8th SESSION OF THE MEETING OF THE PARTIES

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"Strengthening Flyway Conservation in a Changing World"

DRAFT INITIAL GUIDANCE ON ECOSYSTEM SERVICES IN RELATION TO MIGRATORY WATERBIRDS

Introduction

This guidance responds to Target 2.6 in AEWA's Strategic Plan 2019-2027 as follows:

> "Consideration of the ecosystem services derived from migratory waterbirds is integrated into policy and decision-making processes that affect waterbird habitats in at least two-thirds of AEWA Parties."

Three derived actions are indicated:

a) "By MOP8 provide concise initial guidance (in language adapted to policy/decision makers) on the provisioning and cultural aspects of ecosystem services in relation to migratory waterbirds.

b) By MOP9, implement national pilot projects and/or collate and make available examples/case studies of decision-making which takes into consideration waterbird values and their habitats.

c) By MOP10, produce AEWA guidelines on valuation of ecosystem services derived from migratory waterbirds and their habitats and communicate to relevant stakeholders at all levels."

This guidance relates to the first of these actions.

The draft initial guidance was approved for submission to MOP8 by the Technical and Standing Committees at their 16th meeting on the 25-29 January 2021 and 16th meeting on 4-6 May 2021, respectively.

Action requested from the Meeting of the Parties

The Meeting of the Parties is requested to review the draft initial guidance and to adopt it for further use.

DRAFT INITIAL GUIDANCE ON ECOSYSTEM SERVICES IN RELATION TO MIGRATORY WATERBIRDS

Compiled by the Technical Committee

Introduction

Waterbirds provide a significant and direct or indirect range of ecosystem services as fully reviewed by Green & Elmberg (2014)[1]. Many ecosystem services do not have market values or are capable of market valuation. For example, important but more intangible benefits to humankind, come from waterbirds supporting the sound functioning of the ecology of wetlands. Other services do have a direct economic value, whilst some (such as food provision) are of significance in the context of the UN's Sustainable Development Goals.

More importantly, the ecosystem services that derive from waterbirds alone are just elements of the ecosystem services and values (whether of economic significance or not) arising from the wise use of their wetland habitats more generally. As noted by the Ramsar Convention:[2]

> "Wetland ecosystem services far exceed those of terrestrial ecosystems. They provide critical food supplies including rice and freshwater and coastal fish, and fresh water, fibre and fuel. Regulating services influence climate and hydrological regimes and reduce both pollution and disaster risk. Natural features of wetlands often have cultural and spiritual importance."

Waterbird ecosystem services should never be considered (or assessed) in isolation, but rather as an integral component of this wider array of wetland benefits (below). Indeed, the ecosystem service benefits to society that come from waterbirds, including the continued existence of the birds themselves, are direct outcomes of the wise use of their wetland habitats[3] and that should be the central policy objective.

In considering waterbird ecosystem services, it is crucial that as well as market/economic values, non-market values are also considered so as to inform and influence policy decision-making and policy agendas.

Wetland ecosystem services

Whilst this initial guidance addresses specifically ecosystem services derived from waterbirds, there have been several recent publications related to the wider, but integrally linked issue of wetland ecosystem services relevant to the AEWA Agreement Area.

These include the *Global Wetlands Outlook* (Ramsar Convention on Wetlands 2018); the *Mediterranean Wetland Outlook 2* (MedWet 2018); and the recent assessment on biodiversity and ecosystem services by the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES). Additional to its global synthesis (IPBES 2019), this work also published regional assessment reports for Africa (2018a) and Europe and Central Asia (2018b). IPBES's assessment on land degradation and restoration (2018c) is also relevant to AEWA.

The European Union's comprehensive ecosystem assessment for the EU28 (Maes *et al.* 2020) presents much information on the extent of European wetlands and the status of their ecosystem services.

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[1] Green, A.J. & Elmberg, J. 2014. Ecosystem services provided by waterbirds. *Biological Reviews* 89: 105–122. Other valuable reviews that comprehensively cover the subject area are Diamond & Fillon (1987) and especially Cocker (2013).

