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The status of introduced non-native waterbirds in Eurasia and Africa in 2007

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A review was carried out to investigate the status of introduced non-native waterbird species in countries within the area covered by the Agreement on the Conservation of African–Eurasian Migratory Waterbirds (AEWA). A combination of literature review and questionnaires, sent to expert ornithologists, conservationists, academics and civil servants in 116 countries in the AEWA area, was used to obtain the best available information on the current status of introduced waterbirds in each country. Replies were received from at least one correspondent in each of 89 countries. During the past 20 years, 120 introduced waterbird species had been recorded in the AEWA area. Of these, 32 had been recorded breeding more than five times in the wild, 27 had fewer than five breeding records and a further 61 species had been introduced but were not thought to have bred. Countries with the highest numbers of introduced waterbirds tended to be in Western Europe, with the number of introduced species per country broadly related to per-capita GDP. The majority (73%) of introduced waterbird species were Anatidae (ducks, geese and swans). A range of impacts to native biodiversity were either known or suspected to be caused by introduced waterbirds. These included hybridization or competition with native species and eutrophication or other habitat damage. Only one species was recorded to predate native species directly. We found no example where studies had attempted to quantify impacts on the population trends of native species. Although international legislation exists to limit the introduction of non-native species, many countries reported having no national legislation to prevent introductions from occurring. Where legislation does exist, it is often poorly enforced and accidental escapes or purposeful introductions still occur in many countries. A small number of control schemes were reported, with variable efficacy.

Introduction

Introduced species can cause a wide range of ecological problems (Manchester & Bullock 2000) and are considered by some to be one of the world's greatest threats to biodiversity (Vitousek *et al.* 1997, Smith *et al.* 2005). The Millennium Assessment concluded that invasive alien species were one of the most important direct drivers of biodiversity loss and ecosystem service changes (Millennium Ecosystem Assessment 2005). Introduced non-native waterbirds may contribute to this problem, and because of this there has been increasing interest in assessing the status and impacts of introduced non-native waterbirds in recent years (Blair *et al.* 2000, Kestenholtz *et al.* 2005, Rehfisch *et al.* 2006, Rhymer 2006, Williams & Basse 2006).

The Agreement on the Conservation of African–Eurasian Migratory Waterbirds (AEWA) was developed under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and entered into force in 1999. Its Secretariat is administered by the United Nations Environment Programme. The aims of the AEWA are to maintain or restore species to a favourable conservation status through co-ordinated

conservation actions (set out in the AEWa Action Plan) for the waterbirds using the migratory system within 118 countries ranging from the Middle East to Greenland and from Africa to Europe. Introduced non-native waterbirds are one of the key issues set out in the AEWa Action Plan, which recommends regular international reviews of the status of introduced non-native waterbirds across the AEWa region are carried out. The first such review was conducted in 1999 (Blair *et al.* 2000); here we report some of the findings of a second review carried out in 2007 (Banks *et al.* 2008), which provides an up-to-date assessment of the current status of introduced waterbirds across the AEWa region. For the purpose of this study, waterbirds were defined as divers, grebes, pelicans, cormorants, herons, storks, ibises, spoonbills, flamingos, swans, geese, ducks, cranes, rails, gallinules, coots, waders, gulls and terns (following Wetlands International 2006).

Non-native waterbirds have been introduced in many countries around the world, and prior to this study many species were known to have well-established, and often increasing, populations in various countries. For example, in the Netherlands the Egyptian Goose *Alopochen aegyptiaca* had increased from a single breeding record in 1967 to 4500–5000 pairs by the time of the latest breeding atlas in that country in 1998–2000 (SOVON 2002), while in the United Kingdom and many other European countries there are large and increasing populations of Greater Canada Geese *Branta canadensis* (e.g. SOVON 2002, Austin *et al.* 2007). However, in addition to these relatively well-studied species, many species of non-native waterbirds have been introduced only in small numbers and there is a lack of comprehensive and up-to-date information regarding their status.

The aim of this study was thus to provide a comprehensive summary of the current status of all known introduced waterbird species in the AEWa region, based on the best information available. Specifically, this paper investigates the following questions: (i) is the number of introduced waterbird species related to a country's wealth? (ii) which waterbird families are the most likely to be introduced? (iii) what threats are posed to native biodiversity by introduced waterbirds? (iv) what legislation is in place to prevent the introduction of non-native species, and is such legislation effective?

Methods

To obtain the best available information regarding introduced waterbirds in the AEWa range, a combination of methods was employed. Searches of peer-reviewed published literature and grey literature were carried out, and questionnaires were sent to expert correspondents in each country within the AEWa range. Although the correspondents were experts in their fields, such information cannot be considered as rigorous as peer-reviewed published data. Priority was therefore given to information from published peer-reviewed literature, followed by questionnaire responses from expert correspondents, followed by information from the grey literature. Questionnaire correspondents were asked to provide sources of information in either published or grey literature, and thus grey literature from the study countries was obtained largely through information provided by questionnaire correspondents, although some was found through citations given in other sources used in the literature review. Published peer-reviewed information was obtained both through information provided by questionnaire correspondents, and by searching Web of Science for each introduced waterbird species mentioned by questionnaire correspondents. The search aimed to identify articles containing either the English or the scientific name of the species as well as either the term 'introduced' or 'non-native', such that four separate combinations for each species would return results: (i) the English name plus the word 'introduced', (ii) the English name plus the term 'non native', (iii) the scientific name plus the word 'introduced' and (iv) the scientific name plus the term 'non native'. All peer-reviewed and grey literature was cross-referenced so that any potentially useful references cited by the articles found in the literature review were also obtained and included in the review if they contained appropriate information.

Correspondents were identified and targeted in three ways. First, the AEWA database of ‘Focal Points’ for range states was used. Secondly, established international contacts were approached, resulting either from links with British Trust for Ornithology from other projects, or having participated in the previous non-native waterbird review (Blair *et al.* 2000). Thirdly, an extensive search of internet and library resources was undertaken to generate contacts for specific countries. All contacts were emailed or posted details of the review and invited to complete a comprehensive questionnaire to give information regarding the numbers, breeding status, origin of introduction and impacts of each species of introduced waterbird, what legislation or policies were in place to prevent further introductions, or to control existing populations in their country, and the efficacy of legislation and policies (a copy of the questionnaire is given in Appendix 2). Responses were sought from at least one politician or civil servant and at least one conservationist or ornithologist in each country in order to receive expert input to all aspects of the review. Many correspondents had access to data from national waterbird monitoring schemes (such as the Wetland Bird Survey in the UK (Austin *et al.* 2008), the Waterbird Census Scheme in the Netherlands (van Roomen *et al.* 2007) or the International Waterbird Census (Wetlands International 2006)); in other cases only qualitative data were available.

