endanger its survival and future hunting opportunities and are unwilling to be seen as pest controllers.

Shooting of adults at nest sites

This may be effective against some species whose nest sites are easy to find. However, if such sites are in public view or on private land, exercising such control would be practically difficult and politically sensitive. It may also be possible only to get access to females at nest sites if the males desert the females during incubation. Care should of course also be taken not to shoot in or closed to mixed colonies (Non native/Native species) in order to avoid disturbance of native species, based on an appropriate risk assessment.

Killing flightless birds

Where a species undertakes a flightless moult (as do all *Anatidae* species), it would be possible to round up and humanely dispatch flightless birds. This represents a very effective potential control measure for some species. For example Canada Geese are rounded up in large numbers for ringing during the moult and an intensive control programme would no doubt be very effective against this species. The main problems with adopting this approach would be problems of access onto private land and the public acceptability of such action.

The number of species for which this would be practicable is limited because access to the moulting sites of some species is difficult and others (e.g. diving birds) would be very difficult to catch in any numbers

~~Poisoning~~

~~Poisoning of birds using narcotised baits or poisons has been practiced in many countries to control problem species, mainly those that are considered pests because they impinge on Man's agricultural or fisheries interests or pose a threat to public health, such as a number of species of gulls. This could be very effective for species that will readily accept bait, but potential problems are many, including the acceptability of using certain chemicals, the effects on non-target species and welfare concerns.~~

Populations excluded from analysis

The analysis does not consider species established within captivity within the AEWA region that are not yet established as non-native species in the wild (but of course may become introduced in the future). In addition, non-native populations of the following species are not considered (as well as domestic species (e.g. domestic geese, swan geese or domestic ducks)):

Chilean Flamingo (Phoenicopterus chilensis)Introduced along with Greater Flamingos in Germany in early 1980s growing to a small breeding population (6 pairs in 1993), but the colony apparently becoming extinct since 1995 (Snow & Perrins 1998; Bijlsma et. al. 2001).

Greater Flamingo (Phoenicopterus ruber)

Introduced along with Chilean Flamingos in Germany in early 1980s growing to a small breeding population (6 pairs in 1993), but the breeding colony apparently becoming extinct since 1995 (Snow & Perrins 1998; Bijlsma et. al. 2001).

Mute Swan (Cygnus olor) – European populations

Introduced in many countries in west and central Europe starting in the 16th and 17th centuries, but within or close to natural range (Snow & Perrins 1998). Now often impossible to distinguish between introduced and wild populations and has become a species of high cultural importance.

Mute Swan (Cygnus olor) – Southern Africa population

Up until recently was established as a non-native bird in South Africa and Zimbabwe, but has become extinct for unknown reasons (Harrison et. al. 1997).

Mute Swan (Cygnus olor) – Egyptian population

Described as an introduced species in Egypt by Brown et. al. (1982), but not by Snow & Perrins 1998) and seemingly a mistake by the former authors.

Greater White-fronted Goose (Anser albifrons)

A small introduced population has become established in the Netherlands from escapes from captivity, but this is within the natural wintering range of the species (Bijlsma et. al. 2001).

Lesser White-fronted Goose (Anser erythropus)

Reintroductions in Sweden and Finland for conservation purposes have led to the establishment of a wintering population outside the natural range, mainly in the Netherlands (van den Berg & Bosman 1999), though the species has always made sporadic appearances in the Low Countries.

Greylag Goose (Anser anser)

Non-native breeding populations have become established in many areas of north-west Europe owing to escapes from captivity and releases for hunting (Callaghan et. al. 1997b; Snow & Perrins 1998). These are usually within or adjacent to the natural range of the species. It is now often impossible to distinguish between non-native and wild populations.

Snow Goose (Anser caerulescens)

Long history of regular escapes from captivity and irregular breeding in the wild (e.g. Norway, Sweden and Finland), but as yet no established populations there (Snow & Perrins 1998). There is a small population on the island of Coll, Scotland, which has numbered over 100 birds, but the last count revealed a maximum of only 38 birds (C.R. Mitchell pers. comm., M.A. Ogilvie pers. comm.).