[2] Ramsar Convention on Wetlands 2018. *Global Wetland Outlook: State of the World's Wetlands and their Services to People.* Gland, Switzerland: Ramsar Convention Secretariat.

[3] See Ramsar's Handbook on the *Wise use of wetlands* [FR ici, ES aquí].

Together, these multiple assessments present much more detailed understanding of the state of wetlands and their ecosystem services within the Agreement area than has existed before.

See document AEWA/MOP 8.35 for further information on state of wetlands.

Legality, sustainability and wise use

It is very important to note that not all the ecosystem services listed in Tables 1 and 2 are necessarily legal under the provisions of AEWA, nor do they necessarily amount to 'wise use' under the provisions of the Ramsar Convention.

For example, much trapping of ducks in Africa is undertaken using nets and/or snares (as documented by Zwarts *et al.* (2009) especially for Pintail *Anas acuta* and Garganey *Spatula querquedula*, both methods of which are illegal under AEWA provisions due to their non-selectivity.

Further, the taking of harvests of seabird eggs and breeding adults (as occurs in some coastal areas), can be (depending on species) both illegal and unsustainable for the colony concerned. Yet it occurs and provides a food resource for those undertaking the activity. Nørrevang (1986) however, described how the socio-cultural regulation of traditional capture of seabirds in the Faroes ensured its ecological sustainability.

AEWA's legal provisions require that the taking of waterbirds is sustainable, yet not all activities that are biologically sustainable are within the legal provisions of the Agreement.

It is accordingly stressed that the inclusion of an ecosystem service linked to waterbirds in this guidance does <u>not</u> necessarily imply that it is legal under AEWA provisions, but merely indicates that it occurs.

Waterbird ecosystem services

The Table 1 below provides a high-level summary of these benefits ordered by category of ecosystem service. Table 2 orders this same information sorted by policy sector for ease of reference.

Direction of benefits

Many of the 'services' and 'benefits' listed in the Tables can have either positive or negative effects depending on local contexts. Thus, for example, light grazing of arable crops can enhance subsequent yield through increasing tillering; however, if more intense grazing occurs, yield can be reduced even to the extent of total crop destruction. Similarly, nutrients derived from goose droppings can be either beneficial or problematic depending on where, and in what quantity, they are deposited.

Thus, any assessment of direction of benefits will depend on understanding local contexts.

Indicators

The development of indicators in relation to ecosystem services will be important, especially in relation to the sustainability of the activity. Typically, this will likely require local assessment. Thus, ecotourism at a wetland may bring economic benefits to local communities, but if the volume of tourism is excessive then the associated disturbance may result in reductions in waterbird populations and other disbenefits (for example pollution arising from new tourism developments).

Indicators will be easier to develop for tangible benefits than for intangible one (such as support of local cultures for example).

Use of this information to implement the AEWA Strategic Plan

The Strategic Plan encourages Parties to implement national pilot projects and/or collate and make available examples/case studies of decision-making which takes into consideration waterbird values and their habitats.

With respect to projects which take into consideration waterbird values and their habitats:

- It is important that that Environmental Impact Assessments and/or Strategic Environmental Assessments fully consider the impact of a project on the range of ecosystem services derived from waterbirds and their wetland habitats.

- Economic benefits for waterbird ecosystem services alone have been rarely quantified. It would be valuable to exploit opportunities to assess economic valuations, as one component of wider assessments of wetland service valuation.

- Benefits from waterbirds potentially accrue to a range of different beneficiaries – from local communities with potential interests in resource sustainability to those living off-site with potentially less concern for ultimate resource conservation. It is valuable to document these.

With respect to collating examples of waterbird ecosystem services, the Tables can provide a check list of issues for consideration.

Conclusion

Ultimately, the conservation status of waterbird populations depends on achieving or maintaining their favourable conservation status. This in turn will deliver derived ecosystem services through the application of the full range of conservation interventions specified in AEWA's Action Plan, including and especially through the conservation and wise use of the key ecosystems on which these birds depend.

Table 1. Policy relevance of ecosystem services provided by waterbirds (ordered by ecosystem service category).

