WASTE MANAGEMENT:
Best Practices To Conserve Migrating Soaring Birds (MSB’s) In The Rift Valley/Red Sea Flyway

Migratory Soaring Birds Project
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1. Executive Summary

The report entitled “Best practices and Impact to conserve MSBs in the RVRSF” reviews the current knowledge of the incidence of different type of wastes and their management on the conservation of Migratory Soaring Birds (MSBs) along the Rift Valley-Red Sea Flyway, and proposes an adequate management of waste disposal sites to favour the conservation of soaring birds (migratory and resident) and other threatened species.

The RVRSF is the second most important flyway for MSBs in the world, with over 1.5 million birds comprising 37 species migrating twice each year between their breeding grounds in Europe and West Asia and wintering areas in Africa. Between 50-100% of the global or regional populations of some of these species pass along this route and through narrow “bottlenecks” in a frame time of just a few weeks. Due the biannual movement and characteristics of the birds involved they are highly vulnerable to human threats particularly from hunting, energy infrastructures, waste management developments, and certain agricultural practices. Soaring birds are vulnerable; both along their migratory routes and at stopovers, reasons include habitat destruction due to agricultural expansion and intensification, overgrazing, inappropriate tourism development, industrial expansion, urbanization with an improper management of waste-disposal facilities, oil pollution (Clark 1987) and hunting. All are widespread threats to soaring birds. Twenty seven (69%) out of the 37 MSBs species found in the RVRSF have an unfavourable conservation status and also present are the local populations of globally threatened and vulnerable species such as the Northern Bald Ibis (Geronticus eremita) and the Egyptian Vulture (Neophron percnopterus) (Porter 2006).

The improper management of waste may cause serious impacts on biodiversity and the environment in general, but waste sites may also offer resources and habitats for biodiversity which can be positive in terms of wildlife conservation. Rubbish dumps can constitute appropriate feeding sites for many generalist bird species. Superabundance of organic residues provides certain species with a predictable spatial and temporal food source that greatly reduces the required foraging time and their feeding range. Many species have increased their distribution range and population sizes due to the utility of these rubbish sites. Human expansion has been used by both local and migrant species to increase and expand the number of available places and sites for birds. Food predictability can result in large post-breeding concentrations while migrating or wintering, increasing the number and size of colonies or roost sites around them. Birds which have access to and can exploit predictable food resources, lead to reduce movements and improve the individual fitness (Pons 1992, Donátzar et al. 1996 Newton 1998, Garrido & Sarasa 1999, Garrido et al. 2002b).

Thus, there is a network of dumping sites over migration routes that periodically gather hundreds or thousands of individuals feeding and roosting nearby. Some species have changed their migratory pattern becoming sedentary or having highly shortened the migration routes (Fernández-Cruz & Sarasa 1998, Garrido & Sarasa 1999, Aguirre 2012). However, rubbish dumps may also have detrimental effects on certain species as the increase of those that are generalists may cause the displacement of those having a reduced trophic spectrum (Garrido & Sarasa 1999, Garrido et al. 2002a, UNDP 2006); other potential detrimental impacts are:

- the consumption of inappropriate disposed of poisoned animals;
- zoonosis (diseases which can be transmitted from animals to humans) expansion;
- impact of human infrastructures nearby;
- Artificial survival due to an excess of food abundance for individuals that otherwise would die because of natural selection.

The demands of an increasing human population have resulted in a marked reduction of natural wetlands and conversion for agricultural or industrial development and human settlement. Further loss of natural wetlands is imminent, particularly the coastal ones, which have been predicted to decline by 70% by the 2080, with a sea-level rise concomitant with the climate change accounting for about a third by then (Murray & Hamilton 2010). Flood control schemes, irrigation, and diversion of water for domestic and industrial consumption have resulted in significant loss and degradation of wetlands in the region. The fact that rivers such as the Jordan flow independently of national borders means that proposed irrigation schemes in countries upstream can greatly impact upon water quality and scarce water supplies of the river and other remaining wetlands downstream. Almost all of the original freshwater wetlands in Syria, Lebanon and Israel were drained for agriculture in the early 1900s (Dugan 1993).
The relative importance of wastewater treatment wetlands for wildlife, regardless of their intended primary purpose, has undoubtedly increased as a result of the loss of natural wetlands, to the point they are now a significant habitat source for many waterbirds and have an unanticipated role in conservation. Wastewater treatment systems, constructed wetlands included, are a valuable resource for waterbirds as suitable habitat but they are not without risks. Waterbirds may adversely affect the water treatment process and may act as vectors of human disease, whilst wastewater treatment of wetlands could potentially have detrimental impacts on waterbird health due to pathogens, heavy metals, chemical contaminants and human disturbance.

Other types of waste management which can be very important for bird’s conservation are the slaughterhouses and carcass disposal from livestock raising facilities or farms. The management of these can greatly affect vulture populations. Declines and changes in traditional farming and grazing practices, hunting and wild ungulate populations, that once provided food are now absent or considerably diminished (Mundy et al. 1992), so vulture restaurants, which this industry can additionally supply are considered as an appropriate conservation measure, although they also have sometimes negative effects on populations as by reducing the dispersal capacity of young birds, particularly females, leading so to undesirable situations such as skewed sex-ratios and an overall reduction in breeding success (Martínez-Abraín & Oro 2013).

On the other hand, although networks of protected areas provide a way of enhancing species dispersal there is also a need to manage the wider countryside in a manner that favours dispersal. In this context, waste management could contribute not only as a problem, but also as adaptive management opportunity. Appropriate management of waste sites could provide a network of alternative feeding sites along large corridors to allow birds to move among suitable areas, functioning as stopover sites. There may also be increased attention to the management of waste sites either beneficial or detrimental to wildlife, depending on whether the method and timing of management included consideration of biodiversity interests.

The design and operation of solid waste disposal facilities is often also hazardous to birds. Waste sites pose particular threats in desert environments (predominant in this flyway corridor) where they represent an obvious and attractive source of food and water to MSBs.

An integrated waste management and conservation strategy could be a complementary way of protecting certain species through these corridors in addition to the existing network of protected areas. On the contrary, there are negative impacts when waste management facilities for solid and liquid wastes are being designed and constructed without sufficient consideration to impacts on migratory species such as creating hazards, causing intoxications, injuries, illness and finally death.

Within the RVRSF context, waste management is a matter of concern as both human populations and industrialization increase. Waste disposal and management are poorly regulated in much of the region, with toxic materials often present. Currently there is minimal sorting of organic and non-organic waste, which is often dumped in open-air pits and partially buried or burned. Waste water and effluents are often discharged directly into rivers without prior anti-pollution treatment even dumped into rivers and lakes (Birdlife 2013). Within this report, we make a review of impacts on birds of management of different types of waste (domestic and hazardous solid wastes, sewage and slaughterhouse) with the goal of proposing best practices guidelines for waste disposal sites which could provide valuable feeding habitats for birds if they are properly managed.

### Table 1.
Main impacts of waste management sites on the MSBs.

<table>
<thead>
<tr>
<th>POSITIVE IMPACTS</th>
<th>NEGATIVE IMPACTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Resting and foraging habitat</td>
<td>• Intoxications for drink contaminated water and eat hazardous substances: plastics, heavy metals, PCBs, EDCs, veterinary drugs, etc.</td>
</tr>
<tr>
<td>• Predictable food source.</td>
<td>• Risk of injures (broken glass, barbed wire).</td>
</tr>
<tr>
<td></td>
<td>• Risk of accidents (drowning in the sludge).</td>
</tr>
<tr>
<td></td>
<td>• Accidental poisoning (control scavenging animals).</td>
</tr>
<tr>
<td></td>
<td>• Infections and expansion of disease (botulism, salmonellosis, avian cholera, etc.).</td>
</tr>
<tr>
<td></td>
<td>• Human disturbance</td>
</tr>
<tr>
<td></td>
<td>• Hunting</td>
</tr>
</tbody>
</table>
A waste management strategy that is sympathetic to MSBs is proposed for being used as a conservation tool and to preserve migrant and wintering populations within the RVRSF.

Best practices guidelines on waste management will help to meet the Convention on Migratory Species (CMS) key conservation priorities:

- Work to protect and retain and, where feasible, recreate/restore high quality bird habitats on a flyway and landscape scale.
- Work to safeguard and manage networks of critical sites, key to the migration and survival of migratory species.
- Address specific threats that are known to threaten the survival of individual species and species groups.
- Attempt to mitigate the effects of climate change, affording migratory species the best possible chance of survival.

The guidelines will ensure the design of waste management facilities to consider and minimize the impacts on soaring birds, avoiding the creation of hazards causing injury, illness and death due to the consumption of non-organic and/or toxic waste or causing fatalities with infrastructures nearby. They can also help to get local benefits from ecotourism development at appropriate and bird friendly waste sites through bird-watching whilst conserving MSBs.

The main tools to solve these problems should be application of appropriated legal framework, the use of a strategic planning framework, precise EIA guidelines, provision of financial support and capacity building linked to sustainable development and environmental. However, it is necessary to get that all concerned parties and key stakeholders understand and agree to goals and benefits of getting a MSBs-friendly waste management programme and sites in operation.

At project level, developers should start their engagement with relevant stakeholders at the earliest stages of the project development process, especially with Birdlife International and its National Partners, to identify potential conflicts at different sites, some of which may not be apparent to the developer or the planner.

Governments should incorporate EIA as a priority during the planning and implementation phases of the development of any project to avoid and, when avoidance is not possible, minimize the adverse impacts.

Adopting such an approach makes development proposals more certain, reducing unnecessary costs and delays. It also reduces the risks of negative publicity and potentially forges long-term progressive relationships between industry and stakeholders to get a MSBs-friendly waste management.

Risks and recommendations on opportunities to engage with and mainstream migratory bird conservation into the waste management sector include

- **Integrated Planning Processes.** Potential problems to solve through early and proactive consultation and joint working include:
  - Limited technical infrastructure, plans and strategies.
  - Limited human capacities and financial resources.
  - Lack of incorporation of stakeholders as complete partners in the conservation and waste management responsibilities which leads to short term success rather than long-term, sustainable impact.
  - Lack of awareness about the importance of MSBs and even biodiversity, so they are not linked with sustainable development and most projects use to be performed without an EIA.
  - The sub-culture of unregulated income from waste management involving poor local communities within the region.

It should be clear in the process of planning and consultation that waste management should:

- Ensure optimal use and protection of the environment.
- Clarify roles and responsibilities and separation between regulatory, monitoring and executive duties.
- Clarify roles of each stakeholder.
- Facilitate availability of information exchange among involved stakeholders.
- Ensure transparency of institutional, financial, monitoring and administration systems.
Waste Management Best Practices

- Promote the principles of “polluter pays”,
- Create incentives to encourage successful practices.
- Penalize those parties that do not adhere to appropriate procedures in dealing with solid waste.

- **Identifying stakeholders:** An analysis was already made by UNDP (2006) in each of the 11 countries along the RVRSF to identify and involve project stakeholders (beneficiaries/supporters and those who may be opposed to the project or consider that it may have a negative impact on them).

**Decision-Making regarding Projects within the Rift Valley Red Sea Flyway corridor affecting designated sites (IBAs and EBAs):** There should be a precautionary avoidance approach to waste management development in priority areas for conservation such as protected areas, IBAs and KBAs, Ramsar sites etc. This will help enshrine that the precautionary principle of not affecting MSBs and their habitats is applied in the decision-making process (however, if it is not possible to select other sites to dispose or manage wastes, then the decision-making process must require compensatory measures to ensure and protect the overall coherence of the goal for which an IBA was designated).

- **Adaptive Management Frameworks:** When a MSBs-friendly Waste Disposal Site (WDS) becomes operational, decision-makers should require monitoring of the efficacy of MSB friendly measures through post-construction monitoring. Ideally, an adaptive management approach should be undertaken so that if adaptation and mitigation measures to avoid impacts on MSBs are shown not to be working as predicted, these can be modified to ensure that impacts are reduced. This adaptive management process should be overseen by the regulator, ideally advised by a management group comprising experts representing the developer, government nature advisor (if one exists) and relevant nature conservation stakeholders. The management of WDS to MSBs conservation must be regarded as part of a dynamic system whose creation and management must be constantly monitored in order to detect any indications that will give rise to new strategies and techniques that will be of use in the future.

- **Definition of BirdLife and UNDP/GEF MSB Project framework to identify good waste disposal sites.** In the last points of the report there are criteria for the definition of MSBs friendly WDS according to the UNDP/GEF MSB Project. The proposals are for facilities of solid waste, water waste, slaughterhouses, healthcare waste, military waste, industrial waste, mining waste and pesticides waste.

- **Bird watching of MSBs at properly managed waste disposal sites on the Rift Valley Red Sea Flyway corridor.** Finally, appropriated framework to make bird watching tourism at a properly managed waste disposal sites are proposed. This approach has the potential to provide funds and social profits for the local communities, organizations and authorities managing WDS with conservation purposes.
1.1 Background

In 2010, the Gulf countries generated in excess of 22.2 million tons of municipal waste and approximately 4.6 million tons of industrial solid waste (Al Ansari 2012). It is necessary to determine appropriated management to minimize risks of waste disposal sites for MSBs and others birds, and to enhance the connectivity of birds populations. Thus, it is necessary to establish first best practice guidelines on waste management and disposal and, secondly, to design and develop a network of sites to preserve MSBs and the flyway.

Open landfill sites and waste water treatment plants can be key feeding habitats of birds if properly managed. Rubbish dumps have been shown to provide good feeding habitats to many trophic generalist species, including some MSBs such as storks and scavengers raptors (Garrido & Sarasa 1999, Garrido et al. 2002a and 2002b). Wastewater treatment wetlands can restore and increase natural waterbird habitats, including also MSBs such as storks, pelicans, and cranes (Murray & Hamilton 2010). The creation of the feeding stations to remove animal carcasses from farms is a common feature of many conservation programs of scavenger raptors, including Black and Red Kites, Griffon, Egyptian and Cinereous Vultures (Donázar et al. 2009, Martínez-Abraín & Oro 2013).

Wildlife friendly waste sites management along MSBs flyways may improve the resilience of some species to cope and adapt to climate change pressure.

Within this context, developing waste management guidelines to preserve MSBs are necessary to establish a proper plan for waste management within the RVRSF.

