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CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE
AND NATURAL HABITATS

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EUROPEAN CODE OF CONDUCT ON ZOOLOGICAL GARDENS AND AQUARIA AND INVASIVE ALIEN SPECIES

Code, rationale and supporting information

- FINAL VERSION –

(October 2012)

COUNCIL OF EUROPE CONSEIL DE L'EUROPE

ISSG Invasive Species Specialist Group

EUROPEAN ASSOCIATION OF ZOOS AND AQUARIA EAZA

Report prepared by
Mr Riccardo Scalera, Mr Piero Genovesi, Mr Danny de man, Mr Bjarne Klausen, Ms Lesley Dickie

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N.B. The present document is meant to provide the rationale and additional information to the "European code of conduct on zoological gardens and aquaria and invasive alien species" appended

It should be formally noted here that zoos and aquariums present a low risk in relation to Invasive Alien Species.

1. INTRODUCTION

As highlighted in the *Millennium Ecosystem Assessment*[1], invasive alien species (IAS) are one of the most important direct drivers of biodiversity loss and ecosystem service changes. IAS are widely recognised as a major threat to biodiversity on a global scale - together with overexploitation, pollution, habitat destruction and climate change - and the greatest threat to fragile ecosystems such as islands. Biological invasions not only constitute one of the most pervasive global threats to biodiversity (apart from the cost in terms of biodiversity loss), IAS can also have an adverse impact on human life and health, and cause serious economic damage, endangering the ecosystem services we rely on and affect negatively many socio-economic interests, including agriculture, forestry and fisheries. Past introductions have usually occurred with little awareness of the potential negative consequences of IAS, but in recent times the true extent of their threat, posed in both ecological terms and socio-economic terms, has become better understood. For example, of the 395 European native species listed as critically endangered by the IUCN Red List of Threatened Species, 134 are in danger due to the impacts of IAS and possibly other factors[2]. In terms of economic impact, at the European level it has been estimated that damage caused by IAS exceeds 12 billion Euros a year (Kettunen et al. 2009).

Today, several strategies have been developed and implemented to deal with IAS (e.g. eradication, control, containment) yet prevention is unanimously acknowledged as the best available management option, when feasible. In this context, once the main pathways are identified, controlling the key entry routes is considered the most effective way of tackling the threats from IAS. For this reason several codes of conduct or similar "incitative" voluntary instruments are being developed with different industries and activities (i.e. the horticulture and the pet industry, which are considered, together with species arriving accidentally via normal trade and tourism, the main pathways of entry of IAS into Europe).

The Bern Convention has thus embarked in the drafting of a series of codes of conduct covering a number of activities linked with plants and animals, namely "Horticulture and IAS", and has ready for adoption by the Standing Committee of the Convention "Hunting and IAS" and "Pets and IAS". The other codes in preparation focus on "Botanical Gardens" and "Recreational Fishing". At the same time the Convention is also working on "Guidelines for protected areas management and IAS". All these codes intend to mobilise a number of professionals that are linked to trade, exhibition, or sale of wild plants and animals (plus hunters, anglers and managers of protected areas) in the hope that, because of their genuine interest in conservation, they will be good allies in fighting IAS introduction and spread.

The development of these codes is in line with Aichi Target 9 of the Strategic Plan for biodiversity 2011–2020, adopted during the tenth meeting of the Conference of the Parties of the Convention on Biological Diversity (CBD COP10, which took place in Nagoya, Aichi Prefecture, Japan, in October 2010). Aichi Target 9 states that "by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment". The same target - with a slight modification at the end to focus on new threats - has been embodied by the European Commission in its recent Communication "Our

[1] Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC.

[2] IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 24 March 2012.

life insurance, our natural capital: an EU biodiversity strategy to 2020" (COM (2011) 244 final) (see § 4.2).

Zoological gardens and aquaria are recognised as a potential pathway of invasions in Europe, although the responsibilities of such institutions in contributing to the spread of IAS is certainly limited compared to other sectors (e.g. pet trade, horticulture, aquaculture, angling, hunting, etc.). In fact, comprehensive studies on the role of zoological gardens and aquaria as a potential pathway of IAS are lacking in Europe, and most of the relevant accounts of escapes/releases refer to single events or are just anecdotal. The only exception is a recent study (Fábregas et al. 2010) which examined the risk of *potential* escape of zoo animals due to lack of security at their enclosures. On the other hand, the same study pointed out that those institutions that are members of professional associations are more likely to be already taking this matter seriously (as in the case of the members of the Spanish AIZA, who have been found to have fewer non-secure enclosures than non-members).

Thus, it is important to promote a wider enforcement of measures aimed at avoiding the escape (and intentional releases in some cases) of potential IAS from these facilities, and to respond rapidly in case prevention fails.

That zoological gardens and aquaria may be a potential pathway for IAS is not new to the sector, in fact, in Europe (via EAZA's policy on invasive species) and in regions other than Europe relevant measures are already being undertaken. For example, the Association of Zoos and Aquariums (AZA) - a network of more than 6 000 committed zoo and aquarium professionals, organizations, and suppliers world-wide - has adopted a specific *Policy on Non-Native Invasive Species*[3] since 2003. The need to reduce the risk of invasive species escape was also considered within the IUCN-SSC ex situ conservation guidelines (Maunder and Byers 2005).

It must be stressed also that, besides preventing the risks of escapees, zoological gardens and aquaria can play a much wider and important role in addressing the risks of biological invasions by raising awareness on the issue. In fact, these institutions are recognized as key players in global conservation programmes, thanks to the living collections of endangered species they host, public outreach and their significant contribution to both funding and participating in *in situ* conservation. Indeed, zoos and aquaria attract hundreds of millions of Europeans each year and can thus contribute to outreach and raising awareness. In the past decade EAZA members' institutions have received more than 1 billion visits. Many zoological gardens and aquaria are organised into associations (such as European Association of Zoos and Aquariums, EAZA) and as such have demonstrated an ability to work together in a synergistic manner, by sharing priorities and policies, thus forming a powerful ally to conservation agencies and institutions (to this regard it is extremely important to differentiate between professional association zoos and those that do not join such associations). Also, the presence of potential IAS in their living collections, might offer such institutions unique opportunities for dedicated environmental education programmes. For example, the messages to be conveyed could be: (i) where the IAS is the primary attraction – is important to tell its story as a both a legitimate species in its native range and an IAS where introduced; and (ii) where a species in the collection is threatened by IAS in its native range, e.g. island endemics etc. such treats should be explicitly highlighted. Thus, zoological gardens and aquaria could indeed contribute significantly to raising awareness to prevent the introduction of new IAS (e.g. through specific information activities targeting the general public). Finally, giving the leadership in supporting both species and habitat restoration programmes - often including the management of IAS - the role of zoos and aquaria in supporting conservation related activities, i.e. from research projects to eradication/control and restoration/reintroduction initiatives, is of fundamental importance in this context.

1.1 Why a code of conduct?

In 2003 a specific strategy to deal with Invasive Alien Species at the European level (Genovesi and Shine 2004) was adopted by the Council of Europe. The *European Strategy on IAS* – as it will be called

[3] http://www.aza.org/AnimalCare/detail.aspx?id=2723

hereafter - is aimed at providing guidance to Bern Convention Parties in their effort to increase awareness and information on IAS, strengthen national and regional capacity and co-operation to deal with IAS, prevent the introduction of new IAS into and within Europe, support rapid response to detected incursions, reduce the adverse impact of existing IAS, recover species and restore natural habitats and ecosystems adversely affected by biological invasions, and identify and prioritise key actions to be implemented at the national and regional level. As a follow up of the *European Strategy on IAS*, some European countries have developed national strategies and related legal and technical tools for implementation[4].