Adapted, with acknowledgement from Green, A.J. & Elmberg, J. 2014. Ecosystem services provided by waterbirds. *Biological Reviews* 89: 105–122. Note that Green & Elmberg give a full literature review with many more sources. See also Diamond & Fillon 1987 and Cocker 2013.

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
Provisioning services					
Meat	The harvest of waterbirds provides a source of food for people throughout the Agreement area. It can be especially important in situations of food poverty. However, it is critical that any such harvests are undertaken both legally (according to AEWA provisions) and sustainably to ensure the long-term viability of this food source. AEWA Parties are legally required to regulate migratory waterbird taking, including in respect of species (some are protected), and the modes and seasons of taking. National and other legislations need to reflect these requirements. AEWA's Guidance on sustainable hunting, and on national legislation.	**Food security (especially for subsistence livelihoods)**	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Anatidae	Nørrevang 1986; Scott 1987; Merkel & Barry 2008; Zwarts *et al.* 2009; Krcmar *et al.* 2010 **Case studies:** • Balmaki & Barati 2006 present a case study of migratory waterbird harvesting in Gilan Province, northern Iran. • Nørrevang (1986) describes how the socio-cultural regulation of traditional capture of seabirds in the Faroes ensured its ecological sustainability. • Zwarts *et al.* (2009) give much detailed information on duck harvesting in Sahelian wetlands.

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
Eggs	Eggs are sometimes harvested from seabird colonies or other breeding waterbirds in significant numbers. This can provide significant food for local communities. AEWA Parties are legally required to regulate the taking of migratory waterbird eggs, including in respect of species (some are protected). National and other legislations need to reflect these requirements. AEWA's Guidance on sustainable hunting, and on national legislation.	**Food security (especially for subsistence livelihoods)**	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Potentially all waterbirds, but especially (colonial) seabirds	Nørrevang 1986; Kear 1990; Feare *et al.* 2007; Merkel & Barry 2008; Green & Elmberg 2014
Down	Down collection is traditional in some locations and can be an important element of local economy.	**(Poverty reduction)**		Common Eider, geese	Sveinsson undated; Kear 1990; Cocker 2013
Feathers and skins for clothing and ornaments	Traditional clothing of northern peoples has often incorporated bird skins from several species.	**(Poverty reduction)**		Anatidae, herons, others	Doughty 1975; Hansen & Gulløv 1989; Møller 1989; Cocker 2013
Grease for waterproofing				Geese	MacMillan & Leader-Williams 2008
Supporting services					
Animal propagule dispersal				Anatidae, coots	Green & Figuerola 2005; Frisch *et al.* 2007; papers in: *Animal-mediated dispersal in understudied systems*
Plant propagule dispersal	Waterbirds play an important role in dispersing plant propagules thus			Anatidae, waders	Green *et al.* 2002b; Klein *et al.* 2008; Brochet *et al.* 2009; Green *et al.* 2016;

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	aiding dynamic adaptation to climate change				Viana 2017; Kleyheeg *et al.* 2019
Nutrient cycling				Geese, cormorants	Iaccobelli & Jefferies 1991; Gauthier *et al.* 2006; Kameda *et al.* 2006; Fujita & Kameda 2016
Stimulating primary productivity	Goose faeces are an important source of nutrients in some habitats			Geese	Cargill & Jefferies 1984; Bazeley & Jefferies 1985; Nolet 2004
Stimulating decomposition	Keeping rice fields flooded after the harvest, not only benefits waterbirds but also help with weed control and decomposition.			Ducks	Bird *et al.* 2000; van Groeningen *et al.* 2003; Pernollet *et al.* 2015
Scavenging and removal of organic wastes	With vultures, Marabou Storks provide important scavenging functions in urban and other habitats	**Health and urban policy**		Marabou Stork *Leptoptilos crumenifer*	Kahl 1966; Pomeroy 1975
Influencing methane production[4]		**Climate change**		Swans	Bodelier *et al.* 2006; Winton & River 2017
Plant diversity		**Biodiversity conservation**	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes	Anatidae	Maron *et al.* 2006; Jasmin *et al.* 2008; Hidding *et al.* 2010
Animal diversity	Migratory waterbirds are an important element of wetland biodiversity. Through their visibility	**Biodiversity conservation**	**Target 6.6**: By 2020, protect and restore water-related	Anatidae, others	Fabricius & Norgren 1987; Georgiev *et al.* 2005, 2007

[4] Can be either a positive or negative effect depending on the local context and wetland type (*e.g.* Winton & Richardson 2017).