The guidelines allow for the design of waste management facilities considering and minimizing the impacts on soaring bird species and maximizing the potential co-benefits from ecotourism development at bird friendly waste sites through bird-watching whilst preserving MSBs.
# 2. Glossary & Acronyms

## 2.1 Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abattoir</td>
<td>Place where the animals are slaughtered for their food</td>
</tr>
<tr>
<td>Alternatives</td>
<td>These are different ways of achieving the goals or objectives of a plan or proposal. Alternatives are also referred to as options.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Work done to determine and describe the environmental conditions against which future changes can be measured.</td>
</tr>
<tr>
<td>Avoidance</td>
<td>Measures taken to prevent impacts from happening in the first place. Baseline studies.</td>
</tr>
<tr>
<td>Bottlenecks</td>
<td>Site specific locations where due to topographical or geographical conditions birds concentrate during migration (e.g. Gabel el Zeit; Bab el Mandib Striat, Ain Sukna)</td>
</tr>
<tr>
<td>Carcass disposal</td>
<td>The procedure used for shepherds and livestock raisers to remove the corpses of the losses they have. It also includes the removal of by products from slaughterhouses.</td>
</tr>
<tr>
<td>Compensation</td>
<td>Measures which may be taken to enhance, restore or create a habitat to compensate for residual impacts on a habitat and/or its associated species to achieve no-net-loss or net gain of habitat and/or species. Such measures are normally offsite, but as close as possible to the site.</td>
</tr>
<tr>
<td>Constructed Wetland</td>
<td>Artificial wetlands created by human activities (e.g. wastewater treatment) or natural phenomena (stormwater).</td>
</tr>
<tr>
<td>Cumulative effects</td>
<td>The effects that result from changes caused by a project, plan, programme or policy in association with other past, present or reasonably foreseeable future plans and actions. Consideration of cumulative effects emphasizes the need for broad and comprehensive information regarding the effects. Cumulative effects may need to be considered at a flyway scale for migratory soaring birds.</td>
</tr>
<tr>
<td>Environmental Assessment</td>
<td>The process of integrating environmental considerations into decision making process in assessment of a new development. The process assesses evaluates and defines the extent of environmental impacts.</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Environmental assessment as applied to projects.</td>
</tr>
<tr>
<td>Feeding site</td>
<td>A place where carcasses are disposed of to be consumed by birds or mammals and easily removed from the landscape.</td>
</tr>
<tr>
<td>Flyway</td>
<td>Main corridor used by migrating soaring birds when moving between breeding and wintering grounds. They are almost fixed on a wide earth band.</td>
</tr>
<tr>
<td>IBAS</td>
<td>Important Birds and Biodiversity Areas</td>
</tr>
<tr>
<td>Intra-specific competition</td>
<td>Interaction among individuals of the same species competing for limited resources.</td>
</tr>
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</table>
IUCN
International Union for the Conservation of Nature that establishes the criteria on which the threatened status of species is based, as showed below:

CR: Critically Endangered
EN: Endangered
NT: Near Threatened
VU: Vulnerable
LC: Least Concern

Landfill
A site where waste is disposed of by burial

Mesopredator
Medium-sized predator which often increases in abundance when larger predators vanished.

Mitigation
Measures which aim to minimize impacts to the point where they have the lesser adverse effects.

Monitoring
Activities undertaken after the decision is made to adopt a plan, programme or project to examine its implementation. For example, monitoring to examine whether the significant environmental effects occur as predicted or to establish whether mitigation measures are effectively implemented.

Muladar/es
Traditional dumping place/s in Spain where carcasses from domestic livestock were disposed of for vultures to feed on. The shepherds provide the corpses on their own without any ecological basis.

Necrophagous species
Species that feed on carcasses either from the wild or livestock / carrion

Objective
A statement of what is intended, specifying the desired direction of change in trends

Offset
A wide range of measures that may be taken to compensate for residual impacts.

Plan
A detailed proposal, scheme, program, or method worked out beforehand for the accomplishment of an objective.

Decision-making authority
The authority that authorizes a plan or project.

Precautionary principle
A fundamental principle of environmental assessment Taking the safe approach to an activity/ action avoiding the possibility of irreversible environmental damage in situations where the scientific evidence is inconclusive but the potential damage could be significant.

Project programme
The execution of construction works or of other installations or schemes
— other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources. Defined in Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (as amended by Directive 97/11/EC).

Ramsar sites
Sites designated as internationally important wetland habitats under the International Convention on Wetlands of International Importance (1976) (Ramsar Convention).

Residual Impacts
Impacts that remain after the effect of mitigation measures have been accounted for.

Rubbish dump
A place where people dispose their rubbish.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoping</td>
<td>The process of pre-planning level of detail of an SEA or EIA, including the environmental effects and alternatives which need to be considered, the assessment methods to be used, and the structure and contents of the report.</td>
</tr>
<tr>
<td>Screening</td>
<td>The process of deciding whether a plan or programme requires SEA or whether a project requires EIA.</td>
</tr>
<tr>
<td>SMART objective</td>
<td>Specific, Measurable, Achievable, Relevant, Time-bound (specific) objective.</td>
</tr>
<tr>
<td>Soaring birds</td>
<td>Birds that use upcurrent air drafts for flying with low energy expenditure.</td>
</tr>
<tr>
<td>Strategic Environmental Assessment (SEA)</td>
<td>Generic term used to describe environmental assessment as applied to policies, plans and programmes. This is usually a pre-cursor to EIA and is taken on a regional or national level</td>
</tr>
<tr>
<td>Sustainability Appraisal (SA)</td>
<td>An appraisal of the economic, environmental and social effects of a plan from the outset of the preparation process to allow decisions to be made that accord with sustainable development.</td>
</tr>
<tr>
<td>Sustainable Development</td>
<td>‘Development which meets the needs of the present without compromising the ability of future generations to meet their own needs’.</td>
</tr>
<tr>
<td>Tiering</td>
<td>The linking of assessments for policies, plans, programmes and projects to achieve a logical hierarchy and avoid unnecessary duplication of assessment work.</td>
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<tr>
<td>Trophic spectrum</td>
<td>Diversity of types of food items consumed by one animal species</td>
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<tr>
<td>Zoonosis</td>
<td>A disease transmissible from animals to humans under natural conditions</td>
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2.2 Acronyms

**AEWA**  Agreement on the Conservation of African-Eurasian Migratory Waterbirds

**BOD**  Biological Oxygen Demand

**BSE**  Bovine Spongiform Encephalopathy

**CMS**  Convention of Migratory Species

**CW**  Constructed Wetland

**EIA**  Environmental Impact Assessment

**GHG**  Green House Gases

**IBAS**  Important Bird and Biodiversity Areas

**ISWM**  Integrated Solid Waste Management

**MSB**  Migrating Soaring Birds

**OIE**  Organization of Animal Health

**PCB**  Polychlorinated biphenyls

**PV**  Photovoltaic Plants

**RVRSF**  Rift Valley-Red Sea Flyway

**SMART**  Specific, Measurable, Achievable, Relevant, Time-bound (specific) objective

**SEA**  Strategic Environmental Assessment

**SA**  Sustainability Appraisal

**SWM**  Solid Waste Management

**TOR**  Terms of Reference

**IUCN**  International Union for the Conservation of Nature

**UN**  United Nations

**UNDP**  United Nations Development Programme

**UNEP**  United Nations Environment Programme

**WDS**  Waste Disposal Site

**WHO**  World Health Organization

**WSP**  Waste Stabilization Pond

**WTP**  Water Treatment Plant
### 3. Glossary of MSBS Species

The Migration Soaring Birds (MSBs) project it is focused on 37 species, mostly raptors belonging to six families, Table 1. Five of them are Globally Threatened: The Egyptian Vulture (*Neophron percnopterus*), Eastern Imperial Eagle (*Aquila heliaca*), Greater Spotted Eagle (*Aquila clanga*), Saker Falcon (*Falco cherrug*) and Northern Bald Ibis (*Geronticus eremita*). Later in the text we will deal with the IUCN category status, population sizes and trends, using such information to discuss the different waste use and the proposed management techniques. Thus, here we will only sort the species according to their taxonomic groups.

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<th>Species</th>
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<td>Eastern Imperial Eagle</td>
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<td>Booted Eagle</td>
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<td>Lesser Kestrel</td>
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<td>Northern Bald Ibis</td>
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<td>Fam. Gruidae</td>
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<td>Cranes</td>
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<tr>
<td>Eurasian Crane</td>
<td><em>Grus grus</em></td>
<td>Eastern Imperial Eagle</td>
<td><em>Aquila heliaca</em></td>
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4. Introduction

4.1 Birds and waste management

The improper management of waste has the potential to cause serious impacts on the environment and biodiversity. Pollution can accumulate and procedures employed for elimination cause atmospheric and water contamination. Their management requires regulation.

However, waste sites may also be of value for biodiversity and migrating species. They can serve as stop over sites and a source of food for many species of birds, especially in those altered or heavily human transformed habitats (Garrido & Sarasa 1999).

Rubbish dumps constitute appropriate feeding sites for many generalist bird species. Superabundance of organic residues provides species with a predictable spatial and temporal food source that greatly reduces the species both foraging time and home range. Within this frame, rubbish dumps have a high carrying capacity (Isenmann 1978, Donázar 1992, Sampietro et al. 1997, Garrido & Sarasa 1999). In addition, domestic waste has a high energetic content (Sibly & Mc Cleery 1983). Rubbish dumps in southwestern Europe have been shown to provide key habitats for at least twenty one species (Garrido et al. 2002a) where they feed directly from organic wastes.

An additional twenty two species also use rubbish dumps as a foraging habitat as they indirectly provide food sources such as mice, rats and invertebrates that also concentrate for feeding at these sites. The more food available results in higher survival and productivity rates (Donázar 1992, Garrido & Sarasa 1999, Serrano & Cantos 2013). Thanks to the key role of rubbish dumps during the breeding season many species have increased their distribution range and population sizes.

Food predictability can result in large post-breeding concentrations while migrating or wintering, increasing the number and size of colonies or roost sites around feeding sites. Birds have enough, predictable and ensured food, reducing their movements and improving the individual fitness (Pons 1992, Donázar et al. 1996, Newton 1998, Garrido & Sarasa 1999, Garrido et al. 2002b). Several studies have demonstrated the key role of rubbish dumps in the expansion of the distribution and demography of the Cattle Egret (Bubulcus ibis) and the White Stork (Ciconia ciconia) in the Iberian Peninsula over the past 20 years (Garrido & Sarasa 1999, Garrido & Fernández Cruz 2001, Molina & Del Moral 2005, Aguirre 2012, Garrido et al. 2012).

However, despite the key role of rubbish dumps during the migrating season, it is quite also important during the breeding and wintering time. Then, they act as stop-over sites along the route. The best examples of the importance of rubbish dumps on the conservation of some birds species in Europe are the increase of populations of Black Kite (Milvus migrans), Red Kite (Milvus milvus), Griffon Vulture (Gyps fulvus) Common Raven (Corvus corax), Carrion Crow (Corvus corone), Magpie (Pica pica), White Stork, Black-headed (Larus ridibundus), Lesser Back-backed (Larus fuscus) and Yellow-legged (Larus cachinans) gulls and Cattle Egret (Sunyer 1988, Donázar 1992, Pons 1992, Sampietro et al. 1997, Garrido & Sarasa 1998 and 1999, Garrido et al. 2002a and 2002b, Molina & Del Moral 2005, Oro & Martínez-Abraín 2007, Aguirre 2012; Garrido et al. 2012, Serrano & Cantos, 2013).

Studies revealed that for migrating birds which feed from rubbish dumps, they act as stop-over sites on the route, increasing survival during a highly stressful and mortality susceptible phase of their lives. In Spain and some North African countries (pers. obs.) there is a network of dumping sites over the migration routes gathering hundreds or even thousands of individuals feeding and roosting nearby (Sunyer 1988, Donázar 1992, Sampietro et al. 1997, Garrido & Sarasa 1998 and 1999, Garrido et al. 2002a and 2002b, Serrano & Cantos 2013). Sometimes, birds have become sedentary or have greatly reduced their migration routes, as it is the case of the White Stork in Spain (Fernández-Cruz & Sarasa 1998, Garrido & Sarasa 1999, Aguirre 2012). Rubbish dumps can thus provide new wintering grounds for some species because of the resources they provide (Fernández-Cruz & Sarasa 1998, Garrido & Sarasa 1999, Aguirre 2012, and Global Interflyway Network 2012. See Box 1).

1 Cattle Egret (Bubulcus ibis), Grey Heron (Ardea cinerea), White Stork (Ciconia ciconia), Black Kite (Milvus migrans), Red Kite (Milvus milvus), Egyptian Vulture (Neophron percnopterus), Eurasian Griffon Vulture (Gyps fulvus), Common Buzzard (Buteo buteo), Red-legged Partridge (Alectoris rufa), Caspian/Yellow-legged Gull (Larus cachinans/michahellis), Herring Gull (Larus argentatus), Black-headed Gull (Larus ridibundus), Lesser Black-backed Gull (Larus fuscus), Rock Pigeon (Columba livia), Common Wood Pigeon (Columba palumbus), Common Raven (Corvus corax), Black-billed Magpie (Pica pica), Eurasian Jackdaw (Corvus monedula), Carrion Crow (Corvus corone), Eurasian Tree Sparrow (Passer montanus), House Sparrow (Passer domesticus).

2 Black Stork (Ciconia nigra), Cinereus Vulture (Aegypius monachus), Short-toed Snake-eagle (Circaetus gallicus), Booted Eagle (Hieraaetus pennatus), Common Kestrel (Falco tinnunculus), Lesser Kestrel (Falco naumanni), Eurasian eagle-owl (Bubo bubo), Little Owl (Athene noctua), Barn Owl (Tyto alba), Common Swift (Apus apus), Pallid Swift (Apus pallidus), Eurasian Hoopoe (Upupa epops), Crested Lark (Galerida cristata), Wood Lark (Lullula arborea), Barn Swallow (Hirundo rustica), Northern House-martin (Delichon urbica), Grey Wagtail (Motacilla cinerea), White Wagtail (Motacilla alba), Common Stonechat (Saxicola torquata), Common Starling (Sturnus vulgaris), Spotted Starling (Sturnus unicolor), Eurasian Chaffinch (Fringilla coelebs).
This is a key issue to be considered. At the migration bottleneck sites such as the Strait of Gibraltar, where the Palearctic migration corridor meets, some rubbish dumps meet the criteria to be designated as Important Bird Areas (IBA) in Europe according to the BirdLife International criteria (http://www.birdlife.org/datazone/info/ibacriteria, Fernández-Cruz & Sarasa 1998, Garrido & Sarasa, 2002b). Also in India there were large vulture concentrations of Genus *Gyps* and *Pseudogyps* species feeding from organic waste sites in certain regions (Satheesan 2000).