Barnacle Goose (Branta leucopsis)

Small breeding populations have become established in recent decades in the Netherlands, Belgium, Finland, Sweden, Estonia, Denmark and the UK mostly owing to escapes from captivity but also seemingly involving wild individuals in some countries. All are within the natural wintering and migration range of the species (Snow & Perrins 1998).

Gadwall (Anas strepera)

Large breeding population in southern UK originating from releases from captivity, but within natural winter range and close to natural breeding range (and non-native population also augmented by wild birds) (Snow & Perrins 1998; C. R. Mitchell pers. comm.).

~~*Biodiversity risk assessment*~~

~~Sacred Ibis (Threskiornis aethiopicus)~~

~~Biodiversity risk: Low~~

~~Small non-native population established in France (Snow & Perrins 1998), United Arab Emirates (Richardson & Aspinall 1998) and Italy (U. Gallo Orsi, pers. comm.; M. Gustin pers. comm.). In the UAE, free-flying collections are kept in Al Ain Zoo and Sir Bani Yas Island, where the species sometimes nests ferally (Richardson and Aspinall 1998). The species is recorded singly or in flocks elsewhere, though the absence of recent records from the UAE birders' newsletter indicates that they are not numerous outside these few locations (D.A. Scott pers. comm.).~~

~~Negative impacts on biodiversity have not been recorded and the species seems unlikely to become numerous outside its natural range. However, if large populations become established it may become a problem through, perhaps, competition for tree nest sites with colonial nesting birds such as herons.~~

~~Black Swan (Cygnus atratus)~~

~~Biodiversity risk: Medium~~

~~Long history of regular escapes from captivity but as yet only very small populations established in Slovenia and the Netherlands (Snow & Perrins 1998; Bijlsma et. al. 2001). Negative impacts on biodiversity have generally not been recorded within AEWA region, but the large non-native population in New Zealand is known to have negative impacts on biodiversity through grazing of macrophyte communities (Scott 1972). In the UK, Black Swans nest in winter and are observed to be very aggressive in the company of wild swans, such as Whooper and Bewick Swans (M. Smart, pers. comm.), which may prove serious should the numbers of this non-native species increase.~~

~~Bar-headed Goose (Anser indicus)~~

~~Biodiversity risk: Low~~

~~Long history of regular escapes from captivity but as yet only very small population established in the Netherlands (Snow & Perrins 1998; Bijlsma et. al. 2001). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through grazing and, perhaps, competition.~~

~~Canada Goose (Branta canadensis)~~

~~Biodiversity risk: Medium~~

~~Long history of introductions from 17th century up to recent times for aesthetic and hunting reasons has led to large established populations in the UK, Ireland, Norway, Sweden, Denmark, Belgium, France, Germany, Russia and Finland (Callaghan et. al. 1997b; Snow & Perrins 1998). Negative impacts on biodiversity little understood, but some evidence of local problems through grazing, competition and eutrophication of wetlands (Allan et. al. 1995; Allan 1999, Hagermeier & Blair 1997; Callaghan et. al. 1997b, Wattola et. al. 1996).~~

Egyptian Goose (Alopochen aegyptiacus)

Biodiversity risk: Medium

Substantial populations have become established in the UK and the Netherlands and Germany, with smaller numbers in the UK, Belgium and France (Hagermeier & Blair 1997; Snow & Perrins 1998). Population in the Netherlands is expanding rapidly throughout the country and spreading to neighboring regions (Bijlsma et. al. 2001). Negative impacts on biodiversity little understood, but may be significant locally through competition and, perhaps, grazing.