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	and seasonal movements, they can act as an important public awareness 'flagships' - raising awareness of other biodiversity. Waterbirds also support biodiversity directly, e.g. of many parasites with complex life cycles that live in invertebrates and then waterbirds.		ecosystems, including … wetlands, rivers, aquifers and lakes		
Protection from predators	The presence of gulls and other colonial breeding birds can provide safer breeding opportunities of other species by deterring predators.	**Biodiversity conservation**		Geese	Fabricius & Norgren 1987; Allard & Gilchrist 2002; Fox *et al.* 2016
Bioindicators of plants	Habitats that protect waterbirds also sustain multiple other wetland plant species.	**Biodiversity conservation**	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes. **Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and freshwater ecosystems and their services …	Anatidae, coots	Elmberg *et al.* 1993; Wicker & Endres 1995; Green *et al.* 2002a
Bioindicators of animals	Habitats that protect waterbirds also sustain multiple other wetland animal species.	**Biodiversity conservation**	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including	Anatidae	Elmberg *et al.* 1993; Gunnarsson *et al.* 2004; Elmberg *et al.* 2010; Guareschi *et al.* 2015

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
			… wetlands, rivers, aquifers and lakes **Target 14.2** By 2020, sustainably manage and protect marine and coastal ecosystems… **Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and freshwater ecosystems and their services …		
Bioindicators of nutrients/contaminants	Monitoring body burdens of contaminants (for example lead and other heavy metals) can be a cost-effective means of understanding the extent and modes of environmental pollution. Bird populations can provide a practical way of monitoring changes in contaminant loads, *e.g.* after the major mine spill of 1998 in Doñana (Martínez-Haro 2013)	**Biodiversity conservation**	**Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and freshwater ecosystems and their services …	Herons, grebes, ducks	Fasola *et al.* 1998; Nummi *et al.* 2000; Burger & Eichhorst 2007; Martínez-Haro 2013
Regulating services					
Pest-control	Waterbirds can provide effective and cost-effective means of controlling pests of wetland agriculture, so negating the need to use hazardous, toxic, and expensive pesticides.	**Sustainable agriculture** **Organic agriculture**	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Ducks	Hamilton *et al.* 1994; Teo 2001; Miles *et al.* 2002

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	CMS Resolution 11.15 on preventing poisoning of migratory birds. [FR ici] CMS Guidelines on preventing poisoning of wild birds. [FR ici]	**Reduction/control of toxic pesticides** **Health**	**Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that .... help maintain ecosystems… **Target 3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals…		
Weed control	Anatidae are major consumers of seeds of weeds in ricefields and may provide a significant economic benefit by reducing the abundance of such seeds. Wintering of ducks in flooded ricefields can reduce the weed biomass the following growing season by more than 50%.	**Sustainable agriculture** **Organic agriculture**	**Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that	Anatidae, especially ducks	van Groenigen *et al.* 2003
Disease regulation and surveillance	Surveillance of waterbird diseases (such as avian influenza) can provide important early warning of the circulation of potential or actual zoonotic diseases of risk to people, or of animal diseases of economic significance. Ramsar Wetland Disease Manual AEWA Resolution 4.15 Responding to the spread of Highly Pathogenic	**Human health** **Animal health**	**Goal 3:** Ensure healthy lives and promote well-being for all at all ages	Ducks	Munster *et al.* 2005; Wallensten *et al.* 2007; Ziegler *et al.* 2010. **Case studies**: There has been much experience since the mid-2000s with respect to High Pathogenic Avian Influenza. • Ramsar avian influenza guidance. [FR ici]