From the demographic point of view, rubbish dumps provide a resource with nearly unlimited food availability. They represent an adaptive advantage for juvenile and immature birds, less experienced when getting food and also suffering from intra specific competition with adults. Juvenile survival is then higher and results on exponential population growths (Donázar et al. 1996, Garrido & Sarasa 1999, Igual et al. 2000). Migratory species feeding at rubbish dumps during migration or wintering times where there are adequate food resources and an absence of additional hazard may have a mortality rate due to starvation nearly equal to zero. In addition, individuals would return to the breeding grounds in a supposed good body condition, favouring high clutch sizes and productivity rates (Serrano & Cantos 2013). Finally, use of rubbish dumps also reduces the predation rates because of human presence. This is the case of game species such as the Red-Legged Partridge (*Alectoris rufa*) during the hunting season in Spain (Garrido et al. 2002a).

Rubbish dumps may also have detrimental effects on the species attending (Garrido et al. 2002a), despite mortalities being compensated from the exponential growth of the populations, at least it has been the case in gulls, Cattle Egrets or White Storks (Garrido & Fernández-Cruz 2003, Molina & Del Moral 2005, Oro & Martínez-Abrain 2007, Aguirre 2012, Garrido et al. 2012, Serrano & Cantos 2013). Among other negative impacts (Gar- rido et al. 2002a, UNDP 2006) we must highlight the increase of certain species that are generalists (for example Caspian/ Yellow-legged gulls (*Larus cachinnans* and *L. michaellis*), Herring Gull (*L. argentatus*) and Indian House Crow (*Corvus splendens*) and may cause the displacement of those with a more reduced trophic spectrum (Gar- rido & Sarasa 1999, Garrido et al. 2002a, UNDP 2006).

Rubbish dumps may also act as trap-habitats (“habitats that birds perceive as favourable, but being unsuitable, by virtue of some feature to which birds are unresponsive”, Newton 1998) because the presence of toxic substances at sub lethal levels are not perceived as detrimental by the birds. This includes the consumption of inappropriately-disposed of poisoned animals (e.g. rodents) at rubbish dumps (Tavares 2013), zoonosis expansion, impact of human infrastructures nearby or artificial survival (due to an excess of food abundance for individuals that otherwise would die) because of natural selection. These individuals could suppose a genetic degeneration for the species (Garrido et al. 2002a). Birds feeding from rubbish dumps may roost at wetlands or artificial dams that supply humanized populated areas. Thus, they could act as vectors of pathogens present in the disposed and unprocessed waste. However, to date no cases have been described. This could be due to the fact that waste on which birds feed has no pathogens at all, as it comes from healthy human food discards dropped at rubbish dumps (Serrano y Cantos 2013).

Coupled with this expansion of waste sites the demands of an increasing human population have resulted in a marked reduction in natural wetlands and conversion for agricultural development, human settlement and industrial development (Murray & Hamilton 2010). This could be disastrous for bird species which rely on those areas providing critical habitats and important stopover sites for many migratory species (Murray & Hamilton 2010). Further loss of natural wetlands is imminent, particularly coastal wetlands, which have been predict- ed to decline by 70% by the 2080, with a sea-level rise concomitant with the climate change accounting for about a third by then (Murray & Hamilton 2010). Sewage treatment plants with waste stabilization ponds have been documented as significant habitat for waterbirds (Murray & Hamilton 2010). The relative importance of wastewater treatment wetlands for wildlife, regardless of their intended primary purpose, has undoubtedly increased as a result of the loss of natural wetlands, such that they are now a significant habitat source for a number of species and have an unanticipated role in conservation (Murray & Hamilton 2010).

Waste stabilization ponds (WSPs) are open-water earthen basins that exploit natural processes to treat waste-treatment technology in many countries. They are also promoted in the World Health Organization’s wastewater re-use guidelines as a pragmatic and effective means of treating wastewater (WHO 2006). This is significant, because UN projections suggest significant increases in sanitation, particularly in Africa and Asia by 2015. Increased need for adequate sanitation in the region will lead to increase waste water treatment (Murray & Hamilton 2010) and new WSPs could be used by waterbirds.

However, in many countries wastewater management through waste stabilization ponds has led to a problem because it leads to the eutrophication of receiving waters. WSPs have been replaced with more intensive (and less accessible for waterbirds) treatment systems, such as the trickling filters, up-flow anaerobic sludge blanket reactors, and activated sludge plants (Murray & Hamilton 2010).
In summary, wetlands use as wastewater management is a valuable resource for many bird species but they are not without risks. Waterbirds may adversely affect the water treatment process and may act as vectors of human disease, whilst wastewater on wetlands could potentially have detrimental impacts on waterbirds health due to pathogens, heavy metals, chemical contaminants and human disturbance (Murray & Hamilton 2010). Despite these possible adverse effects it is important to recognize the value of wastewater treatment facilities for waterbirds habitat.

Another example of waste management which can be very important to conservation of soaring birds is slaughterhouses and carcasses disposal. Traditional sources of food for vultures and other scavengers have declined dramatically in the last century in certain regions (Meretsky & Mannan 1999). Declines and changes in traditional farming and grazing practices, hunting and wild ungulate populations, that once provided food are now absent or diminished (e.g., Mundy et al. 1992, Mateo-Tomas & Olea 2010). Lack of food is considered to affect not only reproductive strategy and success (e.g., Wilbur & Jackson 1983, Donázar & Fernández 1990, Mundy et al. 1992) but it also results in increased mortality of fledglings and free-ranging adults (Court et al. 1997, Ferro 2000). However, see Houston (1977) to regard about the role of livestock on vultures when adapting to human environments, because in absence of threats such poisoning or electrocutions, vulture populations increase as a consequence of the higher domestic livestock ungulate densities as compared with those form wild species.

Alternative strategies have been developed over the last decades to support vultures and other scavengers by means of providing supplemental food at “restaurants” (Friedman & Mundy 1983, Parra & Tellería 2004) with livestock carcasses, offal or bone remains. For example, in Spain leaving carcasses in the field at traditional dumping sites, which are referred as “muladares”, was a common practice for decades despite being banned since the 50s. The effects of this superabundant food supply (Camiña 2004) together or in addition with the supplemental feeding of Eurasian Griffons, Red Kites, Egyptian Vulture (Neophron percnopterus) and Cinereous Vulture (Aegypius monachus) within their ranges in Western Europe have resulted in increased survival and reproduction and higher densities and fledging success (Donázar 1987, Donázar & Fernandez 1990, Camiña & Yosef 2012). It has also led to behavioural changes (e.g., Gilbert et al. 2007, Zuberogoitia et al. 2010) and, in fact, supplementary feeding may be the only way of providing these birds with sufficient food supply (Donázar et al. 2009).

However, carrion eating birds can be threatened through the implementation of sanitary regulations. Since 2000, the appearance of the Bovine Spongiform Encephalopathy (BSE), commonly known as “mad-cow disease” in Europe resulted in the implementation of the 1774/2002 Regalemant of the European Commission that required the removal and incineration at processing plants of any livestock carcass within the European Union (Official Journal of the European Union 2002). This measure resulted in a reduction of food availability for scavengers (Tella 2001) and consequently had negative effects in the Griffon Vulture population (Donázar et al. 2009, Camiña & Yosef 2012).

Although historically vulture restaurants have been considered as an appropriate conservation measure, they can also have negative effects on populations as they can reduce the dispersal willingness of young birds. This leads leading so to undesirable situations such as skewed sex-ratios because the i.e. increase of trios (differential recruitment of immature females that remain in the vicinity without dispersal because food easily available) and an overall reduction in breeding success (Martínez-Abraín & Oro 2013). Feeding stations can also promote nest predation by non-target facultative scavenger predators of ground-nesting species that breed nearby and produce changes in top and mesopredators dynamics (Martínez-Abraín & Oro 2013).

Finally, carrion eating birds may die because of the presence of different chemicals which act as poisons. This could impact on the population level. Poison may also be secondary through the consumption of poisoned animals at rubbish dumps (e.g. rodent control), or lead poisoning by feeding on carcasses of previously shot game (Gangoso et al. 2009, Hernández & Margalida 2009). The last question of concern it is the consumption of dead livestock previously treated with veterinary drugs. Diclofenac has been proved to reduce the Indian population of Gyps vulture species by 99% since 2000 (Oaks et al. 2004, Cuthbert et al. 2011).
**BOX 1. CHANGE OF WHITE STORK MIGRATORY BEHAVIOUR AS A CONSEQUENCE OF OPENING SOLID WASTE DISPOSAL SITES**

In a recent Swiss project using GPS satellite transmitters it has been proved that tracked White Storks modify the migration routes to feed in open rubbish dumps (http://storkmigration2es.wordpress.com/project/). The recorded migratory behaviour for White Storks along the Western European/ Western African flyway has changed, with shortstopping in Spain and now no longer reaching Africa. Several thousand of “Western migrants” have ceased their migration to Africa, standing in Spanish rice fields, and especially in large open landfills.

This study showed a significant and growing dependence on landfills as a food source, so they select this habitat as feeding sites during breeding season, at migratory stop-over and wintering sites. Thus, Spanish landfills can get to concentrate up to 10,000 storks during pre and post nuptial migration (Alés 1995, Marchamalo 1995, Martinez 1995, Tortosa et al. 1995, Blanco 1996, Medina et al. 1998, Fernández-Cruz & Sarasa 1998). Results are similar to those obtained in 2001-2002, when nearly half of Swiss storks did not continue their route, staying in southern Spain. The same picture occurs twelve years later.

One of the causes of this behaviour may be the fact that being “nutrition opportunists”, White Storks know how exploit the all-year-round of food availability at landfills. That project also marked non-migrating storks in Spain, which flew to waste disposal sites which could be long distances away in order to find nutrition and fed mainly or even exclusively on waste.

Feeding on waste disposal sites is an adaptive behaviour because it shortens migratory journey and decreases young mortality during the migration and wintering time. Storks are coming back to the breeding areas in good physiological condition and even before than the long - distance migratory Storks. They can set in the best breeding territories and it could be the main reason of the high breeding population increase in Western Europe (Garrido & Sarasa, 1999, Garrido Fernández-Cruz 2001, Molina & Del Moral 2005).

**Figure 1.**
Strait of Gibraltar, the main point in the Western Mediterranean migratory route (J. Martin 2012).
4.2 The Rift Valley / Red Sea Flyway RVRSF and the conservation on Migrating Soaring Birds (MSB)

Conserving MSB populations is particularly challenging. They occupy a range of habitats during the course of their annual cycle and the added threats that they may encounter whilst moving between their breeding and wintering areas is manifold. MSBs use thermals, the up currents of air to soar and gain altitude, and then move on to the next thermal by a long, shallow, downward glides. Such birds tend to follow regular flyways that provide good opportunities for soaring flight, whilst minimizing energy expenditure and shortening migration distances.

As a result, soaring birds will concentrate along their migration routes, particularly at ‘bottleneck sites’, such as mountain passes, land-bridges and peninsulas. Migratory populations of soaring birds are therefore particularly vulnerable at these “bottlenecks” because it may affect a large proportion of their populations. Soaring birds face a range of other potential impacts: Re habitat loss through agricultural expansion and intensification, overgrazing, inappropriate tourism development, industry particularly energy infrastructure, urbanization desertification; improper management of waste-disposal facilities, oil pollution and hunting. All are widespread threats to migratory raptors (Newton 2004, UNDP 2006). Soaring birds are particularly at risk because they are generally large, long-lived (and thus slow to reproduce) and often naturally scarce.

The RVRSF is the second most important flyway for MSBs in the world with over 1.5 million birds comprising 37 species migrating twice each year between their breeding grounds in Europe and West Asia and wintering areas in Africa. Between 50-100% of the global or regional populations of some of these species pass along this route and through the narrow “bottlenecks” in a frame time of just a few weeks. This makes them highly vulnerable to a number of human threats particularly from hunting, energy infrastructures, waste management developments and certain agricultural practices (UNDP 2006).

A significant proportion of the soaring birds as listed in Table 2 use the RVRSF, including White Pelican (Pelecanus onocrotalus), Common Crane (Grus grus), Black Stork (Ciconia nigra), White Stork, Honey Buzzard (Pernis apivorus), Short-toed Eagle (Circaetus gallicus), Levant Sparrow Hawk (Accipiter brevipes), Steppe Buzzard (Buteo buteo vulpinus), Lesser Spotted Eagle (Aquila pomarina), Steppe Eagle (Aquila nipalensis) and Eastern Imperial Eagle (Aquila heliaca). Certain species, notably the harriers and falcons, migrate more on a broad front, though they frequently engage in soaring and will join those species that follow historical routes which they also use for their return journey in spring (Porter 2006).

The knowledge of these migratory routes seems limited, as it is based on a few species and studies that have uncovered with the same intensity all geographic areas of interest. Either way, it seems that the RVRSF has two main points of entry/exit between south-west Asia (Middle East) and the African continent: the Gulf of Suez in Egypt (Eastern Mediterranean, River Jordan to Nile valley corridor) and the Straits of Bab al -Mandab at the southern end of the Red Sea between Yemen and Djibouti. In the first, the birds fly through Syria, Lebanon, Palestine and Jordan; the Jordan Valley is a particularly important part of the corridor. Another branch from central and eastern Asia joins the flyway in Jordan (see Figure 2). The raptors branch westwards across the northern Sinai to skirt round the north of the Gulf of Suez before crossing the eastern desert to reach the Nile Valley. White Storks head due south across the Sinai and bridge the Gulf of Suez from the south-west shore of the Sinai to make landfall around Gebel el Zeit before heading over to the Nile valley and then turning southward. About 1.5 million soaring birds regularly pass along this route each season largely following lines of hills and concentrating at the bottleneck sites of Aqaba, Suez and south Sinai.

Some birds do, however, track along the western shore of the Gulf of Suez and it is thought that they continue on south along the Red Sea coast into Sudan and Eritrea (Porter 2006).
In Arabia the migrant’s stream increases with the addition of migrants from further east and these birds then flow across Bab al Mandab into Djibouti. This strait is an important migration bottleneck because it is the shortest water crossing south of Suez. Over 250,000 raptors of 28 species cross these straits in autumn (Welch & Welch 1988, Hilgerloh 2009 and 2011), mostly Common Buzzard and Steppe Eagle, but also the Pallid Harrier, the Greater Spotted Eagle (Aquila clanga), Eastern Imperial Eagle and the Lesser Kestrel (Falco naumanni); in spring large numbers of Egyptian Vultures and Booted Eagles return through the straits to their breeding areas (Welch & Welch 1991). This stream crosses Ethiopia to reach the eastern edge of the northern highlands – where the birds may be joined by those migrating along the western shore of the Red Sea – before following the Rift Valley southwards.