Ruddy Shelduck (Tadorna ferruginea)

Biodiversity risk: Low

Long history of escapes from captivity but as yet only very small population established in the Netherlands and Ukraine (Askania Nova), which may include some wild birds (Snow & Perrins 1998; Bijlsma et. al. 2001). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through competition.

Carolina Wood Duck (Aix sponsa)

Biodiversity risk: Low

Long history of escapes from captivity but as yet only small population established in the UK (Snow & Perrins 1998). Negative impacts on biodiversity not recorded, but if large population becomes established may become a problem through competition for tree-hole nest sites.

Mandarin Duck (Aix galericulata)

Biodiversity risk: Low

Escapes and deliberate releases from captivity have led to a large established population in the UK and much smaller populations in the Netherlands and Switzerland, with populations apparently becoming established also in Belgium and Germany (Snow & Perrins 1998; Bijlsma et. al. 2001). Negative impacts on biodiversity not recorded, but a localised problem may be competition for tree-hole nest sites.

Mallard (Anas platyrhynchos) – South Africa population

Biodiversity risk: High

Small non-native populations have become established in South Africa where they are increasing and beginning to hybridise with the native Yellow-billed Duck Anas undulata (Harrison et. al. 1997). As yet this remains a very localised problem and the Yellow-billed Duck remains common and widespread in southern Africa (Young, in press). It is still considered a major problem in Western Cape Province (K.A. Shaw, pers. comm.) and if the non-native populations of Mallard in South Africa increase and spread substantially, the future of the Yellow-billed Duck will be threatened.

Red-crested Pochard (Netta rufina)

Biodiversity risk: Low

Small and apparently stable population introduced in southern UK (Snow & Perrins 1998). Negative impacts on biodiversity not recorded and, seemingly, unlikely to arise from current population.

Ruddy Duck (Oxyura jamaicensis)

Biodiversity risk: High

Large non-native population in southern UK and a small population in Ireland, with annual breeding of very small numbers also in seven other European countries and Morocco. Numbers increasing and southward spread into Spain has brought it into contact with the globally threatened White-headed Duck (Oxyura leucocephala), which has resulted in hybridisation. This poses the most significant threat to the future survival of this latter species (Green & Hughes 2001; Hughes 1998). Also, if the spread of the Ruddy Duck continues southward into east and southern Africa it may come to pose a serious threat through hybridisation to the future survival of the Maccoa Duck (Oxyura maccoa).

Appendix 2

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Shooting of full-grown individuals in the hunting season

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The number of species for which this would be practicable is limited because access to the moulting sites of some species is difficult and others (e.g. diving birds) would be very difficult to catch in any numbers

Poisoning

Poisoning of birds using narcotised baits or poisons has been practiced in many countries to control problem species, mainly those that are considered pests because they impinge on Man's agricultural or fisheries interests or pose a threat to public health, such as a number of species of gulls. This could be very effective for species that will readily accept bait, but potential problems are many, including the acceptability of using certain chemicals, the effects on non-target species and welfare concerns.

Appendix 4

Cost Benefit Analysis

by Angus Middleton

Introduction

In the past, biological invasiveness and the consequences of invasions were dealt with mostly by biologists[i]. More recently with the rise of greater complexity in management systems and more public decision making there has been a need to incorporate social and other economic aspects into the decision process. The economic aspects of invasive species are often central to the cause and consequences as most invasions are linked to the intended or unintended consequences of and on economic activities[ii]. For this reason a better understanding of the economics of the issue are important in improving decision making. Indeed in many invasive species management systems the economic aspects must be considered as part of the risk management assessment and in most cases this is based on the Cost Benefit Analysis (CBA).

What is Cost Benefit Analysis

CBA is a tool that was developed within the framework of welfare economics and essentially seeks to provide a structured, practical and somewhat democratic means by which decisions can be taken. In essence, CBA is an attempt to evaluate, in monetary terms, the complete costs and benefits of an action or set of action choices. At the core of a CBA is to ensure that policies are economically efficient after taking into consideration, economic, social and environmental considerations. It is important to distinguish between two types of CBA. These are the *ex-ante* which are conducted before taking action or *ex-post* after taking action (middle or end). In the case of invasive species, especially those related to plants, many CBAs have been conducted ex-post. These are particularly useful when attempting to conduct ex-ante CBAs as will be discussed below.