Correspondents were first contacted in March 2007. Reminders were sent at periodic intervals until October 2007, and any new contacts discovered (such as those recommended by initial correspondents) were approached immediately. Towards the end of the review period, the countries where major gaps in knowledge remained (from a lack of responses) were targeted by searching for new contacts, often made through others not directly linked with waterbird research or policy. Questionnaires were sent to correspondents in 116 states; 101 responses were received from 89 states (i.e. 77% of the countries).

Introduced waterbirds were split into three groups: species that had more than five recorded breeding attempts across all AEWA range states in the past 20 years, those that had fewer than five recorded breeding attempts in the past 20 years and those that were not known to have bred. In cases where there were no data on the number of breeding attempts, species that were described as having bred ‘annually’, ‘regularly’ or whose populations were described as ‘widespread’, ‘established’ or ‘self-sustaining’ were considered as having bred more than five times, while those that were described as having bred ‘occasionally’, ‘rarely’ or ‘not in recent years’ were considered as part of the group with fewer than five recorded breeding attempts.

Introduced species that had been recorded breeding more than five times were further divided into those with increasing populations, populations with stable or unknown trends, those with declining populations, or those that bred only occasionally or in very small numbers. The impacts or potential risks caused by those introduced waterbird species that had bred more than five times were divided into seven categories (Table 1).

Table 1. Categories of impacts or potential risks of introduced waterbird species.

Category	Impact or potential risk
1	Predation of native birds, eggs or young
2	Competitive exclusion of native species, or aggressive to native species
3	Hybridization with native species
4	Eutrophication or pollution of waterbodies
5	Damage to natural or semi-natural habitats
6	Damage to man-made habitats or crops
7	Introduced birds prevent accurate monitoring of numbers of naturally occurring birds of the same species

The relationship between the numbers of introduced species recorded in each country and the values of their associated per-capita GDP in 2007 was investigated using a generalized linear model with log link function and negative binomial error. The per-capita GDP of each country was obtained from the United Nations Statistics Division.

The number of introduced species in each waterbird family was expressed as a percentage of the total number of extant species in that family in the world (taken from Wetlands International 2006).

Results

In the 89 AEWAs for which data were available (questionnaires returned), a total of 120 introduced waterbird species had been recorded during the last 20 years. Of these species, 32 had been recorded breeding more than five times in the wild, 27 had fewer than five breeding records and a further 61 had been introduced but were not thought to have bred in the wild in the countries in which they were introduced. A complete list of species is given in Appendix 1. The estimated population size of each species was compared with that reported in a previous review carried out in 1999 (Blair *et al.* 2000). Of the 32 introduced species that had bred more than five times, 15 had increasing populations, 10 had relatively stable populations and one, the Ruddy Duck *Oxyura jamaicensis*, had a declining population. The remaining six species had localized populations where breeding occurred only occasionally (fewer than five breeding attempts per year).

Countries reporting the highest numbers of introduced waterbird species tended to be in Western Europe, with fewer in other parts of the AEWAs range with the exception of South Africa and the United Arab Emirates. The UK had 112 species of introduced waterbird, far higher than any other country, with the next highest numbers of species per country being in Switzerland (34), France (27) and Germany (21) (Fig. 1). Many countries in central and eastern Africa, and the Middle East, did not return questionnaires, so we do not know how many introduced waterbird species might occur in them.

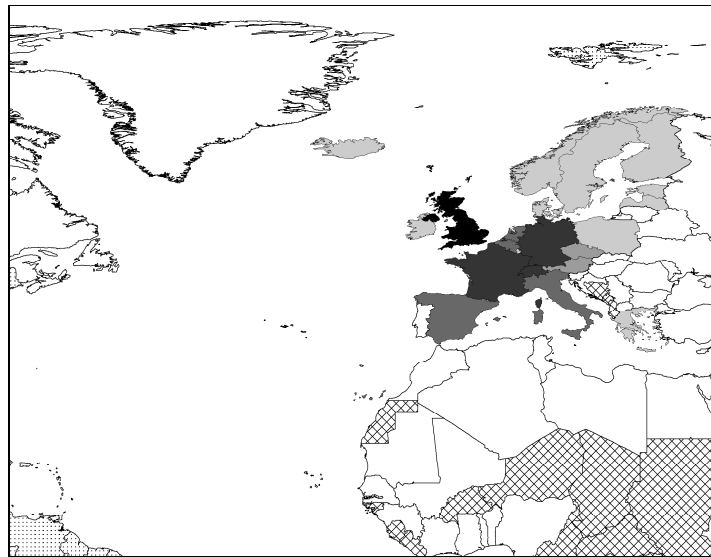


Figure 1. Number of introduced waterbird species recorded per country in 2004-07.

■ 1-5 species, ■ 6-10 species, ■ 11-20 species, ■ 21-35 species, ■ 112 species,
□ No recorded introduced waterbird species in 2007, ⊠ no data, ▨ non-AEWAs countries.

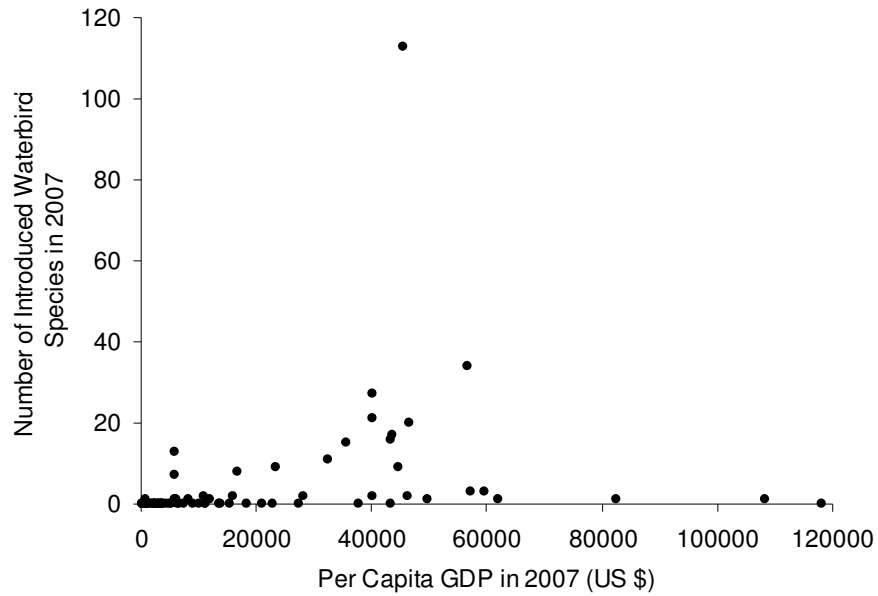


Figure 2. The number of introduced waterbird species recorded in each country in relation to per-capita GDP in 2007.