On their journey towards South, the migrant soaring concentrate on the line of the Rift Valley and the Red Sea coastal mountains. They generally follow lines of hills and the cliffs of valley edges and this is where most of the bottleneck sites are found. These sites vary greatly in their characteristics but all are either at points where the sea is at its narrowest or along the lines of hills, mountains or cliff-edges that provide thermals for soaring birds to maintain height for their migration.

Such sites are therefore of particularly high international importance for bird conservation and qualify as Important Bird Areas (IBAs) as defined by BirdLife International using globally consistent criteria (Evans 1994, Fishpool & Evans 2001, Heath & Evans 2000). There are three main categories by which a site may qualify as an IBA in the Middle East3, one of which, “Congregations”, includes the following criterion relating to migratory bottlenecks for the region: “site where over 5,000 storks, or over 3,000 raptors or cranes regularly pass on spring or autumn migration”.

Along the Eastern Mediterranean, River Jordan to Nile valley corridor and the eastern sector of the Africa-Eurasia flyway a total of 308 IBAs have so far been identified in the countries that make up this migratory route; of these 28 are bottleneck IBAs that support soaring birds on migration (see Table 3).

### Table 3.
Sites that are bottleneck IBAs of regional IBA directories. Source: UNDP 2006, Birdlife International 2013.

<table>
<thead>
<tr>
<th>Country</th>
<th>Site Name</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>Abyata-Shala Lakes NP</td>
<td>One of narrowest parts of rift valley. Importance confirmed for many other species</td>
</tr>
<tr>
<td></td>
<td>Lake Zeway</td>
<td>Many soaring birds recorded - numbers and therefore status need confirmation</td>
</tr>
<tr>
<td></td>
<td>Awash NP</td>
<td>Many soaring birds recorded - numbers and therefore status need confirmation</td>
</tr>
<tr>
<td></td>
<td>Koka Dam and Lake Gelila</td>
<td>Man made dam and lake - 18 soaring bird species occur there. Numbers to be confirmed</td>
</tr>
<tr>
<td></td>
<td>Lake Langano</td>
<td></td>
</tr>
<tr>
<td>Egypt</td>
<td>Hurghada Archipelago</td>
<td>Archipelago of uninhabited islands. Appear to play important role as a stepping stone for migrants crossing mouth of Gulf of Suez</td>
</tr>
<tr>
<td></td>
<td>Upper Nile</td>
<td>Appears to be an important landing and drinking site for White Stork during autumn migration</td>
</tr>
<tr>
<td></td>
<td>Aswan Reservoir</td>
<td>This site and Lake Nasser appear to be important migration sites for soaring birds, particularly White Storks - resting and drinking area</td>
</tr>
<tr>
<td></td>
<td>Lake Nasser</td>
<td>See above</td>
</tr>
<tr>
<td></td>
<td>Safaga</td>
<td>It seems to be an important migration corridor in autumn for soaring birds entering Asia into Africa after crossing from Ras Mohammed, South Sinai - especially storks but also raptors.</td>
</tr>
<tr>
<td></td>
<td>Ein Mousa</td>
<td>Probably major route in spring and autumn, especially raptors</td>
</tr>
<tr>
<td></td>
<td>Sharm El Sheik</td>
<td>Status to be confirmed</td>
</tr>
<tr>
<td></td>
<td>Hurghada</td>
<td>Status to be confirmed</td>
</tr>
</tbody>
</table>

3. The other two are: Species with an unfavourable conservation status in the Middle East and Species with a favourable conservation status but concentrated in the Middle East. For more information, see http://www.birdlife.org/datazone/info/ibacritme.
All the species previously listed at Chapter 3 (Glossary of MSBs species) migrate using soaring flight. However, other species (see Appendix E) either only use this migration system for part of the time or are low altitude flapping fliers. However, all are concentrated at bottleneck IBAs.

<table>
<thead>
<tr>
<th>Country</th>
<th>Site Name</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Djibouti</td>
<td>Sept Frères islands</td>
<td>Collection of volcanic islands that may be important stepping stones assisting migrants crossing Bab el Mandeb straits.</td>
</tr>
<tr>
<td>Eritrea</td>
<td>Dahlak islands and Massawa coast</td>
<td>Large populations of raptors observed - further survey is needed to confirm status</td>
</tr>
<tr>
<td></td>
<td>Hazommo plain</td>
<td>Large plain in agricultural area visited by White Storks</td>
</tr>
<tr>
<td>Jordan</td>
<td>Yarmouk valley</td>
<td>Steep-sided valley, several soaring birds species recorded but status as bottleneck must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Maghtas/Sweimeh</td>
<td>Status for soaring migrants must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Safi – Fifa</td>
<td>Status for soaring migrants must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Wadi Ibn Hammad-Haditha</td>
<td>Several migrants regularly recorded but numbers are not known and status as bottleneck must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Azraq</td>
<td>The only permanent wetland in the eastern desert. Status as bottleneck must be confirmed</td>
</tr>
<tr>
<td>Syria</td>
<td>Jabal Abdul Aziz</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Al-Layat</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Abo Rujmien</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Abo Gubres</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td>Yemen</td>
<td>Al-Mokha-Al-Khokhah, Taiz</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Hodiedah Wetlands (Al-Urj), Hodiedah</td>
<td>Status must be confirmed</td>
</tr>
<tr>
<td></td>
<td>Nukhaylah-Ghulayfiqah, Hodiedah</td>
<td>Status must be confirmed</td>
</tr>
</tbody>
</table>

Waste management may result in positive impacts for birds creating suitable habitats as feeding sources. Food superabundance and predictability favours generalist and necrophagous species. As previously noted (4.1), this may increase their survival by decreasing juvenile mortality during migration. Examples of MSB species that may benefit in this way are White Stork, Griffon and Egyptian Vultures, Black and Red Kites (Blanco 1994, Camiña unpublished). As a result, some exponential increases have been noticed (Camiña & Montelio 2005; Jubete 2005; Tortosa et al. 2003; Garrido & Sarasa 1999).

A second positive impact would be the increase of species survival in geographic areas with heavily altered habitats through the migration route. Some species may reduce the longitude of migration routes and reduce associated risks by using waste disposal sites as wintering grounds closer to the breeding ones (i.e. White Stork and probably Griffon Vulture) (Garrido et al. 2002b; Stork Switzerland 2014).
In addition, appropriate management of liquid waste may be of great value to aquatic species migrating through dry and arid regions (i.e. Pelicans and Ibises). Sabkhat al-Fasl and Al-Hasa in Saudi Arabia, Ramtha lagoons in UAE and Khirbat al Samran in Jordan are examples of IBAs whose origin are fully or partially linked to sewage management. A regional interesting case is Aqaba in Jordan, where the adaptation of some ponds at the waste water treatment plant has resulted in the creation of an important wetland for migratory birds, including some MSBs (see Box 2).

There are also negative impacts when waste management facilities for solid and liquid wastes are being designed and constructed without sufficient consideration to potential impacts on migratory species creating hazards causing intoxications, injuries, illness and death. This has been the case for MSBs such as White Stork (Peris 2003), Black Kite (Blanco 1994, Garrido et al. 2001) and Egyptian Vultures (Donázar 1992) in Southern Spain. Furthermore, toxicosis and damage to birds has also occurred by consumption of plastic remains or ropes (Peris 2003). An analysis of the diet of Egyptian Vultures in the Ebro Valley, Northern Spain, showed that plastic material appeared in a range of 1.6-51% from the analysed pellets. The highest frequency was found at those roosting sites closely located to rubbish dumps (Donázar 1992). Plastic ingestion may obstruct the digestive tract causing ulcers and dilution of toxic substances such as PCBs (Iñigo 1987). Birds are also injured by glass pieces, barbed wire and other sharp materials. Open air burning of garbage is known to cause injuries to birds (see http://kucb.org/news/article/burned-bald-eagles-draw-federal-scrutiny-in-adak/). The soot soils the plumage of birds impairing their flight capabilities (BioMAP 2005). Wastewater treatment ponds (domestic and industrial) have often been constructed with steep sides and have resulted in birds drowning.

Sludge is often not regularly dredged and birds become coated or drowned in the sludge (Porter 2006). Water at some of the plants is of poor quality and potentially toxic to birds and other wildlife. Untreated liquid waste has been proved to be fatal to waterbirds through botulism infections and other diseases. Birds could be responsible for spreading these infections as they move between wetlands (Murray & Hamilton 2010).

In addition, negative effects may increase if the concentrations at waste management sites are located near close to infrastructures which could cause negative impacts such as power lines and windfarms. This is normally linked with their movements to and from waste disposal site (Caminha 2008 and 2010).

Within the RVRSF context, waste management is becoming a matter of concern along the flyway as human populations rise and industrialization increases. Waste disposal and management are poorly regulated in much of the region, with toxic materials often present. There is frequently no sorting of organic and non-organic waste, which is dumped in open-air pits and partially buried or burned, with waste water and effluents usually discharged directly into rivers without prior anti-pollution treatment even dumped into rivers and lakes (UNDP 2006). The design and operation of solid waste disposal facilities is often also hazardous to birds. Waste sites pose particular threats in desert environments (predominant in this flyway corridor) where they represent an obvious, only and attractive source of food and water to MSBs (Kirby 2010).

Although efforts have been made to address the waste disposal issue in some countries, it is often only the aesthetic aspect of the problem that is addressed whilst ecological impacts are ignored (UNDP 2006). In Egypt and Sudan there are unregulated discharges of industrial effluents into the River Nile, Suez Canal and coastal areas, where much of both countries industries are based, such as a manufacturing and industrial zone and the port at Ain Sukhna, Suez, Egypt, which is a very important bottleneck IBA for MSBs, and many other areas identified for future industrial development, e.g. El Qah Plain in Egypt.

In Egypt, the proliferation of garbage has contributed to the increase in the Indian House Crow (Corvus splendens) population at Suez and other sites along the Red Sea coast, estimated in hundreds of thousands. Indian House Crows have been observed harassing migrating birds of prey and roosting in, the area and are thought to be a factor contributing to the declining numbers of MSBs migrating through Suez (Nyari et al 2006; Ryall & Meier 2008; Suliman et al. 2011; GISD 2015).
Unregulated dumping and waste management results in large amounts of exposed waste which then attract scavenging animals, causing the deaths of hundreds, if not thousands, of raptors every year (UNDP 2006) within the RVRSF. Systematic and quantitative data relating to the problem along the flyway is again lacking, but there are some sites where waste management is known to be a threat and their negative effects probably have been underestimated.

Large numbers of dead storks have also been reported at poorly managed waste water treatment facilities (domestic and industrial) due to drowning, entrapment in sludge (due to inappropriate pond designs) or from drinking contaminated water (UNDP 2006). Large waste sites pose a particular threat in desert environments where they represent an attractive source of food and water to storks. The solid waste dump at Sharm El Sheikh has been responsible the death of hundreds of White Storks that die every season at the sewage ponds there due to water contamination. Entrapment in sewage is known at Suez, where because of the construction of the tanks, raptors which dropped-in to drink were unable to take off from the plant because of the steep sides (Baha El Din 1997, BIOMAP 2005).

In a study, the 60-year old Bet Giorgis landfill on the eastern outskirt of Asmara, Eritrea, (at the top of the eastern escarpment, an important bottleneck) was shown to contain 546,000 m$^3$ of solid waste increasing at a rate of 1.2%/year. Samples taken from the site showed a high concentration of heavy metal -lead, cadmium, mercury, zinc, and chromium- along with hydrocarbons, pesticides, dyestuffs, and radioactive substances. Many birds and other wild animals, e.g. baboons, feed at the site and frequent deaths of MSBs have been reported by local people, though there is no quantitative data on mortality (UNDP 2006).

**BOX 2. AN OASIS FOR THE MSBs**

The Jordanian Society for Sustainable Development (JSSD) decided in 2003 to establish lagoons for birdwatching at the natural waste water purification plant in cooperation between the Aqaba Water Company and the Aqaba Special Economic Zone authority.

It was agreed to supply the facultative and maturation ponds, as well as the evaporation ponds with water throughout the year to receive migrating birds. These lagoons have formed an ecological model that combines preserving unique bird species and using the tanks supplied with the reclaimed water by Aqaba Water.

The man made wetland which is now the Aqaba Bird Observatory (ABO) was founded in 2008. It is located at the Old Wastewater Treatment Plant of Aqaba and the adjacent Peace Forest, just 2 km north of the city and just off the road to the King Hussein Internati onal Airport at the road of Aqaba-Eilat crossing border point. (See the Map)

The pools at the sewage plant at Aqaba will be partly maintained even after the development of a new, modern plant. The construction of the new plant started recently, and action was taken to move the local authorities to maintain several pools at the old site, which attracts large numbers of migrants every spring and autumn. The JSSD and the local authority (ASEZA) reached an agreement to maintain the sewage/water sources by feeding several pools. They will develop a management plan for conservation, ecotourism, education and research.

The observatory is in an area of flat alluvial fans at the southern end of Araba Valley near the tip of the Gulf of Aqaba. The observatory area is divided into two zones, the open water ponds, which form two thirds of the total area, and a dense vegetated tranquil forest.

There are five ponds; three of them are cement lined, while the others are semi-natural with aquatic vegetation, used as evaporation ponds. These are separated by sandy walkways. The total area of the open ponds is about 40 ha and the maximum depth of these is 1.5 meters.

The adjacent area of woodland is composed of planted rows of trees that have a maximum height of 10 meters. These trees belong to native and introduced species that tolerate high salinity and high temperatures of the Aqaba climate. The total area of the open ponds is about 22 ha.

The green areas of Aqaba, particularly the relatively dense vegetation and open ponds at the waste water treatment plant attract hundreds of thousands of migratory birds every spring and autumn comprised of more than 350 different species. In the spring, migrants tend to land at any suitable habitat in the region; Aqaba is the first station they encounter after a long journey over the deserts of North Africa.
A Visitor’s Centre has been constructed with an education room where the majority of the educational and awareness programs are implemented. The observatory has a research facility that is used as a research centre. Walking trails in the observatory lead to the bird’s hide for watching birds. The observatory includes a nature garden that educates visitors about the native plants found in the Aqaba area giving support to resident birds dependent on such habitats.

The main objectives of establishing the Aqaba Birds Observatory are to:

- Maintain and preserve habitats of global importance for birds.
- Develop Aqaba as focal point for birdwatching and ecotourism activities on both national and international levels.
- Environmental education for increasing the public awareness of locals and visitors toward the importance of Aqaba for global bird’s migration.
- Scientific monitoring & Research to create database for birds and their migration.

The current observatory designs and landscaping are based on two fundamental rules: To introduce the minimal required infrastructure to achieve the goals of the observatory establishment, and create landscaping that does not affect the visual character of the area and support the observatory capability to improve the habitats for birds.