However, with the notable exception of a few EC legal tools (among which the Council Directive 1999/22/EC hereafter referred to as EC Zoo Directive, see § 4.1) and a few national legislations for the implementation of the *European Strategy on IAS*, there are no specific rules set up to prevent the spread of IAS from zoological gardens and aquaria, or to recognise the educational role of such institutions with respect to the spread of IAS. Until a comprehensive *EU Strategy to Combat IAS* is available (see Shine et al. 2010), the European capacity to respond to such threats will be limited (Genovesi et al. 2010). For this reason, a code of conduct dedicated specifically to zoological gardens and aquaria, fully compatible with the principles of the future *EU Strategy to Combat IAS*, is considered a crucial step to actively involve such important stakeholders in the framework of actions aimed at preventing or mitigating the threats posed by biological invasions at the global, regional and national level. On the other hand, even when a EU legislative instrument driving increased capacity to respond to IAS will be in place, there will still be a need for good practices as legislation cannot regulate and enforce every aspect of behaviours or practices that are relevant to the risks. So it is very likely that the Code will not become redundant even after the adoption of a specific EU legislation on IAS. Besides, such a legislation would not cover countries other than the EU Member States, thus the importance of the Code for a more effective management of the issue at the regional level.

In relation to the role of zoos and aquaria as a potential pathway for future biological invasions, the *European Strategy on IAS* calls for the establishment of effective systems to prevent further introductions, e.g. by implementing dedicated codes of conduct or adapting existing licensing rules for containment facilities holding potential IAS (Genovesi and Shine 2004). The same measures are indicated as appropriate for strengthening national policies, and legal and institutional frameworks. Furthermore, the *European Strategy on IAS* underlines the need for building awareness and support, e.g. by working with key stakeholders – amongst which are zoological parks and aquaria - to produce and disseminate information and guidance on best practices.

Voluntary codes of conduct and best practices are considered as fundamental flexible "implementation" tools which could be scaled up with support from public bodies, industry federations, user groups and/or NGOs as appropriate, with the aim of ensuring responsible, proactive policies, and applying these in a coherent manner across Europe (Shine et al. 2010). On the other hand, in certain situations the principle of self-regulation might be more successful and effective than other legally binding schemes. A voluntary code of conduct to address the risks associated with the use of IAS in zoological gardens and aquaria, e.g. in public exhibitions, can clearly play a multiple role: awareness-raising, stimulating stakeholder involvement, leverage/dissemination of best practices, supplementing existing regulations or filling a regulatory gap. Moreover, in the case of zoological gardens and aquaria the voluntary adoption of a code of conduct focusing on measures to prevent the establishment or spread of IAS would represent a valid incentive to pilot innovative approaches, possibly supported by governments, to contribute to their overarching biodiversity conservation goals. In addition, in contrast with other management options (such as eradication and control), preventing new introductions of IAS would pre-empt the risks associated to a number of potential "ethically" and "emotionally" based critiques and conflicts from different stakeholders (see Perry and Perry 2008).

[4] Also the European Commission is developing a dedicated legal document to combat invasive alien species. This is meant to be finalised by 2012 and would be only for EU Member States.

For all the reasons above, and in the light of the conservation focused institutional role that define modern zoological gardens and aquaria, a specifically dedicated code of conduct might increase the likelihood of being well received and correctly implemented by such institutions. In order to stimulate zoological gardens and aquaria to start implementing an effective framework of action in relation to the IAS issue, such a code is developed under the form of a voluntary regulatory mechanism aimed at setting standards for professionals and voluntary rules of behaviour that all concerned groups of people agree to observe. Such a voluntary tool - needed to demonstrate compliance with a defined standard of reasonable conduct to tackle specific pathway risks - might also encourage further collaboration opportunities between the governments and the addressed institutions.

In the specific case of the EU Member States, this code of conduct would also provide guidance for a sound enforcement of the IAS related provision of Article 3 of the EC Zoo Directive (see § 4.1) which otherwise could be open to interpretation. Concerning escapes from facilities, the implementation of this provision is dependent upon the will, knowledge, experience and available resources of each Member State, and as such might be affected by inconsistencies and weaknesses resulting in major variations in the standards applied in the addressed facilities. In any case such legislation applies only to EU Member States, and not to all 50 countries that are parties to the Bern Convention and to which this code of conduct is addressed.

Finally, it is remarkable that the *European Strategy on IAS* points out that the development of technical codes of conduct to reduce IAS impacts on European biodiversity is to be considered one of the possible roles of the Bern Convention, possibly in collaboration with other relevant sectors and organisations. Thus, the present code of conduct could provide opportunities for promoting new partnerships, e.g. with single institutions and/or their associations (in Europe EAZA) and consolidating old ones, e.g. with ISSG of the IUCN/SSC.

2. SCOPE AND AIM

This code of conduct is addressed to all zoological gardens and aquaria in all 47 Member States of the Council of Europe. The objective is to provide guidance on voluntary measures to be adopted to strengthen the existing role of zoological gardens and aquaria in the conservation of biodiversity - and particularly in the protection of wild fauna and flora in Europe – by contributing to mitigating the problems related to the spread of IAS through the following measures:

- Preventing the introduction and spread of IAS and related pathogens and diseases;
- Promoting the need to raise awareness on biological invasions;
- Promoting IAS related research projects (e.g. including control of IAS and related pathogens and diseases within species recovery projects).

The framework of actions to implement this code of conduct is voluntary and depends on there being a high level of self-regulation by the targeted institutions, which is considered a feasible task, given that the key strategic objectives of modern zoological gardens and aquaria are already highly conservation-oriented.

This code of conduct takes into account the enormous variation in animal collections of zoos. Because of variations amongst the institutions that are known as “zoos”, there is no concise definition of this word. However, in order to agree to a clear terminology it is most appropriate to adopt the wording used by the EC Zoos Directive. according to which “zoos mean all permanent establishments where animals of wild species are kept for exhibition to the public for 7 or more days a year, with the exception of circuses, pet shops and establishments which Member States exempt from the requirements of this Directive on the grounds that they do not exhibit a significant number of animals or species to the public and that the exemption will not jeopardise the objectives of this Directive”.

According to *The World Zoo Conservation Strategy* the great diversity of facilities and specialized institutions characterised by analogous roles and as such collectively designated as “zoos” greatly vary

with respect to the types of animals they exhibit. Indeed zoos can range from general to specialised collections, in which case they might be named after the relevant specialities, e.g. primate zoos, desert zoos, safari parks, birdparks, waterfowl parks, wild fowl reserves, parrot gardens, reptile zoos, insect zoos, butterfly houses, insectaria, vivaria, aquaria, *dolphinaria*, *oceanaria*, marine zoos, sea mammal parks, etc. The precise number of such zoos and aquaria in Europe is not known

In order to ensure the greatest impact in terms of conservation benefit, the use of this code of conduct could be extended also to facilities other than zoos where wild animals are kept in captivity for purposes of scientific research, conservation, display and education. An example are rescue centres for wild animals, It is clear that such structures are not zoos and should not be considered as such in any way. When such facilities are not open to the public, their primary task in relation to the IAS issue should mostly focus on preventative best practices, while the educational function would be relatively limited.

All of the above mentioned institutions can be broadly targeted by the code of conduct.

3. BACKGROUND

3.1 The history of zoological gardens and aquaria

Collections of wild animals confined within enclosures, displayed to the public, and in which they may also breed, have a long history. The highly complex, professionally managed, zoological gardens of modern times are the result of the evolution of the simple collections and menageries of ancient times. Indeed, the first idea of zoological gardens likely rose in concert with the origins and development of agriculture, urbanism, and imperialism in the ancient Near East, i.e. in Mesopotamia and Egypt, where exotic fauna played vital roles in the world's earliest transformations of the natural environment, and where the creation of exotic gardens and menageries was a traditional royal pastime (Foster 1998). The oldest known menagerie of ca. 3500 B.C. was recently discovered at Hierakonpolis, on the Nile south of Luxor (Rose 2010). Later, the first zoos also appeared in Europe, particularly in Greece and in the Roman Empire where they were known as "paradises" (Hughes 2003).

The history of modern zoological gardens, established primarily for scientific interest, originated some 200 years ago with the creation of the first public zoos in London, Paris and Vienna, as remarked in *The World Zoo Conservation Strategy* (1993). Since then, large numbers of zoos have been established globally, with conservation being seen as a central task for such institutions. This also reflects the great changes which have taken place in the world, in terms of both human society and progress in science and education, as well as the changes that have occurred in the overall conservation status of species, habitats, and ecosystems worldwide.