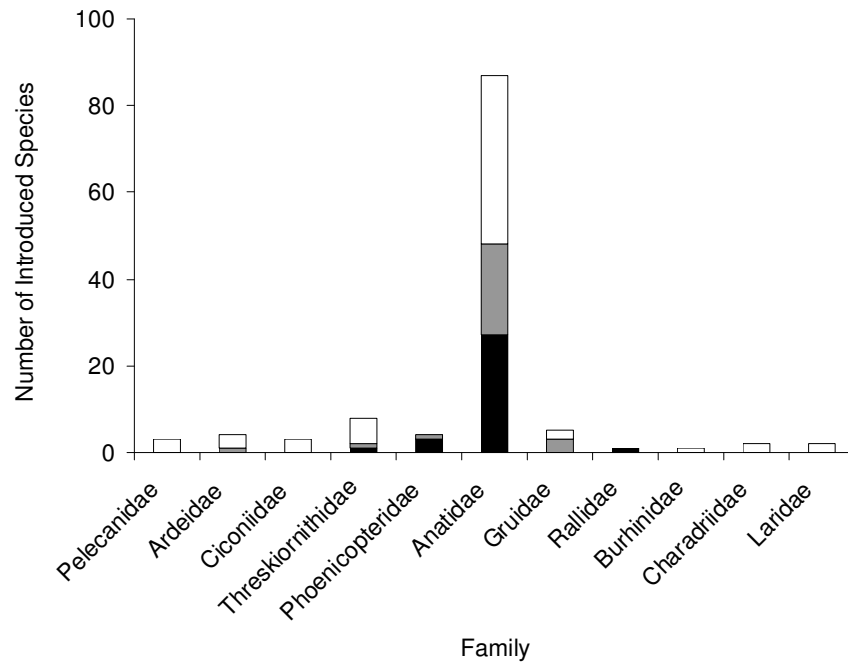


Figure 3. Numbers of introduced species in different waterbird families. Black bars are species with more than five breeding attempts recorded or suspected in the AEWA range in the past 20 years, grey bars are those with fewer than five breeding attempts and white bars are introduced species that are not thought to have bred. Waterbird families with no known introduced species in the AEWA range are not shown.

The number of introduced waterbird species recorded in a country was significantly higher in countries with higher per-capita GDP in 2007 ($\chi^2_1 = 24.4$, $P < 0.0001$) (Fig. 2); however, there was considerable variation around this trend.

The majority of introduced waterbird species (73%) were Anatidae (ducks, geese and swans) with fewer introduced species from other waterbird families (Fig. 3). Only five of the 32 introduced species that had bred more than five times in the wild were not Anatidae. These included three species of Phoenicopteridae (flamingos), one Threskiornithidae (Sacred Ibis *Threskiornis aethiopicus*) and one Rallidae (Purple Swamphen *Porphyrio porphyrio*).

As waterbird families differ in size, the proportion of extant world species of each waterbird family that occurred as introduced species in the AEWA area was also investigated. The family with the greatest proportion of its species introduced was Phoenicopteridae (flamingos), which had two-thirds of its species introduced in at least one AEWA country; however, there are only six species in this family. More than half of the extant species of Anatidae in the world (87 of 158) had been introduced in at least one country in the AEWA range (Fig. 4).

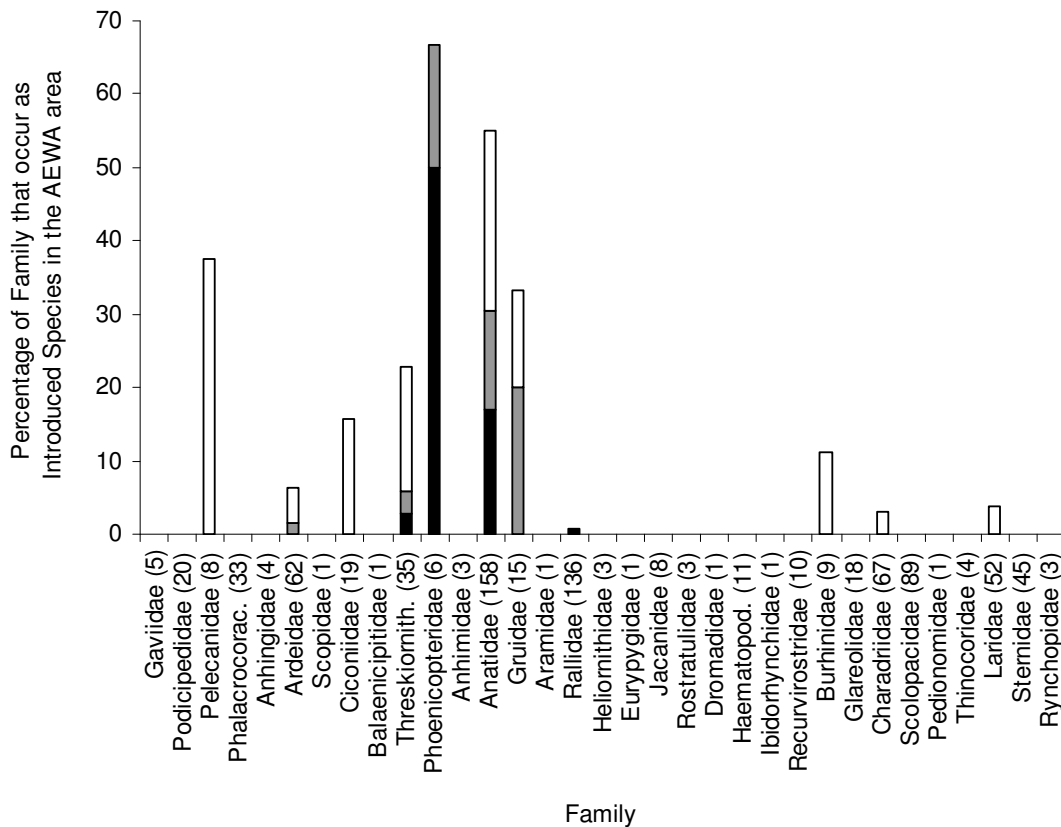


Figure 4. Percentage of species in each waterbird family that have been introduced in any part of the AEWA range. The number of extant world species in each family is shown in parentheses after the family name. Black bars are introduced species with more than five breeding attempts recorded or suspected in the AEWA range in the past 20 years, grey bars are those with fewer than five breeding attempts and white bars are introduced species that are not thought to have bred.