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	Avian Influenza H5N1 (with guidance). [FR ici] CMS Resolution 12.6 on wildlife disease and migratory species. [FR ici]				• FAO Avian Influenza guidance • EMPRES/FAO Manual on Preparing for Highly Pathogenic Avian Influenza
Regime shifts of wetlands	The regular monitoring of waterbird populations through time can provide a valuable means of assessing changing ecological conditions. Regime shifts can be indicated by changes in the waterbird community, for example through the entry of alien Carp (Maceda-Veiga *et al.* 2017); changes to benthos (Bowgen *et al.* 2015); or overgrazing (van Altena *et al.* 2016). AEWA monitoring guidance	**Wetland management**	**Goal 6:** Ensure availability and sustainable management of water and sanitation for all. **Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes.	Cormorants	Leah *et al.* 1980; Dirksen *et al.* 1995; Bowgen *et al.* 2015; van Altena *et al.* 2016; Maceda-Veiga *et al.* 2017
Cultural services					
Recreational hunting	Recreational hunting, when undertaken sustainably, can provide important economic inputs both locally and at wider scales. AEWA's Guidance on sustainable hunting	**Biodiversity conservation** **Sustainable use of natural resources** **Tourism**		Anatidae	Scott 1987; Bregnballe *et al.* 2006; Kanstrup 2006; Losey & Vaughan 2006; Grado *et al.* 2011; Withey & van Kooten 2011; Cocker 2013
Birdwatching	Birdwatching, when undertaken sensitively, can provide important economic inputs locally and at wider	**Tourism** **Mental health**		Geese	MacMillan *et al.* 2004; MacMillan & Leader-Williams 2008

Ecosystem Service (ES)	Advocacy and policy options	Relevant policy sector relevant for this ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	scales, as well as being important for mental health.				
Ecotourism	Ecotourism, when undertaken sustainably, can provide important economic inputs locally and at wider scales. AEWA's Guidance on ecotourism CMS Resolution 12.23 on sustainable tourism and migratory species. [FR ici] Ramsar leaflet on wetland tourism	**Tourism** **Mental health**		All waterbirds	Edgell & Williams 1992 **Case studies** Ramsar's review of wetland tourism [FR ici ES aquí] contains relevant case studies
Conservation flagships	Both through their epic migrations, wide range of lifestyles, and diverse ecology, migratory waterbirds are a very effective mean through which to communicate wider environmental messages. CBD Toolkit on communication, education and public awareness (CEPA)	**Education and awareness raising**		Anatidae, flamingos	Kear 1990; Galicia & Baldassarre 1997
Art	Waterbirds have inspired artists for over 30,000 years (here).	**Culture and arts** **Mental health**		Flamingos, others	Mas 2000; Arnott 2007; Cocker 2013
Religion/spiritual	Some cultures endow waterbirds with spiritual or religious significance. In some cultures, some feathers are used ceremonially.	**Religion**		Seabirds, pelicans, others	Scott 1987; Cocker 2013. The pelican has particular significance in Christianity.

Table 2. Policy relevance of ecosystem services provided by waterbirds (ordered by policy sector).

The content of this Table is the same as Table 1 but ordered by policy sector rather than by type of ecosystem service.

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
Food security (especially for subsistence livelihoods)					
Meat	The harvest of waterbirds provides a source of food for people throughout the Agreement area. It can be especially important in situations of food poverty. However, it is critical that any such harvests are undertaken both legally (according to AEWA provisions) and sustainably to ensure the long-term viability of this food source. AEWA Parties are legally required to regulate migratory waterbird taking, including in respect of species (some are protected), and the modes and seasons of taking. National and other legislations need to reflect these requirements. AEWA's Guidance on sustainable hunting, and on national legislation.	Provisioning	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Anatidae	Nørrevang 1986; Scott 1987; Merkel & Barry 2008; Zwarts *et al.* 2009; Krcmar *et al.* 2010 **Case studies:** • Balmaki & Barati 2006 present a case study of migratory waterbird harvesting in Gilan Province, northern Iran. • Nørrevang (1986) describes how the socio-cultural regulation of traditional capture of seabirds in the Faroes ensured its ecological sustainability. • Zwarts *et al.* (2009) give much detailed information on duck harvesting in Sahelian wetlands.
Eggs	Eggs are sometimes harvested from seabird colonies or other breeding waterbirds in significant numbers. This	Provisioning	**Goal 2:** End hunger, achieve food security and improved nutrition	Potentially all waterbirds, but	Nørrevang 1986; Kear 1990; Feare *et al.* 2007; Merkel & Barry 2008; Green & Elmberg 2014