3.2 Zoological gardens and aquaria as pathways for IAS

Reducing the threat of biological invasions requires a focus on the ways humans facilitate the transport and establishment of species in new areas. While analysis of the pattern of spread of single species remains important, targeting prevention efforts by focusing on specific pathways allows identification of areas that act as sources for new invasions and how multiple species are dispersed through the same vectors. In terms of prevention, the analysis of actual and potential pathways is critical to effectively managing the problems relating to biological invasion, because it allows stakeholders to focus management efforts and reduce the sources of IAS for both animals and plants which, once introduced into the wild, can invade native habitats.

As shown from the examples reported below, zoological gardens and aquaria have contributed to the introduction of several IAS over the centuries, because of either unintentional escapes from captivity or intentional releases (for example, further to the closure of a facility, the dumping of unwanted organisms or the deliberate illegal release by animal rights activities). Even though in terms of relative risk, zoos and aquaria have had a limited responsibility compared to other pathways (i.e. pet trade, hunting, horticulture, etc.) it is worth considering which measures might be undertaken to further mitigate such impacts and potentially to lead by example.

In the case of zoological gardens and aquaria, the term "escape" refers to a variety of circumstances ranging from unforeseen events, such as animals (including their larvae and eggs) gaining freedom because of damage to boundaries, and through waterways - for instance from an aquarium into rivers, lakes and sea – such as in clearing operations through the drainage of water, sewage lines, filtration systems or any other breach (see also Hulme et al. 2008, Padilla and Williams 2004, Fábregas et al. 2010). Other examples of escapes are that some animals might be not be confined or able to move freely, either intentionally or due to accidental events (such as storms and floods). Fires have also occurred in zoo facilities forcing the staff to release some of the animals into the wild, e.g. in the Canary Islands (Juan Luis Rodriguez Luengo, pers. comm. 2011). The possibility for the public to release animals directly (i.e. buying an animal in the zoo, or capturing the animal and removing it from the enclosure) or indirectly (i.e. opening enclosures not properly locked) is another factor with regard to the releases of IAS from zoos due to the lack of "security" of the relevant facilities (see also Fábregas et al. 2010).

Specific and comprehensive analysis regarding IAS originated by escapes/releases from zoological gardens and aquaria in Europe are lacking. Current knowledge on such a pathway is often sparse, but some relevant figures and anecdotes are available for the main groups of species. For example, for mammals it is known that escapes from zoos account for 6% of all known causes of introductions in Europe (Genovesi et al. 2009). Also for amphibians and reptiles, two of the major introduction pathways – the pet trade and "intentional" pathways –include exhibit and zoo releases (Kraus 2009). For birds the impact of zoos is even more evident, because out of a total of 140 alien bird species present in Europe, 77 species escaped to the wild "non-deliberately" and of these 27 species originated from zoos or bird parks (Kark et al. 2009).

The assessment of the actual contribution of zoological gardens and aquaria to the IAS problem in Europe is affected by the fact that most of the documented cases of releases or escapes linked to this pathway have often been associated with multiple pathways (e.g. linked to other sectors, such as the pet and aquarium trade, fur farms, hunting, fishing, etc.) so that zoo escapes are included with introductions from other captive establishments and private holders (see Fitter 1959). The obvious difficulties in distinguishing the actual role/impact of zoological gardens and aquaria reflect on the lack of precise information in available literature. Furthermore, no analysis exists that differentiate between episodes occurring before and after the implementation of the EC Zoo Directive (after which episodes of escapes are likely to be diminished, especially in the institutions with the highest standards) and not even between the EU countries where the EC Zoo Directive has been implemented/enforced (see § 4.1) and all the other countries, or between the impact of non associated vs. associated institutions (see § 5.1).

3.2.1 IAS originating from zoological gardens and aquaria

There are several anecdotes showing that such introductions occurred over the years in many European countries, and contributed to the spread of some of the IAS of highest conservation concern. A selection of documented cases, showing the variety of possible situations created by such introductions in Europe, is reported below.

Among mammals, the presence of the grey squirrel (*Sciurus carolinenisis*) in Edinburgh and of the red-necked wallaby (*Macropus rufogriseus*) in Derbyshire seems due to the deliberate release of a few animals from a nearby zoo in the beginning of 20th century (Fitter 1959). Also, there is the case of a feral population of Siberian chipmunks (*Tamias sibiricus*) in an urban park in the Netherlands, in the province of Noord-Brabant, originated in 1972 from a group of chipmunks left behind after the removal of a small zoo (Thissen and Hollander 1996). Similarly, a few specimens of raccoon (*Procion lotor*) were released from a zoological garden in Hamburg, Germany, in the first half of the 20th century in Northern Hesse and near Berlin (Bartoszewicz 2006). Also the presence of the raccoon dog (*Nyctereutes procyonoides*) in Germany, along the French border is considered partly due to escapes from zoological gardens (Pascal et al. 2006).

In Europe there are also many records of ungulates known to be escapes from zoos. For example, the Chinese water deer (*Hydropotes inermis*) a native to East China and Korea, established wild populations

in the UK in the beginning of 20th century, further to escapes from zoos and private collections along with deliberate releases (Macdonald and Burnham 2010). Also, a small population of Barbary sheep (*Ammotragus lervia*) occurred in the wild near the city of Plzen/Pilsen, West Bohemia (Zima and Andera 1996). The population was established in the late 1970s to the early 1990s by the repeated escapes of individuals from a nearby zoo in western Bohemia and was quite viable due to the fact that the Barbary sheep's behaviour became similar to other animals. Before eradicating this population in 1994, their numbers peaked at 50 individuals (Jan Plesnik, pers. comm.).

Eradication projects have been carried out, or are in progress, to mitigate the impact of some species introduced by zoos or aquaria. For example, the Malayan porcupine (*Hystrix brachyura*) once established in the wild in Devon from a pair escaped in 1972 from a zoological park no longer exists anywhere in Europe as a result of an active eradication programme (Genovesi 2005). Similarly, the Egyptian fruit bat (*Rousettus aegyptiacus*), was recently eradicated from the Canary Islands where it was suspected to be introduced as the result of an escape by several animals from two zoos in 2000 (Nogales et al. 2006, Trujillo 2009). Eradication projects are ongoing for the Canadian beaver (*Castor canadensis*) in the Walloon region of Belgium, from animals that escaped from a zoo in Germany[5]. Fortunately not all introductions have been successful. For example, the Canadian beaver (*Castor canadensis*) is no longer present in Austria, although in the 1980s some animals that escaped from a zoo in Styria managed to thrive in the wild for some years, together with animals originating from other intentional releases (see Nummi 2010).

Surprisingly there are also several records of marine mammals introduced from coastal *dolphinaria* and oceanaria where animals are kept in near-shore open-air pens which do not adequately prevent escapes of captive animals into the sea. According to Birkun (2002) such cases of escape/release have been known since the early 1980s in the Black Sea in the former USSR, and during the last decade in the Russian Federation and Ukraine. The list of such spontaneously released cetaceans and pinnipeds includes the beluga whale (*Delphinapterus leucas*), the northern fur seal (*Callorhinus ursinus*), the Steller sea lion (*Eumetopias jubatus*), the harbour seal (*Phoca vitulina*), the Caspian seal (*Phoca caspica*) and, possibly, one or two other pinniped species. The exact number of irrevocably escaped individuals of alien marine mammals is unknown, but it probably comes to a few tens including two beluga whales which were observed many times in the wild near the Turkish, Romanian, Bulgarian and Ukrainian coasts in the early 1990s (Reeves and Notarbartolo di Sciara 2006). The fate of most accidentally released marine mammals and their possible influence on indigenous Black Sea cetaceans, including bottlenose dolphins, remains uncertain. Presumably, they can be a source of infections circulating in *dolphinaria*. The escape of a sea lion from an aquarium to the wild is also known in the Canary Islands (Juan Luis Rodriguez Luengo, pers. comm. 2011). It is likely that the marine mammals escaped from *dolphinaria* and similar facilities did never lead to established populations, however it is known that species may have a very long lag phase before getting naturalised, or showing any impact. But this does not mean that in the meantime they do not affect the hosting ecosystem. This is especially true in the case of long-living organisms, in which case also a single animal can have a major impact on the ecosystem.