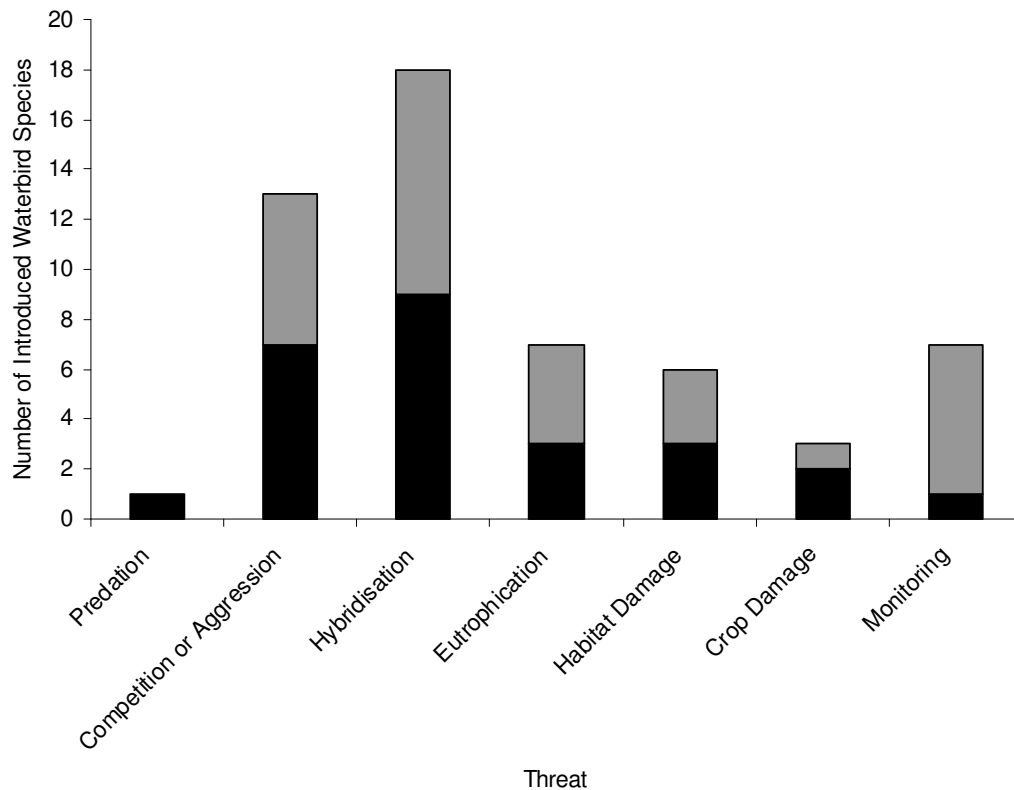


Figure 5. The number of introduced waterbird species causing each of seven threats. Black bars are species for which there is a published source that states the threat is caused. Grey bars are species for which there is no published information regarding a particular threat but for which questionnaire correspondents suggested the species may have an impact. Note that in almost all cases there is no published evidence that these threats affect the population trends of native species, but they may affect individuals, or local populations, of native species. Monitoring = introduced birds prevent accurate monitoring of native populations of the same species (e.g. some feral geese prevent accurate monitoring of native migratory populations).

Introduced waterbirds were known or suspected to have a range of impacts on native biodiversity. In some cases these impacts had been recorded in peer-reviewed published literature, but in many cases impacts were only recorded in grey literature or were suspected to occur by questionnaire correspondents but no scientific study had been carried out to support this (Fig. 5). In almost all cases impacts were only recorded or suspected to occur on a local scale, and wider population-level effects had not been examined. Although in most cases there is no published evidence that introduced waterbirds affect the population trends of native species, in some cases there is evidence that they may affect individuals, or local populations, of native species. The lack of evidence for population-level impacts could be because of a lack of studies rather than the absence of any impacts.

Hybridization with native species was the most widespread potential impact, being recorded or suspected for 18 introduced waterbird species (Fig. 5), but was thought to be relatively rare or localized in most cases. Introduced Mallard *Anas platyrhynchos* (hybridization with a range of native species including Yellow-billed Duck *Anas undulata* and globally endangered Meller's Duck *Anas melleri*) and Ruddy Duck (hybridization with globally threatened White-headed Duck *Oxyura leucocephala*) gave the greatest cause for concern in this respect.

Competitive exclusion of, or aggression towards, native species was recorded or suspected for 13 introduced waterbird species. Other impacts were recorded or suspected to be caused by a smaller number of introduced waterbird species (Fig. 5). The only introduced waterbird that had been recorded to predate native species directly was the Sacred Ibis, which may take the eggs or young of native bird species such as terns (Yésou & Clergeau 2005). Further details of the impacts caused by introduced waterbirds are given in Banks *et al.* (2008).

Not all questionnaire correspondents answered the question about whether there were any measures to stop the introduction of non-native waterbirds in their country (for 32 of 89 countries there was no response to this question), but of those that did answer (57 countries), more than half (34 countries, 54% of those that answered) stated that there was some kind of legislation, permit system or other restriction on the import of non-native species. However, correspondents from 26 countries did not know of any restrictions, or stated that their country had restrictions that applied only to certain parts of the country (e.g. nature reserves, or particular provinces). Countries with no known restrictions were usually those that currently have few introduced waterbirds, although some countries with few or no known introduced waterbirds had quite stringent legislation.

Many countries reported that legislation designed to prevent the introduction of non-native species was not well enforced, and that better enforcement was required for the restrictions to be effective. Shaw (2006) states that despite legislation to prevent the introduction of non-native species being in place, introductions still occur. Furthermore, in some countries legislation on the introduction and control of non-native species is implemented by local or provincial authorities, rather than on a national scale, and this can lead to a lack of co-ordination in terms of both preventing introductions but also in implementing effective control programmes. For example, in South Africa, where introduced Mallards are very invasive and readily hybridize with some native species, conservation bodies in some provinces are actively culling Mallards and Mallard hybrids, while other provinces are less active. Correspondents from this country suggested that co-ordinated eradication plans should be implemented by the national government in all nine provinces, rather than being organized on a provincial scale.

Although more than half of the countries reported some kind of legislation to limit the introduction of non-native species, such legislation has often been introduced relatively recently (in the last 5–20 years). A correspondent from one country reporting having only draft legislation at the present time. This means that unlimited introductions could have occurred legally in the past in most countries, and numerous populations of introduced species in the AEW region are thought to derive from introductions that occurred before there was legislation to prevent them.

Control schemes have been implemented for only a small proportion (six of 32 regularly breeding species) of introduced waterbirds in the AEW region, with variable efficacy. A small number of correspondents reported that non-native species had been effectively removed from their country when their populations were still small and localized, and could be controlled with relative ease. Control schemes for more widespread species, such as feral geese, had been implemented on local scales in various countries. However, because these schemes have only been implemented on a local scale they have had negligible impact on the population as a whole. The only control scheme that has been implemented across the range of an introduced waterbird species is the ongoing Ruddy Duck eradication plan, which is part of the International Species Action Plan for White-headed Duck. Ruddy Ducks have been virtually eliminated from Spain and numbers have declined by more than 50% in the UK (Worden *et al.* 2007). Birds have also been controlled in several other countries, including a large number in France (Hughes *et al.* 2006, Dubois 2007).