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	can provide significant food for local communities. AEWA Parties are legally required to regulate the taking of migratory waterbird eggs, including in respect of species (some are protected). National and other legislations need to reflect these requirements. AEWA's Guidance on sustainable hunting, and on national legislation.		and promote sustainable agriculture	especially (colonial) seabirds	
Poverty reduction					
Down	Down collection is traditional in some locations and can be an important element of local economy.	Provisioning		Common Eider, geese	Sveinsson undated; Kear 1990; Cocker 2013
Feathers and skins for clothing and ornaments	Traditional clothing of northern peoples has often incorporated bird skins from several species.	Provisioning		Anatidae, herons, others	Doughty 1975; Hansen & Gulløv 1989; Møller 1989; Cocker 2013
Health and urban policy					
Scavenging and removal of organic wastes	With vultures, Marabou Storks provide important scavenging functions in urban and other habitats	Supporting		Marabou Stork *Leptoptilos crumenifer*	Kahl 1966; Pomeroy 1975
Climate change					
Influencing methane production[5]		Supporting		Swans	Bodelier *et al.* 2006; Winton & River 2017

[5] Can be either a positive or negative effect depending on the local context and wetland type (*e.g.* Winton & Richardson 2017).

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
Biodiversity conservation					
Plant diversity		Supporting	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes	Anatidae	Maron *et al.* 2006; Jasmin *et al.* 2008; Hidding *et al.* 2010
Animal diversity	Migratory waterbirds are an important element of wetland biodiversity. Through their visibility and seasonal movements, they can act as an important public awareness 'flagships' - raising awareness of other biodiversity. Waterbirds also support biodiversity directly, e.g. of many parasites with complex life cycles that live in invertebrates and then waterbirds.	Supporting	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes	Anatidae, others	Fabricius & Norgren 1987; Georgiev *et al.* 2005, 2007
Protection from predators	The presence of gulls and other colonial breeding birds can provide safer breeding opportunities of other species by deterring predators.	Supporting		Geese	Fabricius & Norgren 1987; Allard & Gilchrist 2002; Fox *et al.* 2016
Bioindicators of plants	Habitats that protect waterbirds also sustain multiple other wetland plant species.	Supporting	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes. **Target 15.1** By 2020, ensure the conservation, restoration and	Anatidae, coots	Elmberg *et al.* 1993; Wicker & Endres 1995; Green *et al.* 2002a

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
			sustainable use of terrestrial and freshwater ecosystems and their services …		
Bioindicators of animals	Habitats that protect waterbirds also sustain multiple other wetland animal species.	Supporting	**Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes **Target 14.2** By 2020, sustainably manage and protect marine and coastal ecosystems… **Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and freshwater ecosystems and their services …	Anatidae	Elmberg *et al.* 1993; Gunnarsson *et al.* 2004; Elmberg *et al.* 2010; Guareschi *et al.* 2015
Bioindicators of nutrients/contaminants	Monitoring body burdens of contaminants (for example lead and other heavy metals) can be a cost-effective means of understanding the extent and modes of environmental pollution. Bird populations can provide a practical way of monitoring changes in contaminant loads, *e.g.* after	Supporting	**Target 15.1** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and freshwater ecosystems and their services …	Herons, grebes, ducks	Fasola *et al.* 1998; Nummi *et al.* 2000; Burger & Eichhorst 2007; Martínez-Haro 2013