Rationale for a CBA

The main rationale for using CBA is that most government policy decisions are made on the basis of economic considerations. Often these are presented as simple market considerations and by using a CBA one can incorporate other non--market considerations into the decision--making process. In addition, the, CBA is now a widely accepted tool and if correctly and transparently applied, it allows for better decision making and therefore greater chances of success.

It is particularly useful as it does the following;

- It addresses social and environmental concerns
- It can be applied in a wider range of situations
- It captures both market and non-market costs and benefits
- It allows a wide range of impacts and measures to be expressed in similar terms
- It allows an assessment of the value of environmental protection and the opportunity cost of the protection[8].
- When conducted properly, it provides a transparent means of supporting policy decisions.

Whilst a CBA is extremely useful it should seldom ever be used as the sole guide to a decision- making process. Amongst other criticisms, the application of monetary values to non market goods (e.g. the beauty value of an exotic waterfowl) is complex and controversial. Also the idea of economic efficiency in this context implies that as long as society is better off the action can go ahead, but some individuals may be losers in the process.

In addition the data requirements to conduct a CBA are usually large and complex and even where data exists, capacity to conduct meaningful CBAs may be limited. Despite this CBA remains an extremely useful tool and within the framework of Invasive Alien Species it should be viewed as an important component of the risk analysis process.

Assessing Costs & Benefits of Invasive Alien Waterfowl

In respect of Invasive Alien Waterfowl, a CBA requires the identification of a baseline or status quo scenario against which the costs and benefits of actions can be assessed. It is usual in such assessments that the baseline is the cost of inaction. When conducting a CBA related to Invasive Alien Waterfowl there are two broad scenarios that should be considered. The first relates to prevention of entry of an invasive species and the second to the management of the presence of an invasive species.

[8] i.e. the value of the next best alternative, for example to eradicate or not eradicate a species.

In the case of preventing the entry of invasive species (i.e. movement restrictions) a proper risk assessment with a CBA is highly advisable to ensure that potential WTO infringements are avoided. Persons moving the birds for economic gain may argue that restrictions inhibit free trade and countries applying such measures will have to ensure that they meet the requirements of the Agreement on Sanitary & Phytosanitary Arrangements[9].

In the case of applying a CBA to managing the presence of an invasive species, this will involve conducting a CBA for each of the management options, including of course the option of not taking any action. The different options are then ranked according to their net present benefit and, together with an appropriate risk assessment, are used to inform decisions.

In both cases the reason for the presence or willingness to import the invasive water fowl should be examined carefully. In some cases it may be that a lucrative trade in ornamental waterfowl supports the conservation of those species in their indigenous range state or the presence of an invasive species may support local livelihoods. In these sort of cases the scope may need to be broadened (see below).

The Basic Parameters of a Cost Benefit Analysis

CBAs are carried out in similar ways, which involve six main steps[iii];