Discussion

Many non-native waterbird species have been introduced across the AEW region, but the pattern of introductions is by no means uniform, with most occurring in Western Europe. Wealthier countries tended to have more introduced waterbird species than poorer countries, but per-capita GDP alone only explained a small proportion of the variation in the number of introduced species. Other factors such as a country's size and climate may also affect the number of introduced waterbird species. Eleven countries had high per-capita GDP (more than \$35 000 in 2007) but fewer than five introduced waterbird species. These were (from highest to lowest GDP) Liechtenstein, Luxembourg, Norway, Iceland, Ireland, Denmark, Sweden, Finland, Canada (only the NE Arctic Islands of Canada are part of the AEW area) Monaco and Greenland. These countries (with the exception of Ireland) are either very small or have harsh climates, which may limit the survival of introduced species. Ireland reported more than twice the number of introduced species in a review in 1999 (Blair *et al.* 2000) compared with this review, and it seems likely that the number of introduced waterbirds in this country could have been under-reported in the 2007 review.

Non-native waterbirds were largely considered to have been introduced either for ornamental reasons or as accidental escapes from captivity (zoos or other collections) (Hughes *et al.* 1999, Lever 2005, Rehfishch *et al.* 2006). However, some had been introduced for hunting or farming purposes and, in some countries, certain non-native species derived from the spread of established introduced populations in neighbouring countries, for example Ruddy Duck populations in many European countries are thought to result from the spread of the UK population (Green & Hughes 1996). Because captive or ornamental collections are almost exclusively found in wealthier countries, it is not surprising that these countries have the highest numbers of introduced waterbird species. The historical culture of the country is also likely to have had a major effect on the number of introduced waterbirds. In countries with similar per-capita GDP the prevalence of exotic bird collections and thus the number of waterbird species that escape to form introduced populations is very variable.

The UK held many more introduced waterbird species than any other country. This result could be due partly to the excellent recording systems in place in the UK (Holling & the Rare Breeding Birds Panel 2007, Austin *et al.* 2008), which mean that introduced waterbirds are more likely to be recorded than in some other countries. However, excellent monitoring and recording schemes are in place in other countries in the AEW region, such as the Netherlands (SOVON 2002, van Roomen *et al.* 2007) and Switzerland (Keller 2008, Keller & Burkhardt 2008), which reported many fewer introduced waterbird species than the UK. The high number of introduced waterbird species in the UK is not, therefore, simply an artefact of good monitoring, and may instead be the legacy of a long history of the collection of captive and ornamental waterbirds in the UK, where such collections are thought to have occurred more widely than in other countries (Blair *et al.* 2000). Correspondents from many countries (including the UK) reported that introduced non-native species were often ignored by birdwatchers and may therefore be under-recorded, but there is no evidence to suggest that this is any more or less prevalent in the UK compared with other countries.

Seventy-three per cent of introduced non-native waterbirds were Anatidae, and although this is a relatively large family, with 158 extant world species, more than 50% of these species had been introduced in the AEW region, a higher proportion than any other family except Phoenicopteridae (flamingos). The reasons for this are not known. It could be that Anatidae have been more widely introduced as ornamental or captive birds than other waterbirds. They may be desirable as ornamental or captive species because of their relatively large size and ease of visibility, and the fact that many species thrive on open lakes or ponds such as those found in parks and gardens, and are therefore relatively easy to keep. Alternatively, Anatidae may be introduced at a similar frequency to other waterbirds but may be more likely to escape and establish wild populations, either because they are more adaptable to novel habitats or more able to compete with native species, or because they are able

to find similar environments to their natural habitats in many parts of the AEWA region. This issue could be explored further by obtaining information on the frequency of different waterbird species in captive collections in each country, which would be a valuable further study.

Although hybridization and competition were the most widely reported threats to native species caused by introduced non-native waterbirds, more rarely reported threats, such as direct predation of native species by introduced Sacred Ibises (Yésou & Clergeau 2005), may have a greater impact on native biodiversity. However, we found no studies where the magnitude of these impacts, in terms of causing changes in the abundance of native wildlife, had been quantified (Banks *et al.* 2008). The impacts of introduced non-native waterbirds on native biodiversity in the AEWA region are discussed in greater detail in Banks *et al.* (2008).

International legislation such as the Convention on Biological Diversity aims to prevent the introduction of, and control or eradicate, any non-native species that threaten native ecosystems, habitats or species. AEWA also requires that countries which are Contracting Parties to the Agreement take action to prevent the introduction of non-native species that may have detrimental effects on native waterbirds, implement precautions to avoid the accidental escape of captive non-native birds and ensure that non-native species which have already been introduced do not pose a threat to native species. However, it has been suggested that although sufficient international legislation exists to limit the introduction of non-native waterbirds, at the national or provincial scale legislation is often inadequate or ineffective (Shaw 2006). This suggestion was upheld in our review, as correspondents from 26 countries reported having no legislation to prevent the introduction of non-native waterbirds, or having limited legislation that only applied to certain parts of the country. Correspondents from countries that had legislation to prevent the introduction of non-native waterbirds reported that this was often poorly enforced due to a lack of resources. Preventing introductions and escapes of non-native waterbirds is likely to be the most cost-effective as well as the most ecologically sound strategy in terms of minimizing their impact on native biodiversity, and strengthening and enforcing legislation to this effect should be a priority.

Locally implemented control schemes had negligible impact on established and widespread non-native waterbird populations. Control was cheapest and most likely to be effective if implemented when populations were small. The internationally coordinated Ruddy Duck eradication plan is the only example of a control programme that has been implemented across the range of an established and widespread introduced waterbird. Although this is the only effective example of control measures reducing the population of an established non-native waterbird species, the long-term success of the project remains to be seen.

Conclusions

A large number of introduced waterbird species have been introduced in the AEWA region, particularly in more affluent countries. Around half of the species that had become established had increasing populations (e.g. Lensink 1999, SOVON 2002, Austin *et al.* 2007), while only one, the Ruddy Duck, which is subject to a control scheme, had a declining population (Worden *et al.* 2007, Austin *et al.* 2008). The Convention on Biological Diversity and the African–Eurasian Waterbird Agreement require countries to prevent the introduction of any non-native species that threaten native ecosystems, habitats or species. However, the impacts of non-native waterbirds on native biodiversity are often not known due to a lack of comprehensive studies of most species, and therefore it is difficult to predict which species could threaten native biodiversity prior to their introduction. Control following introduction is not only difficult and costly, it also raises ethical concerns and can be controversial (Bremner & Park 2007). Although there are few demonstrable impacts of non-native waterbirds on native biodiversity, this is likely to be the result of a lack of study rather than the absence of any impacts, as many species are suspected of having impacts. We suggest that a precautionary principle could be adopted in all countries to prevent the introduction of any new non-native waterbirds, regardless of whether they are known to

have a detrimental effect on native biodiversity. Legislation to prevent introductions is often incomplete or poorly enforced, and more resources are required to make such legislation effective.

This study has highlighted the acute shortage of scientific study of the impacts of introduced non-native waterbird species on native biodiversity. Although some localized impacts had been quantified, we found no studies that attempted to quantify or predict population-level effects on native species. We suggest that this should be a priority for further study, perhaps focusing on the most widespread species (e.g. Greater Canada Goose and Egyptian Goose in northwest Europe) or those where potential impacts give the greatest cause for concern (e.g. Mallard in southern Africa, Madagascar and Mauritius, Sacred Ibis in northwest Europe). In order to study the impacts of non-native waterbird species it is vital that we have good information regarding their distribution and abundance. We therefore suggest that it is important to encourage the recording of non-native waterbird species in existing waterbird monitoring schemes, and to encourage the development of schemes to monitor waterbirds, including non-native species, in countries where they do not currently exist.