Since 2000, the site has been included in RSCN’s annual national bird census program. Results showed a total of 103 bird species belonging to 29 families use the site, including >80% of migratory species that occur in the country.

The majority of birds species reported from the site over 2000 and 2011 belong to the family Anatidae with a total of 19,096 individuals representing 13 species. This was followed by the family Laridae (Gull) with a total of 6,517 individuals comprising eight species, and after that the family Rallidae (Rails) with a total of 3,895 birds representing two species, and lastly Alcedinidae was the least family with a single species recorded at the site.

Altogether ABO, with 47 species, and Karameh dam, with 46 species, are the richest sites in term of species in the country. Since Jordan was identified as a key country for waterbirds in the 1990s, there have been efforts to conserve the important sites for waterbirds or at least try to influence their management. The site at Aqaba is the first to have a "Bird Observatory" and its development is still ongoing, with the aim to attract birdwatchers from across the world and to raise awareness amongst Jordanians of the responsibility to conserve migratory waterbirds.

Some endangered species visiting the ABO:

- Lesser White-fronted Goose (*Anser erythropus*).
- Falcated Duck (*Anas falcata*).
- Marbled Teal (*Marmaronetta angustirostris*).
- Ferruginous Duck (*Aythya nyroca*).
- White-headed Duck (*Oxyura leucocephala*).
- Corn crave (*Crex crex*).
- Black-winged Pratincole (*Glareola nordmanni*).
- Sociable Lapwing (*Vanellus gregarius*).
- Great Snipe (*Gallinago media*).
- Black-tailed Godwit (*Limosa limosa*).
- White-eyed Gull (*Ichthyaetus leucocephalus*).
- Audouin's Gull (*Ichthyaetus audouinii*).

The a ABO can followed in their facebook page:

www.facebook.com/pages/Aqaba-Birds-Observatory-ABO

Sources: Eid et al. 2013.

4.4 Why Waste management guidelines to preserve MSBs are necessary?

Friendly waste management for soaring birds could be a powerful conservation tool to preserve migrant and wintering populations within the RVRSF and as proactive mechanism of adaptation against negative effects of climate change. In 2010, the Gulf countries generated in excess of 22.2 million tons of municipal waste and approximately 4.6 million tons of industrial solid waste (Al Ansari 2012). It is necessary to determine appropriate management to minimize risks of waste disposal sites for MSBs and others birds, and to enhance the connectivity of bird populations.

Thus, it is necessary to establish first best practice guidelines on waste management and disposal and, secondly, to design and develop a network of important WDS to preserve MSBs.

Open landfill sites and waste water treatment plants can be key feeding habitats of birds when properly managed. Rubbish dumps have been shown as good feeding habitats to many birds notably trophic generalist species, including some MSBs as storks and scavengers raptors (Garrido & Sarasa 1999, Garrido et al. 2002a and 2002b) and wastewater treatment wetlands provide an alternative to natural waterbird habitats, including also MSBs such as storks, pelicans, and cranes (Murray & Hamilton 2010). The creation of feeding stations to remove animal carcasses from farms is a common feature of many conservation programs of scavenger raptors, including Black and Red Kites, Griffon, Egyptian and Cinereous vultures (Donázar et al. 2009, Martínez-Abraín & Oro 2013).

Wildlife friendly waste site management along MSBs flyways improve the resilience of some species to cope and adapt to climate change and they can prevent gases emissions feeding organic waste in landfills or dead livestock in slaughterhouses.

Within this context, developing waste management guidelines to preserve MSBs are necessary because the lack of technical information to direct managers in this issue. These guidelines help to meet the Convention on Migratory Species (CMS) key conservation priorities (Kirby 2010):

- Work to protect and retain and, where feasible, recreate / restore high quality bird habitats on a flyway and landscape scale.
- Work to safeguard and manage networks of critical sites, key to the migration and survival of migratory species.
- Address specific threats that are known to threaten the survival of individual species and species groups.
- Attempt to mitigate the effects of climate change, affording migratory species the best possible chance of survival.

The guidelines allow for the design of waste management facilities to consider and minimize the impacts on migratory species of hazards that cause injuries, illness and death. They can also maximize opportunities for migrating birds and help develop local benefits from ecotourism development at appropriate and bird friendly waste sites through bird-watching.
5. Review of The Impacts of Waste Management on Birds, Notably Migratory Species

5.1 Waste types

For practical purposes according to their origin, management and possible effect on MSBs wastes have been differentiated in four types: solid waste, sewage (water waste), slaughterhouses and other waste.

1. Solid Waste. It includes solid waste generated from combined domestic, industrial and commercial activities in a given area. They are deposited in landfills or rubbish dump and they can be generally considered as non-hazardous wastes. They are those commonly known as “domestic waste” that come from households (residential and commercial), institutional, and industrial sources mainly consisting of paper, wood, food and other organic residuals, plastics, leather, rubber, and other combustible materials. It also includes non-combustible materials such as metal, glass and rock and slaughter animal waste (when it is not dumped in a specific slaughterhouse). In the context of these guidelines solid waste is equivalent to municipal solid waste, and it can also include demolition and construction debris and small quantities of hazardous waste, such as electric light bulbs, batteries, automotive parts and discarded medicines and chemicals, though they might also be considered as other waste and hazardous waste.

Management of solid waste also includes management of sludge from a wastewater treatment plant or water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material, which comes from deposited solid waste in a landfill site or rubbish dump. It is very important to consider the management of leachate that percolate material through and/or been generated by decomposition of waste into the surface and groundwater (i.e. see Palestinian Wildlife Society 2013a). Leachate includes water that comes into contact with waste and is potentially contaminated by nutrients, metals, salts and other soluble or suspended components and products of decomposition of the waste.

Solid waste sites can have large amounts of exposed dead animals and organic waste which attract scavenging birds including Storks, Vultures, Eagles and other soaring raptors.

2. Sewage or Wastewater. It includes any type of contaminated water generated from households and commercial areas. This includes water that becomes dirty through use. It can be differentiated in:

- **Domestic sewage**: A mixture of drinking water, organic and inorganic materials in both solid and dissolved form, including human faecal matter, hair, food waste, cleaning agents and detergents, different wash water, as well as various types of chemicals, papers, rags and sand.

- **Industrial sewage**: Water from manufacturing or chemical processes usually containing specific and readily identifiable chemical compounds, depending on the nature of the industrial process.

Domestic sewage is the primary source of pathogens (disease-causing microorganisms) and putrescible organic substances. Because pathogens are excreted in faeces, all sewage from cities and inhabited areas is likely to contain some type of pathogens and potentially having a direct threat to public health. Putrescible organic matter presents a different sort of threat to water quality. As organics are decomposed naturally in the sewage by bacteria and other microorganisms, the dissolved oxygen content of water is depleted. The latter endangers the quality of lakes and streams, where high levels of oxygen are required for fishes and other aquatic organisms to survive. Domestic sewage is also the major source of plant nutrients, mainly nitrates and phosphates. The excess of nitrates and phosphates in water promote the growth of algae, sometimes causing unusually dense and rapid growths known as algal blooms.

Industrial sewage can also include hazardous materials such as toxic chemicals, oil, and radioactive substances.

Finally, sewage sludge is a solid, semisolid, or liquid that results after sewage (human and other waste from households and industries) and can contain volatiles, disease-causing pathogenic organisms, bacteria, heavy metals, inorganic ions along with toxic chemicals from industrial wastes, chemicals and pesticides. Sewage sludge may also cause erosion and runoff sludge, which would negatively affect to wastewater treatment facilities.
In certain areas worldwide, where strong and concentrated rainfalls occur, storm sewage is another type of wastewater. It forms from the precipitation that is collected in a system of pipes or open channels. Storm sewage carries organic materials, suspended and dissolved solids, and other substances picked up as it travels throughout the ground.

Traditionally surface water has been removed from built up sites using underground pipe systems, which prevent flooding locally by conveying the water away as quickly as possible. This has led to alterations of natural water flow patterns which, in turn, often lead to problems elsewhere in the catchment area. Sustainable urban drainage systems (SUDS) are made up of one or more structures built to manage surface water runoff, used in conjunction with good management of the site. However this is not considered in this document.

3. Slaughterhouses waste: It includes animal body parts cut off in the preparation of carcasses for use as food. The wastes from slaughter houses are similar chemically to domestic organic waste, but they are considerably more concentrated. They are almost wholly organic, chiefly having dissolved and suspended material. The principal deleterious effect of these wastes on streams and water courses is their de-oxygenation. Slaughtering of animals generates wastes consisting of blood and offal such as lungs, stomachs, large intestines and their contents, organs and even body parts, dung or bones. All these types of wastes are required to be disposed by adopting methods like rendering, controlled incineration, burial, composting or anaerobic digestion.

This waste is often deposited in landfills together solid waste and sometimes dumped in uncontrolled and unhygienic places. This produces clogging of drains due to this illegal dumping of animal waste.

4. Other waste. Sanitary, military, toxic and hazardous waste: They include all other waste, originating from specialized technologies and facilities. Hazardous waste is so called because of the capacity to affect human health. These waste types are currently mixed and disposed together with the aforementioned waste types (1-3). Notable types of this waste are:

- **Sanitary waste:** includes discarded materials generated from hospitals in diagnosis, and treatment of human beings or animals, in research pertaining thereto, or in the production or testing of biological treatments.

- **Military waste:** Among which can be found generally used and outdated conventional ammunition and all related material, excluding nuclear and chemical ammunition. It also comprises remains from military operations and entire armament production plants and military facilities dismantled after conflicts. They can be abandoned without being used or destroyed, and can be buried or even dumped without any environmental safety precautions (Teaf et al. 2006). Many substances present in military waste are thus still active and can cause problems for nature and human health if not properly managed.

- **Toxic waste:** includes liquids, solids, gases, sludge, discarded commercial products (e.g., cleaning fluids or pesticides), generated from commercial, industrial, and institutional activities.

- **Hazardous waste:** includes cleaning solvents, acids and bases, metal finishing wastes, painting, sludge from air and water pollution control units, and many other discarded materials. It also includes many items that would not be normally thought of being hazardous; such as batteries (containing acids, bases and metals like lead and cadmium), electronic waste such as CRT-based computer monitors (Lead), thermostats and fluorescent lamps (Mercury) and renovation and demolition waste (lead-based paint). The mining and extractive industrial wastes (overburden, rock, tailings) can also be hazardous and have high contamination levels. Obsolete pesticides also belong to this group, as they have probably decomposed into other chemical components which are sometimes more toxic than the original pesticide. Most pesticides expire two years after production which means they cannot be used unless they are tested and proved stable.

All these hazardous wastes might be disposed of in special landfills or incineration may also be practiced for healthcare wastes. However, in many countries within the RVRS flyway (Table 4), where uncontrolled open dumps are common, all waste tends to be dumped together, regardless of their origins or its hazardous nature. The leachate from hazardous industrial wastes may be toxic to the bacteria naturally present, delaying the biodegradation of organic substances in the leachate.
Table 6
5.2 MSBs species: Conservation status and relationship with waste management

MSBs can be broadly grouped into similar ecological guilds according to their biology. All the Eagles (Boot-ed, Lesser Spotted, Short-toed Snake and Eastern Imperial) rely on prey of a certain size like mammals, birds, amphibians or reptiles that they must actively search. Kites are extremely versatile with many food sources ranging from small animals to organic waste, with a close relationship with humans that probably reflects the success of certain species as the population grows and expands (Del Hoyo et al. 1994). Harriers and small falcons, despite feeding from small vertebrates, obtain much of their biomass at wintering areas from ephemeral invertebrates (Brown et al. 1982); all of them are active flying predators. The Northern Bald Ibis has a broad diet spectrum of animals and vegetation (Hancock et al. 1992, Aghnaj et al. 2001), thus it is susceptible to being affected by both solid waste and sewage. The White Pelican it is entirely piscivorous. However, it has been also registered at rubbish dumps in South Africa (A. Camiña pers. obs.). Storks have varied and opportunistic diets (Del Hoyo et al. 1992, Hancock et al. 1992) that makes them susceptible to use either solid waste or sewage. All of them can be considered generalists. Cranes are omnivorous with a diet where plants comprise an important percentage (Cramp and Simmons 1980, Urban et al. 1986) Finally vultures rely either on dead corpses from medium and big size livestock or wild ungulates in certain areas where they are abundant, or find small food scraps even capturing little preys. Apart from these “guilds” of species, there are other species with very specific feeding habits that do not fall into the above mention such as Oriental and European Honey Buzzards and Osprey.

Breeding comprises a time in the year that requires from a great investment of the parents to support the fledglings with food of good quality. They must also get enough amounts to maintain themselves. It must be remembered that despite being active predators, any animal would scavenge if it has the possibility (Houston 1979). In addition, landfills are a highly predictable food source and birds only need to move between sites to find the most suitable each day. This is the way vultures feed every day in Northern Spain (Camiña & Montelio 2012). The relationship of MSBs with the different types of waste is thus based on the above mentioned feeding habits and also on gregariousness of the species.

Birds must re-fuel along the migration flyway though they only need to obtain enough food for an individual basis as not on breeding grounds. Birds tend to concentrate at easy places to locate where food superabundance may occur as their extensive travels within a predominantly arid landscape with reduced and limited resources would require time to locate prey. Thus, rubbish dumps or any waterbody may be the most attractive way of obtaining food. Birds adapt to these resources as effort required for taking food becomes minimal. In the case of juveniles, much less experienced than adults on obtaining food by themselves, predictable feeding points let them to reduce inter and intraspecific competition to some extent.

Excepting vultures, which only feed from medium and big size wild or domestic ungulates (Houston 1979, Mundy et al. 1992), all remaining MSB’s must actively search for prey. However, scavenging may offer an alternative food source when the only need during migration is to maintain individual fitness and physical condition for the long journey.

In Table 5 it has been classified species according their use of WM sites, establishing a ranking of those species which are attracted to such sites. This is based according to recorded use from rubbish dumps. The Northern Bald Ibis has been considered occasional at waste facilities (its population is now as small as >10 individuals in the region) that this could not be qualified but the feeding habits of the species would suggest it. The third columns concerns conservation status and the population trend stated by Birdlife: I- Increase, D-decrease, U-unknown and S- Stable. Finally, the last column expresses the size of the population and the last year for which information is available.
Table 5. Main MSBs species along the RVRSF showing an intended ‘use of waste sites’ indicator (from low use * to higher use ***, authors unpub. data), their conservation status after the IU CN Red List (2014): CR: Critically Endangered, EN: Endangered, NT: Near Threatened, VU: Vulnerable and LC: Least Concern), population trends (U: unknown, S: stable, I: increasing, D: decreasing) and estimate of their population size (mature individuals, n.a.: data not available) after Birdlife International 2014.