Records of animals that have escaped from zoological gardens and similar institutions are also known for species deliberately shown to the public in areas not confined by adequate fencing systems, and basically free to move throughout the zoo facilities. It is the case of many bird species that are frequently left free to fly in those zoological parks from which they can escape and sometimes establish wild populations. An example regarding a species of major concern in Europe is the ruddy duck (*Oxyura jamaicensis*), a species of North American origin, which has become established in the wild in the Western Palaearctic, following escapes from wildfowl collections which occurred in the second half of the twentieth century (Muñoz-Fuentes 2006). In Europe this species represents the greatest long-term threat to the white-headed duck (*Oxyura leucocephala*) due to the risk of introgressive hybridisation and

[5] NOBANIS newlsetter 4 June 2010 (available at http://www.nobanis.org/Newsletter.asp)

competition, and is now the object of a large scale eradication programme in the UK, co-financed through an EC LIFE-Nature Project (Cranswick and Hall 2010).

Another example is the recently introduced African sacred ibis (*Threskiornis aethiopicus*). This species has escaped from zoological parks in many countries and is now established at least in Italy, Spain and France (Clergeau and Yésou 2006). In contrast with the case of the ruddy duck, which according to specific genetic studies is likely to derive solely from the captive population (Muñoz-Fuentes 2006) the introduction of the African sacred ibis shows that it is not always possible to identify the exact origin of an alien species, particularly for highly vagrant species (which creates major problems not only for reason of management options to be envisaged, but also from a scientific point of view).

The case of the pink-backed pelican (*Pelecanus rufescens*) is a good illustration of the potential problem created by escapees, in fact although in this case most of European records are due to escapes from the French free-flying colony, there are reports of natural dispersal to Europe of a few African wild pink-backed pelicans (Jiguet et al. 2008). Another bird species of major concern is the Canada goose (*Branta canadensis*). In Poland this species was unintentionally introduced not only through birds spreading from neighbouring countries but also through escapes from a local zoo (Solarz 2007). However in Poland the majority of breeding individuals were captured and rendered flightless as they wintered in a local zoo (Wojciech Solarz pers. comm. 2011). Also in Scandinavia the populations of Canada geese seem to originate from only five individuals, mostly orginating from a German zoo (Jansson et al. 2008).

One of the best candidates as “the most famous escape” from a zoological facility is the tropical alga (*Caulerpa taxifolia*). In 1984 a genetically altered type of this seaweed was unintentionally introduced into the Mediterranean Sea possibly with aquaria outflow by a public aquarium in Monaco (Kluser et al. 2004). Further to a secondary spread facilitated by shipping and currents Caularpa is now dominating large patches along the Mediterranean coastline where it forms dense carpets and outcompetes the indigenous seagrasses, *Cymodocea nodosa* and *Posidonia oceanica*. Although it seems to be regressing in many spots, another effect of the alga is that it produces endotoxins meant to provide protection against epiphytes and herbivores, which are also toxic to molluscs, sea urchins, and herbivorous fish (Galil 2006) and all this is clearly contributing to the irreversible spread of the species in the Mediterranean, leading to a loss of biodiversity and affecting local activities such as recreational diving, tourism and the fishing industry.

The escape/release of species from zoological gardens and aquaria can also carry an associated risk of introducing exotic and potentially unknown diseases and parasites into naive settings. The transmission of such pathogens can be very complex, as shown in the case of the Australian tick *Amblyomma moreliae* found on a European snake, the Balkan whip snake (*Coluber gemonensis*) in a zoo in India (Burridge and Simmons 2003). In this context, captive breeding and re-introduction programmes (although invaluable conservation practices that are helping several threatened species to recover from the risk of local or global extinction) can contribute to the spread of diseases (Dejean et al. 2010). For example, it is recognised that in captive populations of amphibians the occurrence of *Batrachochytrium dendrobatidis* (a pathogenic fungus responsible of a disease called chytridiomycosis, also known as Bd for short and responsible of massive die-offs worldwide) may interfere with the success of relevant reintroduction programmes. For example, in the case of a reintroduction programme for the endangered Mallorcan midwife toad (*Alytes muletensis*) the animals bred in captivity in a zoological facility were released before Bd was identified as a pathogen, and relevant screening methods were established (see Walker et al. 2008). As a consequence, Bd was apparently transmitted to the native island populations of the Mallorcan midwife toad – thus jeopardising the survival of the entire stock of this very localised species. For this reason, captive individuals should never be released unless they can be shown to be disease-free through the implementation of sound diagnostic screening procedures[6].

[6] See the *IUCN/SSC Guidelines for Re-Introductions* http://www.iucnsscrsg.org/download/English.pdf

It is worth considering that these are historical escapes, and that more may have happened since, as it might take decades for IAS to establish. In fact, current patterns of alien species richness may better reflect historical rather than contemporary human activities, a phenomenon which has been called "invasion debt" (Essl et al. 2011). This means that many of the most problematic IAS are not recent arrivals, but could be introductions that occurred several decades ago. Consequences of the current high levels of socio-economic activities will probably not be completely realized until decades into the future. Thus adequate management of IAS should be expanded also to species that are likely to pose the greatest future threat.

3.3 The multifaceted role of zoological gardens and aquaria in conservation

Zoological gardens and aquaria have an enormous potential for action in conservation, education and research. Such potential – already demonstrated by a large number of institutions, particularly those organised in professional associations - is a combination of the added value offered by the way that living collections are managed today, with a growing focus on local to global conservation and research initiatives, together with the particular power of attraction that such living collections have on the general public. The over 300 zoos organised in the European Association of Zoos and Aquaria are visited annually by 130-140 million people according to the EAZA, which is approximately 15% of the current European population (although such figures include people making repeat visits). This number of visitors results in great potential for global conservation, education and research through zoos and aquaria and their networks. Another fundamental contribution is the extent of the financial support for *in situ* conservation and the international training work of European zoos. Indeed, this might increase the ability of people in cities to maintain a connection with nature, and as a consequence to engage the public in conservation actions (see the "pigeon paradox" by Dunn et al. 2006).

An increasing number of zoos are involved in both in situ conservation and sustainable development efforts, and *ex situ* programmes - such as the European Endangered Species Programme (EEPs); Collection Planning, Sustainable Zoo/Aquarium Collections) including all relevant research and educational activities. Among the others, a few projects have been carried out by zoos and aquaria also in relation to the IAS issue, e.g. by providing temporary relief to endangered species from competition or predation by alien taxa, and from hybridisation (see also Gippoliti 2004). A major example is the LIFE project for the reintroduction of the critically endangered European mink (*Mustela lutreola*) in Estonia. The project, carried out also by the Tallinn zoo, included activities aimed at the removal of the alien American mink (*Neovison vison*), a predator whose presence was considered not compatible with the *ex-situ* and *in-situ* conservation activities planned to guarantee the survival of the European mink (Scalera and Zaghi 2004). Similarly, in 1986 the European Durrell Wildlife Conservation Trust and Mauritian Wildlife Foundation carried out a successful eradication programme in Round Island, a small island north-east of Mauritius. This eradication programme was aimed at removing the rabbit and goat populations introduced to the island 150 years earlier in order to help recover the last remnants of a palm savannah that once characterised the northern plain of Mauritius (Bullock *et al.* 2002). Another relevant initiative is the eradication of the black rat (*Rattus norvegicus*) carried out by the Edinburgh Zoo on the islands of Canna and Sanday - located at the southern end of the Minch in North West Scotland - to protect important seabird breeding populations[7]. Currently, zoos are also playing a key role in supporting proper management and research on *Batrachochytrium dendrobatidis* through a number of initiatives targeting this pathogenic fungus responsible for the amphibian disease, chytridiomycosis. Another interesting example of an activity carried out by **z**oological gardens in relation to IAS management, is the removal of red-billed leiothrix (*Leiothrix lutea*) from the wild in Hawaii where this alien species competes with endemic and native species and their transfer to the Toronto Zoo aimed at establishing self-sustaining gene pools in aviculture (Karsten 2010). Finally, **z**oological gardens and aquaria have proven to be effective partners of universities and other institutions for research activities. At the Rome Bioparco, a study was carried out in collaboration with the University of "Roma Tre" to analyse the reproductive

[7] http://www.edinburghzoo.org.uk/conservation/scottishnativespecies/seabirdrecovery.html

behaviour in a semi-natural habitat of the red-eared slider (*Trachemys scripta elegans*), as well as the competition of this harmful exotic toward the native European pond turtle (*Emys orbicularis*).