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APPENDIX 1

Complete list of the English and scientific names of introduced non-native waterbird species in the AEWA region: (a) species with more than five breeding records during the last 20 years; (b) species with fewer than five breeding records during the last 20 years; (c) introduced species that are not known to have bred in the AEWA region. In all three tables, the species order follows the IOC World Bird List (Gill & Donsker 2010), and nomenclature for species not on the British List (<http://www.bou.org.uk/thebritishlist/British-List-2010.pdf>) is also taken from this source.

(a)

English name	Scientific name
White-faced Whistling Duck	<i>Dendrocygna viduata</i>
Swan Goose	<i>Anser cygnoides</i>
Bean Goose	<i>Anser fabalis</i>
Pink-footed Goose	<i>Anser brachyrhynchus</i>
Greylag Goose	<i>Anser anser</i>
Greater White-fronted Goose	<i>Anser albifrons</i>
Lesser White-fronted Goose	<i>Anser erythropus</i>
Bar-headed Goose	<i>Anser indicus</i>
Snow Goose	<i>Chen caerulescens</i>
Emperor Goose	<i>Chen canagica</i>
Greater Canada Goose	<i>Branta canadensis</i>
Barnacle Goose	<i>Branta leucopsis</i>
Black Swan	<i>Cygnus atratus</i>
Mute Swan	<i>Cygnus olor</i>
Whooper Swan	<i>Cygnus cygnus</i>
Egyptian Goose	<i>Alopochen aegyptiaca</i>
Upland Goose	<i>Chloephaga picta</i>
Ruddy Shelduck	<i>Tadorna ferruginea</i>
Muscovy Duck	<i>Cairina moschata</i>
Wood Duck	<i>Aix sponsa</i>
Mandarin Duck	<i>Aix galericulata</i>
Gadwall	<i>Anas strepera</i>
Eurasian Wigeon	<i>Anas penelope</i>
Mallard	<i>Anas platyrhynchos</i>
Meller's Duck	<i>Anas melleri</i>
Red-crested Pochard	<i>Netta rufina</i>

Ruddy Duck	<i>Oxyura jamaicensis</i>
Greater Flamingo	<i>Phoenicopterus roseus</i>
American Flamingo	<i>Phoenicopterus ruber</i>
Chilean Flamingo	<i>Phoenicopterus chilensis</i>
Sacred Ibis	<i>Threskiornis aethiopicus</i>
Purple Swamphen	<i>Porphyrio porphyrio</i>

(b)

English name	Scientific name
Black-bellied Whistling Duck	<i>Dendrocygna autumnalis</i>
Fulvous Whistling Duck	<i>Dendrocygna bicolor</i>
Ross's Goose	<i>Chen rossii</i>
Nene	<i>Branta sandvicensis</i>
Red-breasted Goose	<i>Branta ruficollis</i>
Trumpeter Swan	<i>Cygnus buccinator</i>
Common Shelduck	<i>Tadorna tadorna</i>
South African Shelduck	<i>Tadorna cana</i>
Ringed Teal	<i>Callonetta leucophrys</i>
Cape Teal	<i>Anas capensis</i>
Chiloe Wigeon	<i>Anas sibilatrix</i>
American Black Duck	<i>Anas rubripes</i>
Blue-winged Teal	<i>Anas discors</i>
Cinnamon Teal	<i>Anas cyanoptera</i>
Chestnut Teal	<i>Anas castanea</i>
White-cheeked Pintail	<i>Anas bahamensis</i>
Speckled Teal	<i>Anas flavirostris</i>
Northern Pintail	<i>Anas acuta</i>
Hottentot Teal	<i>Anas hottentota</i>
Marbled Duck	<i>Marmaronetta angustirostris</i>
Ferruginous Duck	<i>Aythya nyroca</i>
Lesser Flamingo	<i>Phoeniconaias minor</i>
African Spoonbill	<i>Platalea alba</i>
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>

Grey Crowned Crane	<i>Balearica regulorum</i>
Black Crowned Crane	<i>Balearica pavonina</i>
Sarus Crane	<i>Grus antigone</i>

(c)

English name	Scientific name
Magpie Goose	<i>Anseranas semipalmata</i>
West Indian Whistling Duck	<i>Dendrocygna arborea</i>
Lesser Whistling Duck	<i>Dendrocygna javanica</i>
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>
Brant Goose	<i>Branta bernicla</i>
Coscoroba Swan	<i>Coscoroba coscoroba</i>
Black-necked Swan	<i>Cygnus melanocoryphus</i>
Comb Duck	<i>Sarkidiornis sylvicola</i>
Blue-winged Goose	<i>Cyanochen cyanoptera</i>
Orinoco Goose	<i>Neochen jubata</i>
Raja Shelduck	<i>Tadorna radjah</i>
Australian Shelduck	<i>Tadorna tadornoides</i>
Paradise Shelduck	<i>Tadorna variegata</i>
Maned Duck	<i>Chenonetta jubata</i>
Falcated Duck	<i>Anas falcata</i>
American Wigeon	<i>Anas americana</i>
Philippine Duck	<i>Anas luzonica</i>
Yellow-billed Duck	<i>Anas undulata</i>
Red Shoveler	<i>Anas platalea</i>
Australasian Shoveler	<i>Anas rhynchotis</i>
Red-billed Teal	<i>Anas erythrorhyncha</i>
Yellow-billed Pintail	<i>Anas georgica</i>
Baikal Teal	<i>Anas Formosa</i>
Silver Teal	<i>Anas versicolor</i>
Rosy-billed Pochard	<i>Netta peposaca</i>
Canvasback	<i>Aythya valisineria</i>
Redhead	<i>Aythya americana</i>
Common Pochard	<i>Aythya farina</i>