<table>
<thead>
<tr>
<th>Species</th>
<th>Use of waste sites</th>
<th>Conservation status</th>
<th>Population trend</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eurasian Griffon Vulture</td>
<td>***</td>
<td>LC</td>
<td>I</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Egyptian Vulture</td>
<td>***</td>
<td>EN</td>
<td>D</td>
<td>13,000-41,000 (2007)</td>
</tr>
<tr>
<td>Eastern Imp. Eagle</td>
<td>***</td>
<td>VU</td>
<td>D</td>
<td>2,500-9,000 (1999)</td>
</tr>
<tr>
<td>Greater Spotted Eagle</td>
<td>***</td>
<td>VU</td>
<td>D</td>
<td>3,300-8,800 (2004)</td>
</tr>
<tr>
<td>Lesser Spotted Eagle</td>
<td>***</td>
<td>LC</td>
<td>U</td>
<td>42,000-57,000 (2007)</td>
</tr>
<tr>
<td>Steppe Eagle</td>
<td>***</td>
<td>LC</td>
<td>D</td>
<td>16,000 (2009)</td>
</tr>
<tr>
<td>Black Kite</td>
<td>***</td>
<td>LC</td>
<td>U</td>
<td>1-6 million (2009)</td>
</tr>
<tr>
<td>Red Kite</td>
<td>***</td>
<td>NT</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>White Stork</td>
<td>***</td>
<td>LC</td>
<td>I</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Black Stork</td>
<td>**</td>
<td>LC</td>
<td>U</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Booted Eagle</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Short-toed Eagle</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Common Buzzard</td>
<td>**</td>
<td>LC</td>
<td>I</td>
<td>4 million (2009)</td>
</tr>
<tr>
<td>Steppe Buzzard</td>
<td>*</td>
<td>LC</td>
<td>I</td>
<td>100,000 (2008)</td>
</tr>
<tr>
<td>Long-Legged Buzzard</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Oriental Honey Buzzard</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>European H. Buzzard</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>White Pelican</td>
<td>**</td>
<td>LC</td>
<td>U</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Eurasian Crane</td>
<td>*</td>
<td>LC</td>
<td>U</td>
<td>11,800-12,400 (2009)</td>
</tr>
<tr>
<td>Eleonora’s Falcon</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Red-footed Falcon</td>
<td>*</td>
<td>NT</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Sooty Falcon</td>
<td>*</td>
<td>NT</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Peregrine Falcon</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>500,000 (2009)</td>
</tr>
<tr>
<td>Osprey</td>
<td>**</td>
<td>LC</td>
<td>I</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Pallid Harrier</td>
<td>*</td>
<td>NT</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Northern Harrier</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Montagu’s Harrier</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Western Marsh Harrier</td>
<td>*</td>
<td>LC</td>
<td>I</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Lanner Falcon</td>
<td>*</td>
<td>LC</td>
<td>I</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Goshawk</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Eurasian Hobby</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Eurasian Sparrowhawk</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Lesser Kestrel</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Levant Sparrowhawk</td>
<td>*</td>
<td>LC</td>
<td>S</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Common Kestrel</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>n.a. (2009)</td>
</tr>
<tr>
<td>Northern Bald Ibis</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>200-249 (2006)</td>
</tr>
<tr>
<td>Saker Falcon</td>
<td>*</td>
<td>LC</td>
<td>D</td>
<td>12,800-30,800 (2012)</td>
</tr>
</tbody>
</table>
5.2.1 Conservation status of species

There is one Critically Endangered-CR species, Northern Bald Ibis which has been annotated with a medium value for using waste sites, as it primarily uses wetlands for feeding. Saker Falcon and Egyptian Vulture are Endangered (EN). Saker Falcon does not normally use waste sites and, as other falcons, could be present but in such low numbers that the real impact on the populations is negligible compared with other threats. However, the Egyptian Vulture makes an intense use of feeding sites and rubbish dumps. In Northern Spain, roosts involving non breeding and immature birds nearby existed whilst provided with poultry or pig carcasses. *Muladares* greatly contributed to the survival of an important part of the non breeding population (Grande et al. 2006, Donázar 1992, Camiña pers. obs.).

After the appearance of the Bovine Spongiform Encephalopathy-BSE it has been demonstrated that the closure of almost all of the *muladares* led to the disappearance of Egyptian Vulture roosts.

Near Threatened species-NT: Red-footed and Sooty Falcons and Red Kite. Falcons have already been discussed. However, Red Kite makes intensive use of rubbish dumps and also carrion feeding sites (if they are provided with small pieces of meat and there are not other large carrion eating birds such as vultures present). The survival of part of their populations in Spain relies on feeding stations and associated roosting sites accounting for a high number of individuals (Cardiel 2006, Viñuela et al. 1999, A. Camiña pers. obs. 2014).

Two eagle species are classified as Vulnerable-VU, Eastern Imperial and Greater Spotted Eagles.

28 species (75.68%) of migratory soaring birds are classified as Least Concern-LC category. White Pelican and Osprey at very small numbers would use waste-water wetlands in smaller numbers.

At rubbish dumps, mixing organic wastes with carcasses would attract Griffon Vulture, Black Kite, Lesser Spotted and Steppe Eagles and storks, with the White Stork the most prominent due to its population size.

5.3 Impacts of Solid Waste

Solid waste is mainly disposed of at rubbish dumps or landfills just because these sites are the simplest, easiest, cheapest and most effective method of waste disposal. Though the storage of waste in a disposal facility serves to minimise impacts upon the wider environment, it also creates environmental impacts of its own that require appropriate management. Impacts of solid waste have been largely described (see e.g. Taylor & Allen 2006a, 2006b) and they usually include:

1- Groundwater contamination by leachate derived from waste, mainly in case of disposal sites located in the vicinity of sources of drinking-water

2- High concentrations of pathogenic organisms associated with organic waste

3- A mix of hazardous and non-hazardous waste

4- Green House Gas (GHG) emissions from bacterial decomposition of organic waste that also are explosive and flammable (especially methane)

5- Bad and occasional toxic odour emissions
6- Concentrations of fauna that may affect operations close to airports nearby or human populations (such as: birds, rats or feral dogs)

7- Causing injuries and poisoning incidents to people wandering and searching the waste sites within a (large-ly illegal) sub-economy in recycling for subsistence living.

All these impacts are more critical if large human population are within close proximity. When the existing waste collection and transport systems cannot handle the amount of waste generated by large cities with growing populations, waste can be disposed of at uncontrolled dumps or openly burned.

This type of unmonitored and uncontrolled waste disposal has the most negative consequences on human health and the environment according to EPA (2002), and it is the most frequent type of waste management in the area along the RVRSF (Table 4).

Impacts on MSBs can be positive, including the increasing of local bird (kites storks etc.) populations and supporting MSBs populations of different stages of their annual cycle. However, solid waste sites have been designed and constructed without sufficient consideration to the range of potential impacts on migratory species. Birds that land and consume organic materials can become entangled in waste, ingest plastic bags, consume toxic materials, drink contaminated water from leachate or become injured by broken glass, barbed wire and other sharp materials. All these impacts are more important in areas where natural habitats have been largely transformed and rubbish dumps are the only available feeding habitat.

5.3.1 Toxic impacts

Management facilities for solid waste constitute attraction points for scavenging birds including soaring raptors. However, where there is a mix of organic and non-organic wastes, foraging birds can ingest toxic substances. Along the RVRSF it is common that solid waste is disposed in open landfills, often mixing domestic and hazardous and industrial waste where there can be thousands of storks and raptors feeding (UNDP 2006, BirdLife 2013, and Table 4).

Within this context, rubbish dumps can be “trap habitats” (Newton 1998) to birds, because the negative impacts are not apparent to the bird which only sees a food resource. These species swallow toxic or sharp debris that can poison or lodge in and penetrate the gut. The low breeding success of Griffon Vultures in Israel, Jordan and Palestine and Armenia has been attributed to nestlings dying after eating metal objects (Ferro 2000, Houston et al. 2007, BirdLife 2008).

Additionally, accidental poisoning of raptors at rubbish dumps from baits set to control scavenging foxes, jackals and feral dogs is an issue of concern in some areas of the Middle East (UNDP 2006), as it is also the consumption of inappropriately disposed poisoned animals (e.g. rodents) at rubbish dumps (Tavares 2013). Such baits are the cheapest way to control predators at waste sites and risks to other animals are not recognised by, or are unimportant to, site managers (UNDP 2006).

Figure 6. and Figure 7.
Rubbish dump where up to 65 raptors were killed due to incidental poisoning in Tudela municipality, Navarre, Northern Spain (R. Alfaro 2013)
Leachate usually percolates into the surface and groundwater typically and it includes dozens of biological, organic and inorganic pollutants. Sometimes leachate produces small and medium size ponds within the same waste site where birds go to drink and bath after feeding and then they become intoxicated. This can include a high concentration of heavy metals, hydrocarbons and agricultural pesticides, including 12 Persistent Organic Pollutants, called the “Dirty Dozen” by the United Nations Environment Programme. These 12 chemicals include eight pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, and toxaphene), two industrial chemicals (polychlorinated biphenyls and hexachlorobenzene) and two unintended by-products: dioxins and furans.

Intoxications can be very serious not only locally but globally, by causing sub-lethal intoxications during migration at stop-over rubbish dumps that could produce a global population decrease in the medium to long-term due to reduced productivity, breeding success and fitness (Kirby 2010).

5.3.2 Impact of diseases

Feeding from solid waste sites could lead to MSBs to spreading infection because of the speed of migration between breeding and wintering grounds. Landfills are rich in microorganisms because the organic content of the waste is decomposed anaerobically. Most of the organisms that carry out these processes are harmless saprophytes, but a small percentage of the population may be opportunistically pathogenic microorganisms coming from households, poor managed sanitary waste, veterinary practices, industrial sites, other domestic waste (bloodstained materials, such as sanitary pads, tampons and discarded wound dressings) and animal waste, such as dog faeces and soiled cat litter. The potential for pathogens within this mixture of sources is extremely high. Pathogens may also be transported to landfill sites by vermin (rats) and other scavengers, including birds, and specially seagulls (Taylor & Allen 2006). The fate of pathogens in landfills is not well understood. Although it is generally assumed that most are rapidly inactivated by the conditions that prevail in the landfill environment, the potential of leachate and run-off from landfill sites to transport pathogens into local water resources should be addressed in situation assessment (Taylor & Allen, 2006).

The dumping sites can increase the risk of disease transmission because of the higher numbers of resident and migrant birds feeding together (Garrido et al. 2002a, 2002b). Weber (1979) reported that birds associated with rubbish dumps could suffer from more than 60 diseases transmissible to humans and domestic animals. In 2006 a mass death of wild birds, including wild pigeons and vultures, was reported in Yemen (BirdLife 2013) during a “Newcastle disease” outbreak in chickens. Wild birds died as a result of the improper dumping of chickens killed by this disease; Newcastle Disease is now endemic in domestic birds and could potentially have an impact on MSBs (BirdLife 2013). Dead animals dropped off at WDS may have died from infections that could cause mortality among MSBs, including avian influenza, common in the Middle East (Williams & Peterson 2009).

Wild birds could potentially transmit diseases along migratory routes, especially because it is expected that infectious diseases will emerge more frequently and in new areas due to climate change (Kirby 2010), as it is the case of the avian influenza or West Nile Virus (Epstein 2001, Williams & Peterson 2009, Pradier et al. 2012). Similarly, other species like storks, herons and egrets could reduce the water quality of reservoirs where they roost from carrying pathogenic micro-organisms coming from waste into the systems. However, it should be noted that to date pathogenic pollution has never been cited worldwide, because (according to Serrano & Cantos (2013) most organic waste is removed from water through appropriate management before being used by people.
5.3.3 Impacts from waste management

Within the RVRSF it is common to find uncontrolled management of solid wastes (Table 4). The UNDP/GEF Migratory Soaring Birds Project unpublished report which undertook Situation Analysis of the five key productive sectors (energy, hunting, agriculture, tourism and waste management; BirdLife 2013) indicated that most solid waste is disposed in open landfills around big cities and towns, whilst in rural villages waste is either thrown into open pits, burned, or dumped into rivers and lakes, without any further management (Table 4). The waste is often disposed indiscriminately on open fields and roadsides, with only up to 50% of waste collected for landfill, the rest accumulates and is distributed by wind and floods. Plastics tend to remain, which form a nuisance and a potential threat for the environment and animals. In the wet season, waste (plastics) may be flushed into rivers together with other surface contamination (as a result of waste water discharge). No separation of waste products occurs at the point of collection (residential or industrial) or at the landfill itself, that are generally poorly managed (Table 4). All these actions harm public health and the environment.

In the absence of adequate solutions, solid waste is being openly burned near human populations in order to reduce the volume of waste. Smoke from burning may contain toxic gases, including H2S, ammonia, volatile organic compounds and dioxins, causing health damage primarily to people, but also to birds. Furthermore, feeding on landfills may lead to inhalation or plumage impregnation of a variety of toxic compounds all typically found at rubbish dumps and listed by Humprey et al. (1997), Pérez (2000) and Schmid et al. (2000). These compounds are an issue for public health in the vicinity of rubbish dumps, include several kinds of cancer, embryo malformations, infertility and low neonates weight (Humprey et al. 1997, Pérez 2000, Schmid et al. 2000). Some of these toxic substances have damaged birds (Peakall, 1985, Whitley 1989, Donázar 1993, Newton 1998) and inhalation and impregnation could affect their fitness and cause breeding problems to both local and migrant populations.

Birds feeding on dumps frequently become entangled in plastic, wire, and other debris, or are injured by metal scrap or fire. Similarly, birds can inadvertently ingest plastics, ropes and elastic bands, leading to possible medium term fatalities away from the site, sometimes through the cumulative effect of repeated ingestion. In Spain, deaths of globally threatened White-Headed Duck (Oxyura leucocephala) have been found due to secondary ingestion, swallowing elastic bands and entangling plastic remains which had come originally from White Storks and Cattle Egrets pellets. These birds, having gathered at a communal roost near the waterbodies, had released some of the plastic they have ingested at a local WDS during roosting and became a risk for the White Headed Duck population feeding on the lake (Garrido, pers. obs.).

5.3.4 Other impacts

Solid waste can also have some biological impact on MSB species. Landfills can result in the exponential increase of some avian species such as gulls which compete and even prey on other species.