4. LEGAL FRAMEWORK

At the global level, a number of international agreements are in place that include provisions to prevent the introduction of, control or eradicate IAS that threaten species, habitats or ecosystems (for a review see Miller at al. 2006). In Europe, a dedicated strategy has been adopted by the Council of Europe to provide guidance to all 50 parties for the development of further domestic legislative measures (see § 1). Nevertheless, with the notable exception of a few national initiatives, an effective strategy to combat IAS on either a voluntary or a regulatory basis at the regional level is not yet duly implemented. At the EU level, coordinated frameworks dealing at least in part with the issue of IAS already exist in some sectors (Miller et al. 2006). For instance, the Council Directive 92/43/EEC *on the conservation of natural habitats and of wild fauna and flora* requires Member states to "ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction" (Art.22b).

More importantly, among the existing EU legislation and policies, the EC Zoo Directive already provides part of the solution to the problem of IAS. This directive, which entered into force in 2002, includes requirements to prevent the introduction of IAS. In addition, there are a number of EU legal tools addressing zoo such as the Commission Decision 2007/598/EC of 28 August 2007 *Concerning measures to prevent the spread of highly pathogenic avian influenza to other captive birds kept in zoos and approved bodies, institutes or centres in the Member States.*

The EC is also finalising its proposal for an EU legal document specifically addressing IAS, which it intends to bring forward in 2012.

4.1 The EC Zoo Directive

The Council Directive 1999/22/EC of 29 March 1999 relating to the keeping of wild animals in zoos was adopted with the objective of providing a framework for Member States legislation aimed at promoting the protection and conservation of wild animal species and strengthening the role of zoos in the conservation of biodiversity, public education, scientific research and the exchange of information. In particular, in relation to the IAS issues, according to article 3 (Requirements applicable to zoos) Member States shall take measures to ensure all zoos implement the following conservation measures: "preventing the escape of animals in order to avoid possible ecological threats to indigenous species and preventing intrusion of outside pests and vermin" and "keeping of up-to-date records of the zoo's collection appropriate to the species recorded."

Other relevant measures of the EC Zoo Directive include ensuring adequate accommodation facilities for zoo animals with species-specific enrichment of enclosures that aims to meet their biological and behavioural needs, high standards of animal husbandry (including a programme of preventative and curative veterinary care and nutrition), contributions to research or conservation activities, education of the visiting public and training of staff. This is to be achieved by Member States through the implementation of articles 4 and 5, according to which Member States shall adopt measures for licensing and inspection of new and existing zoos in order to ensure that the requirements of Article 3 are met. Another important provision in relation to the IAS issue is found in article 6 (Closure of zoos) according to which "In the event of a zoo or part thereof being closed, the competent authority shall ensure that the animals concerned are treated or disposed of under conditions which the Member State deems appropriate and consistent with the purposes and provisions of this Directive".

For the purposes of this Directive competent authorities shall be designated by Member States (cfr. art. 7). Moreover all EU Members States have been obliged to transpose the requirements of the Directive into national legislation in order to fully implement and enforce its requirements. Although the EC has the responsibility to ensure the effective implementation of the Directive by Member States (and take legal

action in case of non-compliance) no reporting obligations are foreseen, therefore there is no report from Member States to the EC on the actual implementation of its provisions at the national level. In relation to the IAS issue, several authors (e.g. Fábregas et al., 2010) stressed that the EC Zoo Directive has not been implemented or enforced effectively or consistently in some Member States, where facilities might still be in conditions that do not fully guarantee the prevention of escapes.

4.2 The EU strategy on IAS

At the EU scale, the Commission's Communication *Halting the loss of biodiversity by 2010 and beyond: sustaining ecosystem services for human well–being* (COM(2006) 216 final) stressed the need for coordinated action to reduce substantially the impact of IAS on EU biodiversity. More recently, the Commission's Communication *Towards an EU Strategy on Invasive Species* (COM(2008) 789 final), recognised that halting the loss of biodiversity in the EU will not be possible without tackling IAS in a comprehensive manner. As a result, four options were proposed for establishing a harmonised system able to guarantee a consistent approach between neighbouring countries to monitor and control IAS and their effects on European biodiversity.

Such options are characterised by different levels of ambition. In particular, in order of increasing intensity, Option A "Business as usual" foresees the simple continuation with the ongoing implementation of existing instruments (but clearly, if no action is taken, IAS will continue to become established in the EU with increased associated ecological, economic and social consequences and related costs). Option B "Maximise use of existing approaches" is based on the promotion of best use of existing legislation. In practice, formal legal requirements would remain as they are today but there would be a conscious decision to proactively address IAS problems under existing legislation, e.g. by developing and implementing voluntary codes of conduct to encourage responsible behaviours, developing an Early Warning and Rapid Response (EWRR) system, maintaining a European inventory on IAS, increasing awareness, exchanging best practice, implementing eradication and control measures at a national level. The main shortcoming of this option lies in the fact that a system which is built on voluntary undertakings by Member States and voluntary codes of conduct would only be as effective as the weakest link in a chain. Option B+ "Adapt existing legislation" implies amending existing legislation to widen the scope to formally take IAS issues into account, e.g. by extending the list of "ecological threat species" for which import and internal movement are prohibited under the EU Wildlife Trade Regulations. Option C "Comprehensive, dedicated EU legal instrument" includes the basic tools described in option B, but includes the rapid introduction of new legislation, which will make it possible to tackle IAS in a comprehensive manner. In addition a set of horizontal measures that are common and relevant to all options is also considered; these include communication, education and awareness-raising, development of the knowledge base, and financing. Finally it is proposed that the technical aspects of the implementation could be centralized by a dedicated agency or similar structure.

According to a recent study (Shine et al. 2010) Option A is not considered viable for the EU, as environmental, social and economic costs associated with biological invasions would continue to escalate without any gains for issue visibility or policy coherence. Option B is also not considered viable in isolation, as many suggested components would require a legislative basis (with the notable exception of the voluntary codes, best practices and communication campaigns which are foreseen to play a key role in delivery through a partnership-based approach, possibly supported by governments). Option B+ provides opportunities to address IAS by seeking synergies with existing legislation and as such could be the start of a more integrated approach to EU environmental biosecurity, to the extent supported by relevant mandates. The favourite option is therefore Option C, according to which a new legislation would provide a flexible framework by establishing a continuum of prevention and management measures with clearly allocated roles and duties of care.

The same study also presents a detailed analysis of the international, EU and Member State baseline and proposed priorities for action. It provides an interesting discussion of the major voluntary measures to address risks associated with the introduction or use of IAS. According to this study, voluntary measures

can play a multiple role: awareness-raising, stakeholder innovation, leverage/dissemination of best practices, supplementing existing regulations or filling a regulatory gap. So far, some pathway codes have already been developed for sectors not covered by international or EU regulatory frameworks. A major example is the *Code of Conduct on Horticulture and Invasive Alien Plants*, developed jointly with European and Mediterranean Plant Protection Organization (EPPO) (Heywood and Brunel 2009). The horticulture code is non-binding but was formally approved by the respective member countries of EPPO/Council of Europe (including EU-27 MS) and is currently endorsed by Great Britain[8] and Belgium.

With its recent Communication "Our life insurance, our natural capital: an EU biodiversity strategy to 2020" (COM(2011) 244 final[9]) the EC has committed that "By 2020, Invasive Alien Species (IAS) and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS (see Target 5: Combat Invasive Alien Species). In relation to Action 15 (Strengthen the EU Plant and Animal Health Regimes) "The Commission will integrate additional biodiversity concerns into the Plant and Animal Health regimes by 2012". Furthermore, in relation to Action 16 (Establish a dedicated instrument on Invasive Alien Species) "The Commission will fill policy gaps in combating IAS by developing a dedicated legislative instrument by 2012."