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	the major mine spill of 1998 in Doñana (Martínez-Haro 2013)				
Recreational hunting	Recreational hunting, when undertaken sustainably, can provide important economic inputs both locally and at wider scales. AEWA's Guidance on sustainable hunting	Cultural		Anatidae	Scott 1987; Bregnballe *et al.* 2006; Kanstrup 2006; Losey & Vaughan 2006; Grado *et al.* 2011; Withey & van Kooten 2011; Cocker 2013
Sustainable use of natural resources					
Recreational hunting	Recreational hunting, when undertaken sustainably, can provide important economic inputs both locally and at wider scales. AEWA's Guidance on sustainable hunting	Cultural		Anatidae	Scott 1987; Bregnballe *et al.* 2006; Kanstrup 2006; Losey & Vaughan 2006; Grado *et al.* 2011; Withey & van Kooten 2011; Cocker 2013
Agriculture (including organic and sustainable agriculture, and reduction/control of toxic pesticides)					
Pest-control	Waterbirds can provide effective and cost-effective means of controlling pests of wetland agriculture, so negating the need to use hazardous, toxic, and expensive pesticides. CMS Resolution 11.15 on preventing poisoning of migratory birds. [FR ici] CMS Guidelines on preventing poisoning of wild birds. [FR ici]	Regulating	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that .... help maintain ecosystems…	Ducks	Hamilton *et al.* 1994; Teo 2001; Miles *et al.* 2002

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
			Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals…		
Weed control	Anatidae are major consumers of seeds of weeds in ricefields and may provide a significant economic benefit by reducing the abundance of such seeds. Wintering of ducks in flooded ricefields can reduce the weed biomass the following growing season by more than 50%.	Regulating	**Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that ….	Anatidae, especially ducks	van Groenigen *et al.* 2003
Human health					
Disease regulation and surveillance	Surveillance of waterbird diseases (such as avian influenza) can provide important early warning of the circulation of potential or actual zoonotic diseases of risk to people, or of animal diseases of economic significance. Ramsar Wetland Disease Manual AEWA Resolution 4.15 Responding to the spread of Highly Pathogenic Avian Influenza H5N1 (with guidance). [FR ici] CMS Resolution 12.6 on wildlife disease and migratory species. [FR ici]	Regulating	**Goal 3:** Ensure healthy lives and promote well-being for all at all ages	Ducks	Munster *et al.* 2005; Wallensten *et al.* 2007; Ziegler *et al.* 2010. **Case studies**: There has been much experience since the mid-2000s with respect to High Pathogenic Avian Influenza. • Ramsar avian influenza guidance. [FR ici] • FAO Avian Influenza guidance • EMPRES/FAO Manual on Preparing

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
					for Highly Pathogenic Avian Influenza
Pest-control	Waterbirds can provide effective and cost-effective means of controlling pests of wetland agriculture, so negating the need to use hazardous, toxic, and expensive pesticides. CMS Resolution 11.15 on preventing poisoning of migratory birds. [FR ici] CMS Guidelines on preventing poisoning of wild birds. [FR ici]	Regulating	**Goal 2:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture **Target 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that .... help maintain ecosystems… **Target 3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals…	Ducks	Hamilton *et al.* 1994; Teo 2001; Miles *et al.* 2002
Animal health					
Disease regulation and surveillance	Surveillance of waterbird diseases (such as avian influenza) can provide important early warning of the circulation of potential or actual zoonotic diseases of risk to people, or of animal diseases of economic significance. Ramsar Wetland Disease Manual AEWA Resolution 4.15 Responding to the spread of Highly Pathogenic Avian	Regulating	**Goal 3:** Ensure healthy lives and promote well-being for all at all ages	Ducks	Munster *et al.* 2005; Wallensten *et al.* 2007; Ziegler *et al.* 2010. **Case studies**: There has been much experience since the mid-2000s with respect to High Pathogenic Avian Influenza.