In Egypt, the proliferation of rubbish has led to a dramatic increase in the Indian House Crow (Corvus splendens) population at Suez and other sites along the Red Sea coast, estimated to be up to tens of thousands individuals. Indian House Crows have been observed harassing migrating birds of prey both flying through and roosting in the area and are thought to be a factor contributing to the declining numbers of MSBs migrating through Suez (Nyari et al 2006; Ryall & Meier 2008; Suliman et al. 2011; GISD 2015).
Feeding in landfills could be influencing natural selection in some migrating species like White Stork and Griffon Vulture, allowing differential survival of those specific migrating phenotypes as compared to other wintering in natural areas (Garrido & Sarasa 1999, Garrido et al. 2002a, 2002b). Accordingly, as Kokko (1999) suggested, in avian migration MSBs wintering at rubbish dumps near to breeding areas will have an advantage for recruitment to the reproductive cohort over those populations whose phenotype encourages further migration. Rubbish dumps can thus increase the chances of survival for poorly adapted individuals and produce artificially increasing breeding populations that would crash again if the WDS were closed or relocated (Garrido et al. 2002a, 2002b).

Finally, hunting of birds of prey and many migratory species remains to be a significant threat in the Mediterranean region (Giordano et al. 1998, Camiña pers. obs.) and certain areas of the Middle East (e.g. Baumgart et al. 1995 and 2003, Bijlsma 1990, Portelli 1994, van Maanen et al. 2001). It is possible that concentration of migrant soaring raptors in some rubbish dumps could increase the risk of illegal killing of some species.

**BOX 3. INDIAN HOUSE CROWS POPULATION INCREASING BECAUSE FEEDING ON RUBBISH DUMPS: LEADING TO IMPACTS ON OTHER BIRD SPECIES**

Solid waste can lead to increase in undesirable carrion species such as House Crows Corvus splendens in Middle East. This species is native to the Indian subcontinent but has expanded its range due in part to the proliferation of open rubbish dumps. House Crows are omnivores, scavenging on human waste and stealing food. This dependence on man, accounts for their widespread recognition as a pest. House Crows are now common introduced residents in many human settlements, towns and cities in coastal areas of the Arabian Peninsula and the Gulf. Its distribution in Arabia shows a strong preference for the coastal strip, as is the case elsewhere in its range, which reflects the distribution of human settlements on which the species is dependent. Adverse impacts to threatened MSBs can include food theft and harassing migrating birds of prey flying through and roosting. House crows could be a potential vector of human disease as West Nile Fever and bird flu; because cases of H5N1 infected House Crows have been found in the Middle East, making this an important public health issue. Introduced house crows continue to spread across the region with negative effects on agriculture, tourism, human health, and biodiversity. Crows can also be responsible for the reduction or severe depletion of small reptiles and amphibians, birds and mammals, insects, fish and domestic animals (see Suliman et al. 2011).

There have been numerous attempts at controlling House Crow numbers, but none to date, successful. It would be necessary to study specific behavioural investigations e.g. foraging behaviour and spread of other species to combating the House Crow invasion.

*Extra cited information from Nyari et al. 2006; Ryll & Meyer 2008; Suliman et al. 2011; GISD 2015.*

### 5.4. Impacts of Sewage

Sewage receives all types of hazardous waste from households, industry and hospitals. There are arange of substances disposed of from modern society. Many elements such as heavy metals, organic contaminants, pathogen microorganisms, are potentially dangerous to environment and human health (Smith & Scott 2005). If sewage is not treated, all the afford-mentioned substances end up in rivers, lagoons or coastal areas provoking hazardous concentrations for humans and the environment.

Wastewater treatment refers to the treatment of sewage and water used by residences, resorts, business, and industry to a sufficient level that it can be safely returned to the environment. It is important to treat wastewater to remove bacteria, pathogens, organic matter and chemical pollutants that can harm human health, deplete natural oxygen levels in receiving waters, and pose risks to animals and wildlife. Wastewater treatment plants (WTP) are issued with permits permitting discharges of solids, oxygen (as biological oxygen demand, or BOD), bacteria, nutrients, and other regulated pollutants on a plant-by-plant basis, depending on their receiving waters.
5.4.1 Positive impact of Wastewater

The construction of Waste Stabilization Ponds (WSPs) and artificial wetlands for the treatment of wastewater has been developing fast over the last decades and now represents a widely accepted and an increasingly common treatment alternative. The many advantages offered by constructed wetlands (CWs), such as simplicity of design and lower costs of installation, operation, and maintenance, make them an appropriate alternative for both developed and developing countries (Dordio et al. 2008). This is the preferred option, providing simplicity operation and maintenance, a good level of treatment at low capital and which undoubtedly play a crucial role as these countries strive to reduce poverty levels (Varon & Mara 2004). Furthermore, the advantage of these systems in terms of removal of pathogens is an important reason for its use in warm climate areas, such as within the RVRSF.

The system can also provide a variety of indirect benefits, such as wildlife habitat, areas for educational or even recreational purposes. The wetland areas can also be used for growing crops with direct economic value, such as biomass for energy or agricultural purposes.

WSPs and CWs can attract many birds, mainly waterbirds, working as real wetlands especially in places where natural ones have disappeared or are scarce. The importance of artificial wetlands can be very high if situated on migration routes, becoming outstanding stop overs (Anika & Parasharya 2013).

In many places, limited disturbance within the surrounding habitat and the traditional aversion that humans have for sewage coupled with the offensive odour create a relatively safe place for the birds in and around the sewage stabilization ponds (Akinpelu 2006).

A high level of pollution of treatment wetlands would appear to be disadvantageous for waterbirds. However, it has been found that artificial ponds with high levels of pollution over many years can continue to provide habitat for birds, despite the still risk of negative effect on waterbirds (Shutes 2001).

After continuous monitoring over 20 years at 300 Australian wetlands it was noticed that waste stabilization ponds significantly supported higher numbers of birds than all other wetland types. The species composition of waterfowl communities within waste stabilization ponds was also distinctly different from others (Murray et al. 2012). In dryer areas worldwide with erratic rainfall, such as most of Australia, the permanence of water makes WSPs particularly useful for waterbirds and these findings are likely to correspond to arid regions within the RSRV flyway. Many Australian waterfowl species breed on ephemeral inland wetlands and migrate to perennial coastal ones for the non-breeding period and WSPs are important refuges at this time (Hamilton & Taylor 2004).

Even for those areas with many natural wetlands, sewage lagoons may attract large bird concentrations (Kipkemboi et al. 2006). The reason that so many bird species congregate at sewage lagoons is directly related to the constant input of organic matter (human sewage). A wetland with a high organic base provides suitable conditions particularly for the production of many aquatic insects. Some investigations have found that overall arthropod biomass (availability) can be higher on sewage lagoons than on natural wetland habitats. Therefore, sewage lagoons are a favourite stopover site for shorebirds and waterfowl during migration as they feed on the exposed sludge flats and in the shallow water (Zimmerling 2006).

Wastewater treatment wetlands are not natural systems and therefore need to be well understood and actively managed to effectively and safely achieve the dual objectives of wastewater treatment and waterbird habitat (Murray & Hamilton 2010).

The situation at each facility will differ, so waterbird use of some treatment wetlands may be inappropriate, even to the point of requiring deterrents. This review has highlighted the need for further research directed to improving our knowledge of:

- The global distribution of wastewater treatment wetlands.
- Means of mitigating disease outbreaks in waterbird populations frequenting wastewater treatment wetlands.
- The effect of wastewater contaminants and diseases on waterbirds.
5.4.2 Risks to MSBs

Large congregations of birds may gather at artificial wetlands from sewages, especially in dry environments. The gregarious nature and communal roosting behaviour of many species create ideal conditions for the transmission of disease, which, especially in the case of toxins, can kill large numbers of birds in a single event. Thus, although birds may benefit from sewage treatment works, these sites may also have microbial, chemical and mechanical hazards to birds (Hamilton 2007). The range of potential chemical effects on birds includes acute mortality, sub-lethal stress, reduced fertility, suppression of egg formation, eggshell thinning, and impaired incubation and chick rearing behaviour (Fry 1995).

a) Pathogenic and toxin-producing microorganisms

- **Botulism.** It is produced for the bacterium Clostridium botulinum, the most significant microbiological hazard for waterbirds using wastewater treatment wetlands, most commonly ducks (Newton 1998). Higher temperatures and high invertebrate biomass, which are common to WSPs, appear to provide conditions that increase the risk of botulism outbreaks.

- **Salmonellosis:** The causative agent is Salmonella. As a consequence of the infected birds discarding Salmonella in their faeces, outbreaks of the disease commonly occur in concentrated groups of birds, such as are found at roost sites (Friend 1999).

- **Harmful algal blooms:** They mainly appear when there are high nutrients levels (phosphorous and nitrogen particularly). Such blooms are common in waste stabilization ponds and can kill large numbers of waterbirds (Matsunaga et al. 1999).

- **Avian cholera:** This is a highly infectious bacterial disease. Pasteurella multocida is the causal agent, which can lead to mass mortality of birds, particularly waterfowl. The disease is transmitted through direct contact with infected birds, contact with secretions or faeces or infected birds and ingestion of contaminated food or water.

- **Avian influenza:** Avian influenza is a highly contagious disease caused by influenza A viruses, affecting many species of birds, most commonly ducks, geese, swans, waders/shorebirds and gulls. The viruses are passed out with the faeces and/or respiratory secretions and exposed birds then ingest or inhale viruses and, if susceptible, will become infected.

- **Other diseases:** Campylobacteriosis, duck virus enteritis, leptospirosis, west Nile virus disease.

b) Metal and chemical contaminants

- **Selenium.** It can appear in sewage sludge. Plants and invertebrates in contaminated aquatic systems may accumulate selenium in concentrations that are toxic to birds (Friend & Franson 1999).

- **Mercury.** This metal can reach ponds from industrial sewage and accumulate in aquatic organism and sediments. Its presence could cause a diffuse mortality difficult to detect in the case that it occurs (Friend & Franson 1999).

- **Lead.** It is toxic to all vertebrate taxa, acting as a non-specific poison that affects all body systems. Absorption of high concentrations of lead may cause mortality while that of low concentrations may result in a wide range of sub-lethal physiological, biochemical and behavioural effects (Franson & Pain 2011).

- **PCBs.** These toxics can cause very negative effects in birds even at low concentrations. E.g., it has been found that low-level PCBs exposure may have widespread behavioural effects, included changes in the structure of song in songbirds (De Leon et al. 2013).

- **Endocrine disrupting chemicals** (EDCs) and pharmaceuticals. This is a diverse group of chemical compounds which can alter endocrine function in exposed animals. It was found that these substances can be present in sewage treatment ponds and potentially transfer to birds (and other animals such as bats) through consumption of contaminated prey items developing in sewage sludge and waste water at sewage treatment works (Park et al. 2009; Markman et al. 2011). Something similar occurs with pharmaceuticals like the common antidepressant fuoxetine, which at environmentally relevant concentrations can significantly alter behaviour and physiology of birds (Arnold et al. 2014).
c) Physical hazards

A less obvious hazard to birds at sewage treatment plants (STPs) is the infrastructure itself. Steele (2008) reported a series of events in which over 700 ducks died. The deaths ceased when a drainage structure was modified, and it is probable that they resulted from drowning following entrapment. Such incidents are probably under-reported so, in spite of the dearth of such events in literature, careful consideration needs to be given to infrastructure design and maintenance to avoid unintended hazards for birds.

d) Human disturbance

Human activities in close proximity to birds may cause disturbance (Woodfield & Langstone 2004). The lagoons and ponds of sewage plants are under continuous human presence of people working at the facilities but also other occasional visitors attracted by the large bird’s gatherings. These visitors may disturb the birds, which move into other areas for certain time periods. When these wetlands are located along migration corridors that are the only available sites where to roost, disturbance may cause a great energy loss. This problem may not be too significant in a large scale, but it would be important at local scale.

In many CWs legal and illegal hunting can disturb waterbirds. Overall, such effects are likely to be widespread and, local effects may be significant. Large-scale field experiments (see Madsen 1998a, 1998b, Mainguy et al. 2002) have demonstrated the potentially important effects of hunting disturbance in depressing the size of bird populations (examples in Kirby et al. 2004).

Disturbance may frequently cause displacement, either between or within sites, influence feeding and resting behaviour, result in overall increased daily and seasonal energy expenditure and chances of predation (reviewed by Kirby et al. 2004). This may affect the condition and fitness of migratory species. However, at present we do not know of any evidence that displacement has affected non-breeding birds at the population level.
5.4.3 Effects of birds in sewage plants

Sometimes, the primary function of sewage facilities, which is treatment waste water, is in conflict with the provision of bird habitat. It may be possible that birds are responsible for a reduction in water quality, contrary to the main objective of wastewater treatment plant.

There are two possible negative influences of birds on water quality: nutrient input and human diseases introduction.

- **Nutrient importation.** The birds, particularly large waterfowl concentrations, can significantly contribute to nutrient input in wastewater treatment ponds, especially if waterbirds are feeding away and roosting within the plant (Marion et al. 1994).

- **Disease vectoring.** Waterbirds that inhabit wastewater treatment wetlands are potential sources of pathogens (Ghermandi, Bixio & Thoeye 2007). While there are not studies reporting the vectoring of disease by birds at wastewater treatment wetlands, waterbirds, and gulls in particular, have the potential to act as disease vectors. It may occur through feeding on contaminated waters and defecating at wastewater treatment wetlands to use as roosting sites. Salmonella has been found to infect ducks. Faecal coliform bacteria Campylobacter, tick-borne pathogens, fungal spores, and the human tapeworm Taenia saginata also may all be disseminated by gulls (Murray & Hamilton 2010).

5.4.4 Sewage treatment in RVRSF area

The treatment of sewages within the countries of RVRSF share several characteristics. In rural areas, most people have not access to sewage systems or wastewater treatment facilities. Septic tanks are frequently used. Other times, there are sewage systems directly spilling into water courses (Al-Duais 2013, Zaid 2012, Al Mengistou 2012, Atrash et al. 2012, Hashim 2012).

As a general rule, sewage treatment plants are located in the big cities. Countries such as Saudi Arabia have very modern and contemporary facilities. Many sewage treatment plants simply treat the wastewater with sedimentation and aerobic-anaerobic lagoon using commodious land, and do not meet effluent standards. Wastewater treatment is increasingly utilized as a water source. However, treated wastewater is reused mainly for irrigating fodder crops, gardens, highway landscapes and parks. E.g., wastewater represents 10% of Jordan’s total water supply and up to 85% of its treated wastewater is being reused (El-Ashry et al. 2010).

Sometimes, the flows of municipal wastewaters greatly exceed the design capacity of the plants and this overload results in a poor effluent quality. Wastewater in the region is increasingly loaded with further potentially harmful substances such as heavy metals, trace pollutants including organic and inorganic compounds, and emerging contaminants such as pharmaceutical substances, all of which must be removed prior to wastewater re-use (El-Ashry et al. 2010).