5. IMPLEMENTING, MONITORING AND EVALUATING THE CODE

The European code of conduct on zoological gardens and aquaria and IAS suggests some fundamental elements for a sustainable strategy at the regional level that balances the risk posed by IAS against the educational, commercial and aesthetic benefits of the living collections hosted in such institutions. The application of this voluntary based approach in this field is novel and innovative; its strength being the ambitious aim to facilitate the expression of the collective potential of the European zoo and aquarium community in relation to the mitigation of one of the greatest threats to biodiversity.

To guarantee an effective and successful implementation of such a code it is necessary to build on the experience from similar initiatives. For example, it is known that this approach has been used successfully to ameliorate similar problems in the framework of activities of botanical gardens. In particular, in the USA the potential risks posed by living collections of plants led to the launch in 1999 of a voluntary code of ethics for botanic gardens and arboreta known as the *Chapel Hill Challenge* followed in 2002 by the *St Louis Declaration*, a similar set of voluntary guidelines which, besides botanic gardens, targeted the entire horticultural industry. These were international in scope and adopted by gardens beyond the US. The effectiveness of these voluntary codes of practice did not appear particularly strong (Hulme 2011) basically because of the lack of a proper strategy to guarantee a stronger global networking of the targeted institutions to tackle biological invasions involving public outreach, information sharing and capacity building. Such conclusions might not reflect the massive changes in botanic garden mission and management. In any case, some positive examples of proactive behaviour regarding IAS occurred in Florida where growers agreed to voluntarily stop growing 45 potentially invasive plants (Niemiera and VonHolle 2009). In Europe, a major example of best practice refers to the implementation of a *Code of Conduct on Horticulture and Invasive Alien Plants* recently developed by the Council of Europe in collaboration with EPPO (Heywood and Brunel 2009). In this case, as a follow up, a national programme has been financed in Belgium through the LIFE+ Communication and Information funds to stimulate endorsement of the voluntary code and raise awareness of the environmental risks of invasive alien plants along the ornamental horticulture supply chain (Halford et al. 2011).

The national experiences and lessons learnt regarding voluntary codes, such as those mentioned above, have emphasised that, to be fully effective and to increase the likelihood of a long-term behaviour

[8] In Great Britain a horticultural code was already published in 2005 and despite the similarity in the subsequent CoE/EPPO 2009 Code a reviewed Code, taking into consideration the later CoE/EPPO code, was recently re-issued.

[9] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions of 3.5.2011 {SEC(2011) 540 final} and {SEC(2011) 541 final}

change, a code should be widely disseminated. This clearly stresses the importance of information activities aimed at preventing lack of knowledge, possibly coordinated by the key associations and with the support of the national authorities. However, to ensure the success of a code, something more than wide dissemination is required. To establish the credibility of such an instrument and to create ambassadors for its messages within the relevant sector it is important to build partnerships for its promotion and dissemination with key stakeholders. In any case, the effectiveness of voluntary codes is difficult to evaluate with precision. As suggested by Shine et al. (2010) the future *EU Strategy to combat IAS* could proactively support integrated voluntary programmes that combine the development of sectoral codes with targeted media campaigns and training. Such actions could be supported through existing EU funding instruments. As a higher objective, it could also require Member States to consider developing statutory codes of conduct along the lines of the present one that clarify responsible practices and establish a baseline for a duty of care.

5.1 Key actors

The support of all relevant national authorities would be fundamental for a sound and harmonised implementation of both the existing legislation regulating zoos activities in relation to IAS and the relevant code of conduct.

A pivotal role could also be played by the associations of zoological gardens and aquaria (such as EAZA, and national associations). Given their conservation focused objective such associations are likely to guarantee a sound IAS policy, for example by actively encouraging the implementation of the recommendations of the relevant code of conduct, in combination with monitoring and reporting rates of endorsement across their membership. Such systematic reviews would provide verifications for proactive actions by all concerned institutions against IAS and would provide further evidence for the effectiveness of zoos and aquaria as centres of education and conservation. Indeed by working together, the European zoo and aquarium community can have a cumulative conservation impact that builds significantly on the achievements of individual zoos and aquaria but which overall has a greater synergy and impact.

Also, collaboration between the Invasive Species Specialist Group (ISSG), an organization with a history of producing IAS management guidelines, and EAZA could prove beneficial in the development of standard protocols and joint training materials targeting IAS preventative approaches in Europe. Besides, such partnerships would create the right conditions for suggestions for future improvements of the code of conduct and have immediate relevancy beyond Europe.

National authorities in collaboration with European-wide and national associations and the ISSG may play a key role in building awareness, providing the impetus for responsible practices and supporting voluntary compliance with the code. Promoting awareness might also help to raise funds to make a significant and lasting contribution to support all major IAS related activities (management and maintenance of facilities to prevent escapes, information activities, research activities, grants for eradication projects, etc.).

Zoo associations, in particular, may yield a great influence on the zoological gardens and aquaria to adopt best practices in relation to IAS, for example by promoting and/or contributing to the development of manuals and guidelines to raise awareness among member institutions on appropriate methods to prevent IAS introductions. To this regard, the EAZA might yield some influence also through national associations, although this role is limited when it comes to non-association zoos.

5.1.1 National authorities

National authorities should acknowledge that the issue of IAS is a major threat for species, habitats and ecosystems, and undertake measures to ensure that all European legislation established to prevent introductions of IAS from zoological gardens and aquaria (i.e. EC Zoo Directive) is fully understood, and effectively transposed, implemented and enforced. For this purpose, national authorities should ensure that all zoological gardens and aquaria are licensed and regularly inspected to ensure that they comply with the licensing requirements (in particular, in relation to the IAS issue, enclosure security should be accurately

addressed in official inspections and authorization processes). In fact this is still a major issue, as there are zoos across the EU that are still operating without a license. Additionally some countries do not have regular inspections tied into their legislation (Staci McLennan, pers. comm. 2011). National authorities should undertake a risk analysis activity to identify sound management strategies for species identified as high risk of being invasive. In addition it is important to ensure that animals are not released from closing facilities. Potentially such measures to prevent escapes and consequent release of potentially invasive species, should be implemented also in relation to facilities other than zoos, where wild animals are kept in captivity.

For this purpose it is important that national authorities establish financial instruments and incentive programmes to guarantee that captive animals in licensed facilities are kept in conditions that meet the criteria listed in the proposed code of conduct. Such initiatives could be implemented also by facilitating the accession to external funding instruments (e.g. at EU level, the EC may support national and/or regional initiatives through the LIFE+ programme, for example in relation to information and communication campaigns).

At the EU level, this highlights the need for guidance and training from the EC to Member States in order to improve implementation and enforcement of the EC Zoo Directive, for example by providing guidance and establishing enforcement tools such as guidelines and educational courses to ensure adequate capacity building and staff training. EAZA has offered to develop such a training programme for the EU, as the professional zoos and aquaria are best placed to offer such a training component, with EAZA member institution staff often acting as national inspectors throughout Europe.

5.1.2 The European Association of Zoos and Aquaria (EAZA)

The European Association of Zoos and Aquaria (EAZA) is the largest professional zoo and aquarium association in the world. More than 340 zoological gardens, aquaria and associates from 41 countries[10] are associated, 280 of which are located within the EU (and as such are obliged to comply with Directive 1999/22/EC). The EAZA was formed in 1992 with the aim of facilitating cooperation within the European zoo and aquarium community towards the goals of education, research and conservation and of representing the interests of its members. According to the EAZA constitution and the Strategy 2009-2012, the objectives are to promote and facilitate co-operation within the European zoo and aquarium community with the aim of furthering its professional quality in keeping animals and presenting them for education, and for contributing to scientific research and to the conservation of global biodiversity (e.g. through internationally coordinated breeding programmes of wild animals and *in situ* conservation).