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
	Influenza H5N1 (with guidance). [FR ici] CMS Resolution 12.6 on wildlife disease and migratory species. [FR ici]				• Ramsar avian influenza guidance. [FR ici] • FAO Avian Influenza guidance • EMPRES/FAO Manual on Preparing for Highly Pathogenic Avian Influenza
Wetland management					
Regime shifts of wetlands	The regular monitoring of waterbird populations through time can provide a valuable means of assessing changing ecological conditions. Regime shifts can be indicated by changes in the waterbird community, for example through the entry of alien Carp (Maceda-Veiga *et al.* 2017); changes to benthos (Bowgen *et al.* 2015); or overgrazing (van Altena *et al.* 2016). AEWA monitoring guidance	Regulating	**Goal 6:** Ensure availability and sustainable management of water and sanitation for all. **Target 6.6**: By 2020, protect and restore water-related ecosystems, including … wetlands, rivers, aquifers and lakes.	Cormorants	Leah *et al.* 1980; Dirksen *et al.* 1995; Bowgen *et al.* 2015; van Altena *et al.* 2016; Maceda-Veiga *et al.* 2017
Tourism					
Recreational hunting	Recreational hunting, when undertaken sustainably, can provide important economic inputs both locally and at wider scales. AEWA's Guidance on sustainable hunting	Cultural		Anatidae	Scott 1987; Bregnballe *et al.* 2006; Kanstrup 2006; Losey & Vaughan 2006; Grado *et al.* 2011; Withey & van Kooten 2011; Cocker 2013

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
Birdwatching	Birdwatching, when undertaken sensitively, can provide important economic inputs locally and at wider scales, as well as being important for mental health.	Cultural		Geese	MacMillan *et al.* 2004; MacMillan & Leader-Williams 2008
Ecotourism	Ecotourism, when undertaken sustainably, can provide important economic inputs locally and at wider scales. AEWA's Guidance on ecotourism CMS Resolution 12.23 on sustainable tourism and migratory species. [FR ici] Ramsar leaflet on wetland tourism	Cultural		All waterbirds	Edgell & Williams 1992 **Case studies** Ramsar's review of wetland tourism [FR ici ES aquí] contains relevant case studies
Education and awareness raising					
Conservation flagships	Both through their epic migrations, wide range of lifestyles, and diverse ecology, migratory waterbirds are a very effective mean through which to communicate wider environmental messages. CBD Toolkit on communication, education and public awareness (CEPA)	Cultural		Anatidae, flamingos	Kear 1990; Galicia & Baldassarre 1997
Mental health					
Art	Waterbirds have inspired artists for over 30,000 years (here).	Cultural		Flamingos, others	Mas 2000; Arnott 2007; Cocker 2013

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Ecotourism	Ecotourism, when undertaken sustainably, can provide important economic inputs locally and at wider scales. AEWA's Guidance on ecotourism CMS Resolution 12.23 on sustainable tourism and migratory species. [FR ici] Ramsar leaflet on wetland tourism	Cultural		All waterbirds	Edgell & Williams 1992 **Case studies** Ramsar's review of wetland tourism [FR ici ES aquí] contains relevant case studies
Religion					
Religion/spiritual	Some cultures endow waterbirds with spiritual or religious significance. In some cultures, some feathers are used ceremonially.	Cultural		Seabirds, pelicans, others	Scott 1987; Cocker 2013. The pelican has particular significance in Christianity.
No clear link to a policy sector					
Grease for waterproofing		Provisioning		Geese	MacMillan & Leader-Williams 2008
Animal propagule dispersal		Supporting		Anatidae, coots	Green & Figuerola 2005; Frisch *et al.* 2007; papers in: *Animal-mediated dispersal in understudied systems*
Plant propagule dispersal	Waterbirds play an important role in dispersing plant propagules thus aiding dynamic adaptation to climate change	Supporting		Anatidae, waders	Green *et al.* 2002b; Klein *et al.* 2008; Brochet *et al.* 2009; Green *et al.* 2016;

Ecosystem Service (ES)	Advocacy and policy options	Type of ES	Sustainable Development Goals (as relevant)	Example waterbird taxon	Example sources and case studies
					Viana 2017; Kleyheeg *et al.* 2019
Nutrient cycling		Supporting		Geese, cormorants	Iaccobelli & Jefferies 1991; Gauthier *et al.* 2006; Kameda *et al.* 2006; Fujita & Kameda 2016
Stimulating primary productivity	Goose faeces are an important source of nutrients in some habitats	Supporting		Geese	Cargill & Jefferies 1984; Bazeley & Jefferies 1985; Nolet 2004
Stimulating decomposition	Keeping rice fields flooded after the harvest, not only benefits waterbirds but also help with weed control and decomposition.	Supporting		Ducks	Bird *et al.* 2000; van Groeningen *et al.* 2003; Pernollet *et al.* 2015

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