Baer's Pochard	<i>Aythya baeri</i>
New Zealand Scaup	<i>Aythya novaeseelandiae</i>
Ring-necked Duck	<i>Aythya collaris</i>
Tufted Duck	<i>Aythya fuligula</i>
Bufflehead	<i>Bucephala albeola</i>
Barrow's Goldeneye	<i>Bucephala islandica</i>
Hooded Merganser	<i>Lophodytes cucullatus</i>
Black-headed Duck	<i>Heteronetta atricapilla</i>
Lake Duck	<i>Oxyura vittata</i>
Maccoa Duck	<i>Oxyura maccoa</i>
White-headed Duck	<i>Oxyura leucocephala</i>
Yellow-billed Stork	<i>Mycteria ibis</i>
Black Stork	<i>Ciconia nigra</i>
White Stork	<i>Ciconia ciconia</i>
Straw-necked Ibis	<i>Threskiornis spinicollis</i>
Buff-necked Ibis	<i>Theristicus caudatus</i>
Scarlet Ibis	<i>Eudocimus ruber</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Puna Ibis	<i>Plegadis ridgwayi</i>
Eurasian Spoonbill	<i>Platalea leucorodia</i>
Yellow Bittern	<i>Ixobrychus sinensis</i>
Chinese Pond Heron	<i>Ardeola bacchus</i>
Cattle Egret	<i>Bubulcus ibis</i>
Great White Pelican	<i>Pelecanus onocrotalus</i>
Pink-backed Pelican	<i>Pelecanus rufescens</i>
Dalmatian Pelican	<i>Pelecanus crispus</i>
Demoiselle Crane	<i>Anthropoides virgo</i>
Common Crane	<i>Grus grus</i>
Peruvian Thick-knee	<i>Burhinus superciliaris</i>
Blacksmith Lapwing	<i>Vanellus armatus</i>
Spur-winged Lapwing	<i>Vanellus spinosus</i>
Grey-hooded Gull	<i>Larus cirrocephalus</i>
Silver Gull	<i>Larus novaehollandiae</i>

APPENDIX 2

Copy of (a) the general questionnaire and (b) the supplementary questionnaire sent to correspondents. All correspondents filled out the general questionnaire, with the supplementary questionnaire being filled out by those who were able to provide additional information. The questionnaire was made available in French and English, and was available as a downloadable Microsoft Excel spreadsheet to be completed electronically, as well as the text version shown here.

APPENDIX 2A

**REVIEW OF THE STATUS OF INTRODUCED NON-NATIVE WATERBIRDS & THEIR EFFECTS:
 GENERAL QUESTIONNAIRE**

The questionnaire is in three parts: 1. General information about introduced waterbirds in your country; 2. Details of the size and status of populations of introduced species, including information about hybrids and threats to native species; 3. Further sources of information that we can use. Any **non-native introduced waterbird species** which you know of should at least be mentioned. If you have more detailed comments to make, please do so in Part 3 or in the space on the final page. There is also a **Supplementary Questionnaire** for more specialist knowledge of introduced species.

Please tell us which **country** you are reporting on. You may report on any country for which you have a detailed knowledge of non-native waterbirds.

Please tell us your details. Please enter your title, full name, email and postal address and telephone / fax number here:

UK DATA PROTECTION ACT: Your personal details may be kept on a computer database to allow the possibilities of exploring responses more deeply and of developing feedback. If you do not want to be contacted by any third party as a result of this, please put a mark in this box

I. GENERAL INFORMATION

1.1 INTRODUCED NON-NATIVE WATERBIRDS		Yes	No
1.	Do you know of any collections of non-native waterbirds in your country?	<input type="checkbox"/>	<input type="checkbox"/>
2.	Do you know of any deliberately or accidentally introduced populations of waterbirds in your country? 'Population' means any group larger than isolated individuals.	<input type="checkbox"/>	<input type="checkbox"/>

If you have answered **Yes** to either of these questions, please complete section 3 for each introduced species. You should print or copy a new sheet for each different species.

1.2 PROTECTION & CONTROL		Yes	No	?
1.	Have you any responsibility for preparing or applying protection or conservation measures involving introduced non-native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1a.	Please describe your responsibilities:			
2.	Do you know of any measures used to stop introduction of non-native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2a.	Please describe these measures:			
3.	Are steps taken to control non-native waterbirds / hybrids (shooting, trapping, egg-control)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3a.	Please describe these and their effectiveness:			
4.	Please describe any further action you think is needed:			

2. SPECIES INFORMATION

Please use a **new sheet** for each species you report on.

Species name (include scientific name if known) ONE ONLY PLEASE	Location (place name, grid reference or co-ordinates)	Description of area (include habitat if possible)

2.1 CONSULTATIONS, PROTECTION & CONTROL (not AEWA, Bern, Bonn & UN Conventions)		Yes	No	?
1.	Were any consultations taken before introduction of the species?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1a.	If Yes , what consultations occurred?			
2.	Are there protection measures or conservation legislation for the species?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Are these protection / conservation measures practical?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Are these protection / conservation measures applied?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4a.	How successful are these measures? Give reasons if they are not successful.			

2.2 SIZE & STATUS OF INTRODUCED WATERBIRD POPULATIONS				
		Yes	No	?
1.	Introduced waterbird species name:			
2.	When was the species first introduced?			
3.	Where was the species first introduced?			
4.	Why was the species first introduced?			
5.	Is it present all year-round?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Is it widespread?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Is it only in one area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	Does it breed in your country?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	The national population of the introduced species is how many breeding pairs?			
10.	Is its range increasing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.	Is its population increasing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.	Is its population naturally self-sustaining?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.3 EFFECT ON NATIVE WATERBIRDS & HABITATS				
1.	Does the species displace native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Does the species breed with native birds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2a.	If Yes , which native waterbirds?			
3.	Are hybrids produced?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	If Yes , do the hybrids reproduce themselves?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Is the hybrid breeding population increasing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Has the introduced species spread disease?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6a.	If Yes , which native waterbirds have been affected?			
7.	Has the species changed native habitat?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7a.	If Yes , which native waterbird habitat types have been affected?			
8.	Has the species gained from human changes?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8a.	If Yes , changes to which habitat types have been of benefit to introduced species?			
9.	Do escapes/releases add to population?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.	Does the introduced species or its hybrids present any other threat to native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10a	If Yes , what threat(s)?			

3. FURTHER INFORMATION

Please use this sheet to provide any further information or to continue your answers from previous questions.

1.	Please tell us where your information about introduced waterbird species comes from. Names and contact details (email, postal address) of other specialists, politicians or non-specialists that can add to your information are also most welcome.
2.	Please tell us anything you know about the extent of the breeding range or movements / migration of the introduced species (e.g. personal knowledge, books, references, articles, websites, etc.).
3.	Please offer any advice you have for AEWA based on the experiences your country has had with introduced waterbird species.

SPACE FOR CONTINUED COMMENTS (please state question numbers, e.g. 2.1: 2a)

APPENDIX 2B

REVIEW OF THE STATUS OF INTRODUCED NON-NATIVE WATERBIRDS & THEIR EFFECTS: SUPPLEMENTARY QUESTIONNAIRE

This supplementary questionnaire is designed to accompany the General Questionnaire and should be used where participants are able and willing to provide more detailed information on introduced waterbirds or to report information that could not be reported in the General Questionnaire. Please use additional questionnaires if there is more than one introduced species that you would like to comment on.

Please tell us which **country** you are reporting on. You may report on any country for which you have a detailed knowledge of non-native waterbirds.