The EAZA also aims at empowering Europeans to learn about, and contribute to, global biodiversity conservation goals by ensuring that its member zoos and aquaria achieve and maintain the highest standards of care and breeding for the species they house. This association has a significant social role in education concerning animals, their conservation, and overarching threats such as climate change, habitat loss and how human behaviour interacts with these global challenges. It is estimated that more than 140 million people visit EAZA members each year, equivalent to approximately one in five Europeans (although such figures include people coming more than once a year). To this regard, zoos and aquaria have hosted a far more representative and inclusive visitor social spectrum than any other museum or science centre. Besides, EAZA member institutions employ 32.000 staff members, and house more than 250.000 animals, excluding fish and invertebrates. Therefore EAZA members are often important economic drivers and cultural centres in their local communities, and are often important "opinion formers" on environmental issues, including that of IAS (see the 2010 *EAZA Position Statement on the developing EU Strategy for Invasive Alien Species*[11]).

[10] See the 2010 *EAZA Position Statement on the developing EU Strategy for Invasive Alien Species (IAS)*

[11] http://www.eaza.net/about/Documents/Position%20Statements/invasive_alien_species_strategy_for_eu_september_2010.pdf

5.1.3 The IUCN/SSC Invasive Species Specialist Group

The Invasive Species Specialist Group (ISSG) is a global network of scientific and policy experts on IAS, organized under the auspices of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN). The ISSG promotes and facilitates the exchange of IAS information and knowledge across the globe and ensures the linkage between knowledge, practice and policy so that decision making is informed. Indeed, the three core activity areas of the ISSG are information exchange, networking and provide policy and technical advice, particularly to European institutions (i.e. EC) in the context of *European Strategy on IAS* development. The ISSG was established in 1994 and has currently approximately 200 core members from over 40 countries and a wide informal global network of over 2000 conservation practitioners and experts who contribute to its work.

The ISSG is currently contributing to the development of early warning and rapid response frameworks for biological invasions at both the global level and the local level and has been particularly active in providing assistance and advice in the development and implementation of IAS related codes of conducts. In addition the ISSG is collaborating with the Reintroduction Specialist Group of IUCN on the development of revised IUCN Guidelines on conservation translocations.

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Appendix

THE EUROPEAN CODE OF CONDUCT

ON ZOOLOGICAL GARDENS AND AQUARIA AND INVASIVE ALIEN SPECIES

9 March 2012

Invasive alien species (IAS) are recognised as one of the most important direct drivers of biodiversity loss and ecosystem service changes. Among the possible management strategies, prevention is unanimously acknowledged as the best available option, when feasible. For this reason controlling the key actual or potential entries by means of codes of conduct or similar "incitative" voluntary instruments is considered the most effective way of tackling the threats from IAS. The validity of this approach is stressed also by the CBD Strategic Plan for Biodiversity 2011–2020 and the recent European Commission Communication "Our life insurance, our natural capital: an EU biodiversity strategy to 2020" [COM(2011) 244 final] according to which "by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment".

Zoological gardens and aquaria are key players in global conservation programmes, thanks to the living collections of threatened species they manage, their involvement with species recovery and habitat conservation, and their role in public outreach (zoo and aquaria host hundreds of millions of Europeans each year and, as such, can contribute to raising awareness to prevent IAS introductions and spread). At the same time, zoological gardens and aquaria host many potential IAS in their living collections and in some cases have been inadvertently responsible for their introduction into the wild. For this reason, the present code of conduct aims at establishing effective practices for preventing future escapes and the release of potential IAS from zoos and aquaria, particularly among non associated institutions and establishing European zoos as active educators and interpreters on the impacts of IAS to European society.

For additional details see annexed report, including the rationale and other additional information for a European code of conduct for zoological gardens and aquaria and IAS.

On the basis of the comments above, five recommendations have been identified for zoological gardens and aquaria in Europe:

1. Adopt effective preventative measures to avoid unintentional introduction and spread of IAS;
2. Take into account the risks of IAS introductions in all wildlife and habitat management projects;
3. Proactively engage in awareness raising and outreach activities focusing on IAS and their impacts;
4. Adopt best practices for supporting early warning and rapid response system for IAS;
5. Be aware of all relevant regulations concerning zoological gardens and aquaria and IAS.

The recommendations above are to be considered as a fundamental first step needed to encourage voluntary initiatives for zoological gardens and aquaria in compliance with the principles of the *European Strategy on IAS*. They have been developed for single institutions of zoological gardens and aquaria (including institutions that are not involved in professional networks and associations) with the objective of ensuring that their living collections do not represent a source of IAS. In addition, the recommendations proposed aim to increase the overall commitment and engagement of zoological gardens and aquaria in relation to their role in conservation, research and education in relation to the urgent need to mitigate the threat of biological invasions.

Details for the implementation of the proposed measures are described below.

1. Adopt effective preventative measures to avoid unintentional introduction and spread of IAS

The variety of episodes of unintentional introductions of IAS from zoological gardens and aquaria shows that some institutions might face challenges in managing their facilities in order to effectively prevent the escape of species (and related diseases) into the wild. For this reason, it is fundamental that each single institution implements appropriate methods to prevent the risk of escapes, paying particular attention to the following measures:

a) Ensure that structures are designed to prevent the escape of hosted animals and plants, their propagules, their parasites and pathogens (or any other organisms with potentially deleterious impacts on the environment);

b) Ensure regular maintenance of all containment infrastructures, e.g. cages, aviaries, fences, barriers, etc. by establishing an assessment procedure involving responsible and regular monitoring and inspection of the facilities (e.g. to identify damages to fences, etc.);

c) Ensure that strict biosafety protocols to reduce risk of pest and pathogen escape (e.g., management response involving quarantine, waste disposal, etc.) are in place, as well as appropriate contingency plans to pre-empt such risks;

d) Organise dedicated training programmes for the staff of zoos and aquaria to ensure that the personnel understand the possible risks related to the escape or accidental discharge of IAS, including diseases, and that they are adequately trained to prevent such risks;

e) Remove potential IAS from open displays, e.g. displays without roofs, unless all possible measures to prevent their escape/release have been undertaken;

f) Before a decision is made to enable a species to move freely throughout the zoo facilities (e.g. in the case of free-flying psittacine birds or birds of prey in flying displays) specific assessments should be undertaken to evaluate whether such species might represent a threat to native species, habitats and ecosystems (also in relation to the spread of diseases or possible injuries between the public and the animal). To this purpose, dedicated quick screening procedures should be undertaken by the zoos, and contingency plans should be in place to capture, control and contain animals in case of escape[12]. Otherwise effective techniques should be adopted to reduce the invasive potential of the species kept in open displays (e.g. by releasing only males, or by restricting permanently or temporarily the ability of birds to fly, through wing clipping or other suitable methods, whenever feasible and appropriate, in accordance with animal health and welfare regulations and best practices);

g) Given the growing role of plant collections in many zoos and aquaria, including those used for food (e.g. birds seeds), environmental enrichment, exhibit/tank design and environmental education, it is important to ensure that the use of invasive plants which may spread to adjacent natural areas is avoided. As an alternative, non-invasive, possibly native, plants that are aesthetically and horticulturally suitable in the region should be identified and used to replace known or potential IAS;

h) Consider the planning of strict monitoring and appropriate management measures to prevent the accidental introduction into the environment of species that are potentially invasive, such as plants used in zoos and aquaria infrastructures by garden designers and landscape architects, or algae and other organisms used in aquaria (and other similar facilities) for ornamental purposes. Also, in

[12] Note that in the UK, it would be an offence to allow a non-native animal (that was not already ordinarily resident in a wild state) to escape from captivity. The legislation contains a defence if all reasonable steps were taken to prevent escape, which clearly would provide a legal incentive/encouragement adopt these good practices. Other similar legislation might exist in other European countries, and the EU is developing an *ad hoc* legislation on invasive species that might provide additional provision in this regard.

relation to the potential threat by invasive alien species of plants, refer to the *European Code of Conduct for Botanic Gardens on Invasive Alien Species*[13] whenever appropriate;

i) Prevent the risk of escapes of species used as live food, for example by considering the origin of such species (i.e. promoting the use of live food of native origin);

j) Ensure that water from enclosures and aquaria (or any other water body included in the zoo) is not released into the natural environment without being adequately screened and/or treated (e.g. sterilised) as necessary;

k) Establish policies that regulate the acquisition, ownership and disposition of non-native, potentially invasive organisms. Ensure that species kept in captivity are not sold or otherwise distributed to the general public (e.g. exceptions based on register of "reliable buyers" might be considered), and that systems are in place to minimise the risks of theft, malicious damage or release of animals by visitors or other non authorised people;

l) Undertake regular emergency planning to reduce the risk of escape during catastrophic events such as extreme weather conditions, fire, flood or earthquake;

m) Include collection disposition as part of the planning for the closure of any zoo.