1. Policy/Project Definition – this involves setting out exactly what is being analysed. The difficulty in this regard will be defining the population or area covered, i.e. should the analysis of controls include cost and benefits associated with countries where the invasive species is not yet established? Amongst other aspects, this decision will be influenced by whether other countries are willing to pay or not.
2. Identifying Impacts
   Adapting from an FAO description[iv] there are eight main impact groupings not all of which may be entirely applicable to any one case.
   i. Production Impacts – mainly associated with the host country and the impacts an invasive waterfowl could have on local water fowl production (these could be positive i.e. increasing production) or agriculture in general. Part of this will include the spread of zoonoses.
   ii. Price and Market Impacts – if trade issues are concerned how will an introduction or actions affect prices and markets of the waterfowl, the invasive species and other affected species?
   iii. Trade Impacts – this aspect can be very important for commodities affected by invasive species (particularly insects & diseases). With regards to waterfowl this aspect will most likely only be of significant importance in relation to disease and potential trade restrictions following outbreaks in the host country. None the less it should be explored.
   iv. Food Security & Nutritional Impacts – this examines the extent to which an invasion can either impact on the domestic supply of food or impact ~~a countries~~a country's international trade (as above) and thus have impacts on food security. ~~–~~This is particularly important in developing countries and most often of crucial importance at local levels, where the impacts may well be positive.
   v. Human Health – this is related mainly to potential disease in the case of water fowl the potential for invasive species to bring about avian influenza, this may relate to increased densities of waterfowl if the invasion takes such a form.
   vi. Social Impacts – this relates to assessing the impacts on society, e.g. if not managed properly the eradication of an invasive species could become too costly in terms of local acceptance of conservation e.g. removing a waterfowl in local communities without a suitable substitute.
   vii. Financial Costs Impacts – this covers measures taken at the individual, community, national and international levels to prevent, control, eradicate or mitigate invasive waterfowl.
   viii. Environmental Impacts – it should go without saying that with~~in~~ respect to~~of~~ AEWA, the Environmental impacts are crucial as the Agreement concerns the conservation of native waterfowl. But consideration should also be given to wider environmental impacts e.g. on fragile habitats etc.

In general attention needs to be paid to all these aspects to avoid focusing only on the commercial impacts, which quite often tends to be the case[1].

3. Valuing Impacts – one of the important aspects of a CBA is that impacts are expressed in monetary terms, allowing them to be compared. There are well developed tools for this and this should be conducted by a competent economist.
4. Discounting of costs and benefits – this is a crucial aspect as all costs and benefits should be translated into present values, using what is known as a discount rate. This assumes that we value things differently in the

[9] See http://www.wto.org/english/tratop_e/sps_e/sps_e.htm also available in FR & ES.

present than we do in the future, most often we value things more in the present. In such a case an impact that may occur in five~~5~~ years that is valued at X will in fact be expressed as less than X in present value.

5. Applying the net present value test – each course of action is then calculated in terms of its net present value and these are then ranked to present the most favourable options.
6. Sensitivity Analysis – because there is always uncertainly it is good practice to test the sensitivity of results to changes which may occur in different parameters.

Recommendations

CBAs are very important for informing policy decisions regarding Invasive Alien Waterfowl and every effort should be made to use them when examining possible courses of action. Despite this, it is recognized that the requirements of a CBA may be beyond the means, in respect of data and/or capacity, of many contracting Parties to AEWA. In addition such analyses can be very time- consuming. Therefore, in the case where resources are limited or rapid decisions are required careful use can be made of a benefit transfer approach, where data is extrapolated from similar cases to at least produce initial results. This is a suggested approach for the EC Environmental Liability Directive[v].

In all cases the use of a CBA will be improved if the following guidelines are followed[vi]

- The CBA should be an essential part of regulatory decisions or major actions concerning invasive alien waterfowl, especially where decisions and actions involve costs to tax payers.
- Governmental agencies should not however be bound by the outcomes of such CBAs as other criteria (e.g. environmental or social impacts) may be judged more important in some situations
- Costs and benefits should be quantified but uncertainties should be explicitly set out.
- CBAs should be subject to external reviews to keep up good practice and avoid institutional bias.
- The CBA should use core economic assumptions taken from recognized sources, e.g. World Bank, UN, OECD etc. The assumptions include the discount rate, economic value of a life, health etc.
- The CBA should present information on the distributional impacts of and regulation or action, to show who stands to gain and who stands to loose.

If these basic criteria are met they should result in a CBA that facilitates a transparent decision making process. In the case of invasive species this is often most important because the costs of taking action against an invasion are often easily portrayed when in fact the benefits of taking action are more intangible. With a CBA these should then be comparable.

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