Please tell us your details. Please enter your full name, email address, postal address and telephone / fax number here:

UK DATA PROTECTION ACT: Your personal details may be kept on a computer database to allow the possibilities of exploring responses more deeply and of developing feedback. If you do not want to be contacted by any third party as a result of this, please put a mark in this box <input type="checkbox"/>

S1.1 CONSULTATIONS, PROTECTION & CONTROL (excluding AEWA, Bern, Bonn & UN Conventions)

1.	Please give any details of consultations taken before introduction, protection measures and conservation legislation concerning these introduced waterbird species.
2.	Please provide any further details of the effectiveness of these actions, including whether they have failed or succeeded, and why.
3.	Please provide any further details of measures taken against introduced waterbirds and / or their hybrids, either to prevent further introductions or to control existing populations. State whether they have failed or succeeded, and why.
4.	Please describe any further remedial actions that are needed, how likely these are to occur and the likely effect on native waterbirds.

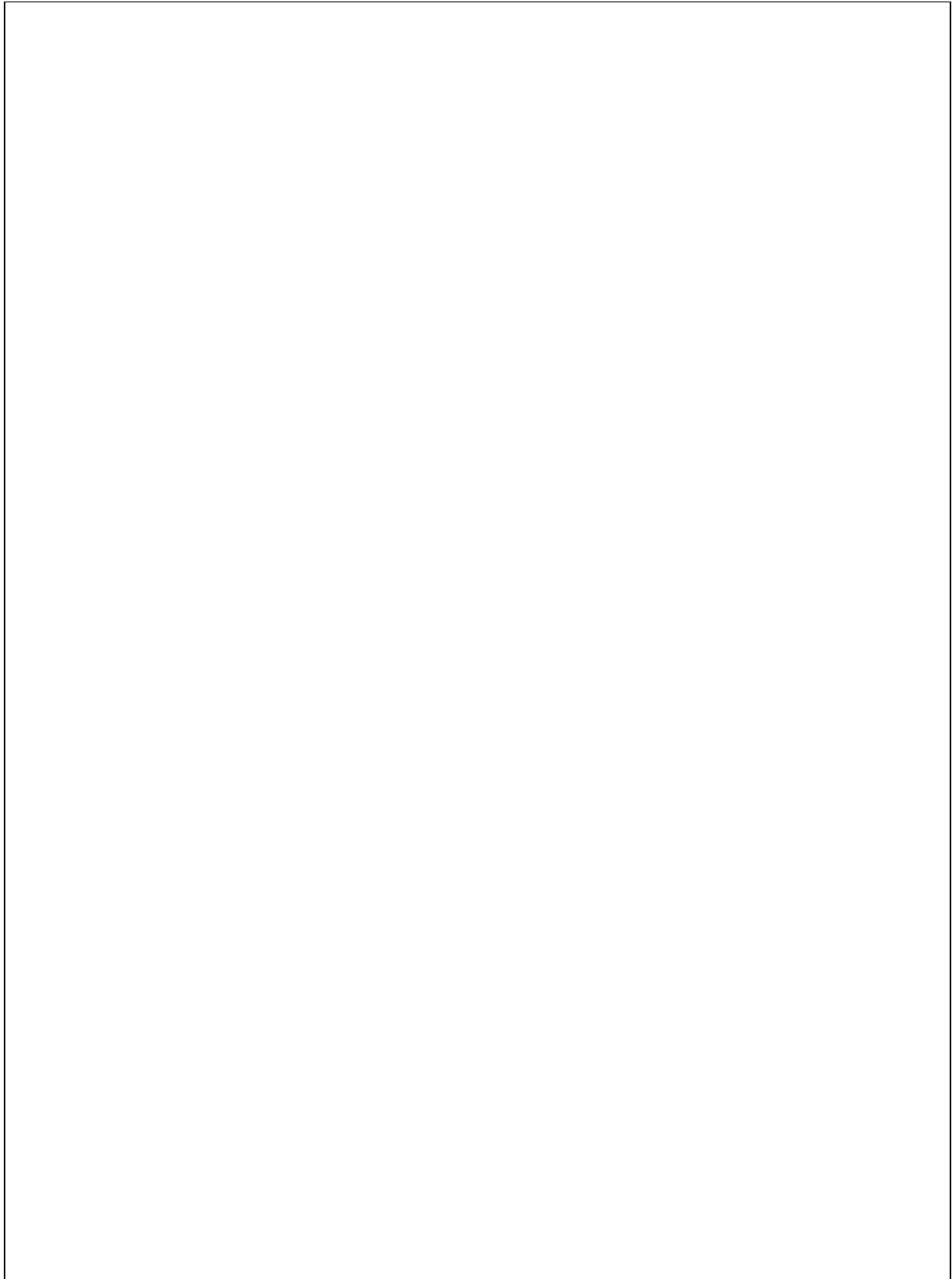
NOTES **S2.1:** **Q**=Quantitative (e.g. survey data or counts); **U**=Unquantified; **A**=Anecdotal. **Pos**=Possible; **Prob**=Probable; **Conf**=Confirmed. **S2.2:** **↑**=increasing; **↓**=decreasing; **=** stable. **S2.3:** Actual/potential threat: please state whether **actual** threats apply to many or few native individuals and whether **potential** threats are based on evidence or speculation. A threat means something negatively affecting native species. Write **NA** (Not Applicable) where appropriate.

S2. 1 SIZE OF INTRODUCED WATERBIRD POPULATIONS		Q	U	A
1.	Introduced waterbird species name:			
2.	Estimated isolated individuals (totals):			
3.	Estimated isolated groups (totals):			
4.	Non-breeding groups:			
5.	Breeding evidence (Pos / Prob / Conf):			
6.	National population estimate (breeding pairs)			
7.	If Q , what is your confidence in the estimate? (low / high / do not know)			
S2. 2 STATUS OF INTRODUCED WATERBIRD POPULATIONS		↑	↓	=
1.	Status of breeding range:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Status of breeding population:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S2. 3 EFFECT ON NATIVE WATERBIRDS & HABITATS		Yes	No	?
1.	Hostile interaction with native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	Dominance over native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Actual/potential threat to native waterbirds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3a.	If Yes , what is the nature of the threat, and which native species are threatened?			
S2. 4 HAS THE INTRODUCED WATERBIRD SPECIES...		Yes	No	?
1.	Reduced native survival / breeding success?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	If Yes , which native waterbirds have been affected?			
3.	Hybridised with native/domesticated birds?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	If Yes , which native waterbirds have hybridised?			
5.	Displayed promiscuous mating?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S2.5 HYBRIDS				
S19	Hybrid fertility? (low / high / do not know)			
S20	How many hybrid generations exist? (2 / 3 / 3+ / none / do not know)			
S21	Do hybrids prefer: hybrids / native species / introduced species / do not know			

FURTHER INFORMATION

Please use this sheet to provide any further information or to continue your answers from previous questions. Please indicate which question your answer relates to (e.g. S2.4 S15).

SPACE FOR CONTINUED COMMENTS (please state question numbers, e.g. S2.4 S15)

A large, empty rectangular box with a thin black border, occupying the central portion of the page. It is intended for the user to provide continued comments, as indicated by the text above it.