2. Take into account the risks of IAS introductions in all wildlife and habitat management projects

Captive breeding, reintroduction and translocations are invaluable conservation practices that are helping threatened species to recover from the risk of local or global extinction. Nevertheless such conservation measures might carry an associated risk of inadvertently introducing IAS (and related diseases and pathogens) into the wild. Such introductions might have severe negative direct ecological impacts on native species, for example through predation or competition dynamics, and in some cases might affect the genetic integrity of native populations (with potentially undesired effect on the adaptations of the affected species to the local ecological conditions). In some cases the release of such species and their pathogens can compromise the success of the conservation measures themselves. For this reason it is crucial that *ex situ* and *in situ* conservation initiatives implemented or supported by zoological gardens and aquaria are rigorously based on globally recognised guidance documents, such as the *IUCN Guidelines for Reintroductions and other Conservation Translocations*.

3. Proactively engage in awareness raising and outreach activities focusing on IAS and their impacts

A major contribution of zoological gardens and aquaria in relation to the IAS issue lies in the high educational role which characterises such institutions. Education, information and awareness-raising activities are needed to influence and change the behaviour of the target audience and facilitate choices to reduce IAS risks related to intentional and unintentional introductions of animals and plants into the wild. Considering that many IAS are quite frequently exhibited in zoos, such institutions can provide an excellent opportunity to raise awareness among the visiting public about the ecological harm associated with the release of such IAS into the wild. It is interesting to note that the educational dimension can be twofold: 1) it can educate people about the threat that exotic species pose to native species and habitats if introduced into the wild outside their natural range; 2) it may contribute to illustrate how exotic species may be threatened in their own native range by other IAS. The overall goal should be to discourage IAS to be kept as pets outside professional and legally inspected institutions.

[13] Vernon Heywood and Suzanne Sharrock. 2012. European Code of Conduct for Botanic Gardens on Invasive Alien Species. Council of Europe. Document T-PVS/Inf (2012)1.

In regard to education, information and awareness-raising activities, the suggested key recommendations are:

a) Promote an understanding of the value of biodiversity and ecosystem services and the important risks posed to society and biodiversity by IAS;

b) Promote information activities to inform visitors on which of the exhibited species are native to an area and which are not, and on their actual and potential impact in the relevant introduction range e.g. through temporary or permanent exhibitions and dedicated panels, guides, etc.;

c) Provide information on IAS, e.g. origin, main pathways, and ecological and socio-economic impacts, both to warn zoo personnel about the potential risk of IAS within their animal collection and to raise awareness amongst the public about the risk of releasing them into the wild;

d) Ensure that an explanation is provided to the public advising the risk associated with the IAS and their function in the facility;

e) Promote the distribution of information about the invasiveness in other biogeographic regions of native species hosted within the relevant facility;

f) Support awareness raising activities (e.g. seminars, dedicated campaigns, etc.) to inform visitors on the general issue of IAS, to encourage preventative measures against the escape and release of IAS into the wild (e.g. by hosting programmes on the importance of not releasing pets into the wild);

g) Circulate information on legislation and best practices among the public, e.g. by explaining specific ways to enable compliance with simple, clear and logical messages tailored for a wider audience;

h) Use an eradication or control programme to communicate information on what different stakeholders can do to reduce the chance of future incursions (e.g. when such programmes are Government led it would be important to engage with any relevant national IAS policy initiatives);

i) Involve interest groups and appropriate media channels in the design and dissemination of public awareness materials, including information on success stories and practical ways to reduce risks.

j) Develop educational toolkits for selected audiences (e.g. schools) to raise awareness on the issue.

4. Adopt best practice for supporting early warning and rapid response system for IAS

The effective implementation of measures against the ecological and socio-economic threat from IAS needs to be supported by all main societal sectors involved in activities directly or indirectly involved in the movement, release, detection and management of IAS. In this context zoological gardens and aquaria can play a pivotal role as key stakeholders. In particular, a major contribution would be offered by the following activities:

a) Establish and implement an early warning system aimed at informing promptly the competent authorities about each case of escape;

b) Develop contingency plans in collaboration with relevant conservation and environmental agencies to prevent the spread into the wild of IAS of hosted animals which might eventually escape from the facilities, including clear information on the established chain of responsibility and consider the need to engage in training in relevant conservation skills;

c) Ensure that all escapes are recorded and relevant detailed reports made (e.g. to national or European authorities) and support specific and comprehensive analysis regarding IAS originated by escapes/releases from zoological gardens and aquaria in Europe;

d) Consider the introduction of a registry and related marking scheme for all animals kept in captivity to guarantee that they can be identified when they escape[14];

e) Promote reporting and rapid response to animals and plants escaped in the wild, and consider participating in developing, implementing or supporting regional, national or local early warning systems for immediate reporting and control;

f) Consider networking with regional and national groups of IAS experts, and collaborating with national policy framework initiatives, in order to promote an effective exchange of information on invasive alien species.

g) Consider involving the public and relevant interest groups in monitoring activities, with appropriate training and information materials, and implement targeted awareness-raising activities to increase the chances of early detection of new IAS and build understanding of why eradication may be necessary. Actively encourage the scientific and research community to support these efforts by ensuring prompt circulation of relevant information. To this regard it is important to engage or work with any national IAS policy frameworks and initiatives which may also have alert species systems, public reporting/citizen science programmes etc (e.g. as it is being done in UK where a IAS public awareness display is also being developed with Bristol Zoo. In such cases, the link with the national policy framework is important to avoid fragmentation and give the public consistent messages).

h) Encourage initiatives, in collaboration with the relevant authorities, aimed at providing temporary or permanent facilities to prevent the spread of IAS, e.g. by establishing rescue centres to host otherwise unwanted/abandoned animals (particularly pets) or for animals removed from the wild whenever suppression is not a feasible option in eradication/control programmes;

i) Strengthen the support to the conservation of wild populations threatened by the presence of IAS in their natural habitat, in the light of future reintroduction/translocation programmes in accordance with the *IUCN Guidelines for Reintroductions and other Conservation Translocations*;

j) Actively promote and engage in research activities on IAS and their impact (e.g. considering all ecological and socio-economic affected aspects), useful to design effective management programmes, also in the light of future reintroduction programmes of the affected native species and relevant habitat restoration activities;

k) Supporting dedicated IAS management programs encompassing research, education and management initiatives;

l) Develop partnerships with international organisations such as the IUCN/SSC Invasive Species Specialist Group (ISSG) e.g. under the form of a Memorandum of Understanding for assistance and advice on IAS related issues. Similarly to other conservation campaigns such partnership could be supported by the Council of Europe (an example is the European Carnivore Campaign ran by the EAZA).

5. Be aware of all relevant regulations concerning zoological gardens and aquaria and IAS

a) Be fully aware of and comply with all relevant laws and regulations relating to the management of animals in zoological gardens and aquaria (e.g. the legislation enforced by the EU Member States for

[14] This point is already covered in the EU Zoos Directive in relation to record keeping. For example the Spanish legislation foresees the keeping of a dedicated register of animals and relative identification system (see art. 6 of Law no. 31/2003, on the conservation of wildlife in zoological parks)

the implementation of the EC Zoo Directive) and particularly ensure that all animals kept in captivity are housed in conditions that prevent the risk of escape of IAS;

b) Consider all laws on importation, exportation, quarantine and distribution of animals across political boundaries.