Thus, through the RSRVF corridor, exist numerous both artificial and natural wetlands with a poor water quality, which are used by the MSBs and could be a risk for their populations. Table 6 shows a summary of the existing information for the countries in the region.
Table 6.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>WASTEWATER TREATED (million m$^3$/year)</th>
<th>MAIN PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGYPT</td>
<td>2.971</td>
<td>• Rural areas, most of people have not access to sewage systems or wastewater treatment facilities. Septic tanks are mostly frequently used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Areas where wastewater treatment facilities exist, the flows of municipal wastewaters greatly exceed the design capacity of the plants.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Urban areas, many sewage treatment plants simply treat the wastewater with sedimentation and aerobic-anaerobic lagoon using commodorous land, and do not meet effluent standards.</td>
</tr>
<tr>
<td>JORDAN</td>
<td>107</td>
<td>• The demand for water in Jordan exceeds the available resources, and as time passes, the gap between both demand and supply is widening. The surface water resources have been developed to be mainly used in irrigation. Dams, channels and advanced irrigation systems were introduced to make the best use of the available resources. Water sources, which have not yet been developed, are very limited and it is expensive to make them available.</td>
</tr>
<tr>
<td>LEBANON</td>
<td>4</td>
<td>• Frequent disposal of sewage and industrial effluents into the sea and rivers, followed by abstraction from the rivers at downstream level for irrigation uses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Most of the wastewater collected through sewer networks flows to the sea.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Wastewater generated from building not connected to a sewer network flow into septic tanks or into the rivers.</td>
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<tr>
<td></td>
<td></td>
<td>• Many farmers use untreated wastewater in an informal manner for irrigation. No accurate data of the amount of wastewater used for irrigation.</td>
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<tr>
<td></td>
<td></td>
<td>According to FAO it could reach around 2 million m$^3$/year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The illegal and uncontrolled reuse of raw sewage, directly or indirectly, is sometimes a common practice in Lebanon as in ancient times. Re-use for agricultural irrigation dominates, crop restrictions are not respected. Farmers or workers who handle untreated wastewater do not always follow public health recommendations and often neglect to wear protective boots and gloves.</td>
</tr>
<tr>
<td>SYRIA</td>
<td>550</td>
<td>• Semi-arid country with scarce water resources. The largest water consuming sector in Syria is agriculture.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The domestic water uses stand only at about 9% of total water use (before the on-going war). All treated wastewater is reused for irrigation.</td>
</tr>
<tr>
<td>PALESTINE</td>
<td>No data</td>
<td>• The total available groundwater in Israel and the Palestinian Territory is 1,209 million cubic metres mcms/year out of which 1,046 mcms/year Palestinians have permitted to use only 259 mcms/year. The imbalance of current water use translates into an imbalance in water consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The Palestinian domestic per capita consumption of 35-80 l/day is far below the WHO standards, which assigns a minimum of 100 l/capita/day.</td>
</tr>
<tr>
<td>ETHIOPIA</td>
<td>No data</td>
<td>Pollution of Akaki River Sub-basin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Southern margins of Addis Ababa with high levels of pollution of fresh water sources due to uncontrolled solid and liquid wastes discharged into open water systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Water is contaminated by heavy metals and some other inorganic pollutants: nitrates account for the high rate of health hazard in this area. Dissolved and suspended particulate matter (SPM) bound Cu, Zn, Ni, As, Pb, Mn and Fe are common.</td>
</tr>
<tr>
<td>SAUDI ARABIA</td>
<td>547</td>
<td>Erosion and sedimentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Erosion and sedimentation in reservoirs and lakes will bring eutrophication in the water bodies which will bring pollution. Point sources of pollution include domestic or industrial discharges via pipe connections to the system. Non-point (Diffuse) sources of pollution include runoff from the agricultural land and waste dumping sites. Both point and diffuse sources of pollution have resulted in two problems in surface waters: eutrophication (nutrient enrichment) and contamination by hazardous organic compounds. From field observation in Gilgel Gehe-I watershed area, the reservoir creates a new habitat for aquatic birds but on the other hand it also creates problems of eutrophication related to erosion and sedimentation.</td>
</tr>
<tr>
<td>YEMEN</td>
<td>46</td>
<td>• Several wetlands in Yemen (e.g. Howa in Aden, Hodeidah, Tarim, Dhahran, and Sanaa, among others) have been created from sewage effluent and are highly attractive to MSBs and other migrant and resident bird species.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Given the primitive standards of sewage treatment in Yemen, the possible accumulation of heavy metals and other toxins in sediments at these wetlands is highly likely. Although the prevalence of these materials and their impacts on MSBs has not been studied, it is expected that they can and do enter the food chain with negative consequences for MSBs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The lakes and wetlands from partially treated or untreated wastewater around the big cities were reported as a source for groundwater contamination, which is confirmed by other researches and publications. Some of the larger sewage treatment plants are overloaded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The polluted wetlands attract MSBs, especially during bad weather. Thus, harmful effects on MSBs are highly anticipated in such dry areas.</td>
</tr>
<tr>
<td>SUDAN</td>
<td>No data</td>
<td>• Man-made wetlands represent sewage disposals surrounding Khartoum and the ponds resulting from extracted water during oil production. The ponds attract both domestic livestock and water birds.</td>
</tr>
<tr>
<td>DJIBOUTI</td>
<td>0</td>
<td>• The main challenge for Djibouti lies with increasingly scarce water resources combined with urban population growth.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Country’s situation is particularly worrying as sustainable water resources are estimated at only 50 cubic metres per capita per year, compared with an average of 1,000 cubic metres per capita per year for the water-stressed Middle East and North Africa region.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Almost all of Djibouti’s water supply is sourced from underground wells, and most of these wells are old and close to exhaustion.</td>
</tr>
</tbody>
</table>
5.4.5 The future of sewage treatment in RVRSF area and MSBs

WSPs are also promoted in the World Health Organization’s wastewater re-use guidelines as a pragmatic and effective means of treating wastewater (WHO 2006) and predict significant increases in sanitation. This has clearly implications. If increased sanitation is used as a rough surrogate for increased use of WSPs, the expected increase in these wetlands will probably occur in RVRS region. Most of countries in Middle East, Asia and Africa have an increasing human population coupled with improved standards of living, which means increasing pressure on natural ecosystems. Alteration and decrease in natural wetlands are expected in these countries. Thus, an increase of sewage treatment plants it is expected throughout the RVRSF together with the increasing loss of natural wetlands. This will result in an increase of the importance of sewage treatment plants for migratory species. It is even more important in such an arid region as the RVRSF, where many natural wetland habitats have been degraded or lost and where climatic conditions dictate a natural scarcity of water rich habitats. With the global loss of natural wetlands waterbirds and some species of MSB have become increasingly dependent on alternative and artificial aquatic habitats.

These areas could also provide some economic income for local populations as a tourist resource for bird-watching activities. Birds can be used for the development of environmental and awareness activities. There are examples within the RVRSF (see Box 2) where sewage/wastewater plants have become a resource for both resident and migratory birds and developed as a tourism facility.

5.5 Impacts of slaughterhouses and other wastes containing meat

“Slaughterhouse” includes abattoirs and any place where cattle, sheep, swine, or other animals are killed for subsequent use as food for human consumption. Options for the disposal of slaughterhouse remains or by-products are usually considered in the following order of priority

1. Processing at a rendering plant.
2. If a rendering plant is not available or cannot accept the waste, incineration in a facility permitted to accept the waste.
3. Disposal at landfill.
4. Burial of the waste on the owner’s property.
There are different definitions of slaughterhouses according to final products (Bos & Wit 1996) or different meat processed products (such as canned, smoked or cured meat or carcasses only). There are also cultural and religious considerations that play a significant role in procedures for producing meat. The World Organization of Animal Health-OIE international standards are compatible with the requirements of Islamic Sharia, which call for the protection of animals against cruel practices and make specific provisions for humane slaughter. Due to religious beliefs in certain instances (i.e. lack of pre-stunning) and lack of veterinary inspections either ante- post-mortem, slaughtering cannot be done in adequately equipped slaughter houses. This leads to illegal slaughtering of animals at a very high level and also to illegal carcasses or remains disposal.

Local bodies are mainly responsible for day-to-day operation/maintenance of slaughter houses. Most are service-oriented and, as such, perform only the killing and dressing of animals without an on-site rendering operation. Most slaughterhouses are old without adequate basic equipment like proper flooring, ventilation, water supply or transport. In addition, slaughterhouses can suffer from low hygiene standards posing public health and environmental hazards due to inappropriate disposal of waste and risk of highly polluted effluent discharge. Slaughterhouses are classified according to the type of animals they process, as large (i.e. cattle, buffalo etc.), middle-medium (goat, sheep and pig) or small (poultry). They can also be sorted with respect to number of animals slaughtered per day (again large, medium or small scales). Large ones are located mainly in big cities, the medium in district/towns while small scale slaughter houses are scattered all over the country.

The different steps of slaughtering are:

- Collection of blood (bleeding): there are bleeding areas having blood drains where collection is immediate.
- Evisceration: this generates the maximum amount of waste. Butchers who carry out illegal slaughtering of animals generally dispose of visceral material in community bins and leading to local pollution. This type of waste is required to be disposed by adopting methods such as rendering, controlled incineration, burial, composting or anaerobic digestion. Care has to be taken to ensure that intestines are not punctured during evisceration to avoid contamination of carcasses.
- Dressing: Each slaughterhouse should have adequate tools for dehiding of animals. Hides and skins are normally immediately transported out of slaughtering area in closed wheel barrows. In some occasions, the hides and skins should be spread on the floor of the slaughtering area for inspection. Legs, bones, hooves etc., should also be removed immediately from the slaughtering area through a spring load floor chute or closed wheel-barrow.

Due to inadequate facilities at the slaughterhouses and scattered illegal slaughtering of animals, very few slaughterhouses collect blood. In both the above methods of slaughtering, blood collection is not done immediately on slaughtering and most goes down into municipal drains causing pollution. This resource, which can be collected for making use in pharmaceutical industry, is thus by and large lost. Due to lack of means and tools, illegal dehiding of the carcasses is carried out even on the street (see Figure 13) which causes meat contamination. Hides and skins are spread on the floor out of the slaughtering area whilst bones limbs and hooves, legs, etc. are not removed immediately.

Water is required for cleaning at slaughterhouses. The wastewater is discharged into freshwater courses without proper treatment. It contains high levels of Total Organic Toxic carbon (TOC) that reduces the Oxygen level in water. Other compounds such as Nitrogen and Phosphorous (Steinfeld 2006) are released. Wastewater also contains remains from slaughtered animals such as rumen contents, intestines or blood.

**Figure 13.** Slaughtering of cattle on the street near Homs, Syria (A. Caminha 2010)
Current methods for routine disposal of carcasses include burial, incineration, composting and rendering:

- Burial is sometimes not permitted, and its use will diminish with increased regulatory pressures and concerns for groundwater quality.
- Incineration is a biologically safe method, but it tends to be slow and expensive and may create air quality issues.
- Composting serves as a suitable and innovative technique and has gained favour in areas where burial and incineration have become restricted.
- Rendering involves conversion of carcasses into three end products—namely, carcass meal (proteinous solids), melted fat or tallow, and water—using mechanical processes (e.g., grinding, mixing, pressing, decanting and separating), thermal processes (e.g., cooking, evaporating, and drying), and sometimes chemical processes like solvent extraction (Kalbashi & Ahmed 2004). However, under the current development of the countries in the RVRSF area, rendering is not used or at best very restricted, with carcass disposal at landfills the most commonly used method. This is the case in Sudan (UNIDO 2010) where animal carcasses rejected from slaughterhouses for health reasons and the remains separated during the slaughtering process are collected and dispose of with municipal waste and finally burned.
5.5.1 Carcasses from illegal practices and livestock producers

Animals dying naturally in the cities are often carried away to city limits by the people who perform the job of dehiding carcasses. After dehiding these carcasses are frequently left out in open. Vultures and other animals feed on meat of these carcasses. This can have public health implications and attract MSBs to areas where they come into conflict with people such as close to airports. Losses from domestic livestock may supply necrophagous birds with high amounts of meat from animals dying naturally.

However, carcass incineration plants using a dry rendering process, could be provided to all major towns to process these carcasses in the proper manner. These plants should process the solid waste generated from the slaughterhouses as well as the places of illegal slaughter. The products of the rendering plants are widely used as meat meal/bone meal. The slaughterhouse waste can also be subjected to bio-methanation as resources recovery. In that case, a balance between the food requirements of necrophagous birds and carcasses to be processed at incineration plants is a major challenge.

**BOX 4. CARCASS DISPOSAL IN SPAIN, A LONG TRADITION OF CO-OPERATION WITH VULTURES**

Carcass disposal has been regulated in Spain since the early 50’s, whatever its origin (Slaughterhouses or livestock producers) made the burial process mandatory. However, people saw in vultures a friendly association: they drop off carcasses for the birds and vultures reduced amounts of meat to just skin and bones in minutes. Thus, burial of carcasses was a practice constantly overlooked for a long time in Spain. Slaughterhouse remains and carcasses were dropped off usually together at “muladares”. These were specific places, usually in the vicinity of inhabited villages (< 2 km away), where a wide range of producers dropped off the bodies and remains of dead or slaughtered livestock. In other circumstances, each slaughterhouse or big farm had their own dumping place due to the amount of byproduct produced. For a long time, since the first breeding censuses in the 70’s, Spain is the only European country where the griffon vulture (Gyps fulvus) population is quite large and plays an important Ecosystem service (Camína 2004, Robles 2010) permitting birds to process large amounts of meat. Egyptian Vulture (Neophron percnopterus) and even Cinereous Vulture (Aegypius monachus) in certain specific locations could also support this process.

However, carcass disposal at rubbish dumps or feeding sites sometimes does not have expected results with carcasses not consumed. Reasons for this are varied, but often related to a seasonal or infrequent presence of vultures in the area; carcasses not being appropriately sited and preventing birds from landing or taking off. Figure 15 shows an example of carcasses not consumed by scavengers in Northern Spain. In this area, it was not common to see vultures between November and May, which led to animal corpses building up and a potential range of environmental problems.
5.5.2 Impacts of slaughterhouses

a) Negative Impacts

- Spread of zoonosis:

The term “zoonosis” refers to a process whereby an infectious disease is transmitted between animals and humans or vice versa. Transmission of zoonosis usually occurs through a vector. Up to three different categories of zoonosis have been defined (International Livestock Research Institute 2012). Firstly,

- Endemic zoonoses affect many people and animals are responsible for the great majority of human cases of illness (estimated in a 99.9%) and deaths (96%) and reduction in livestock production as well. Examples are: brucellosis, leptospirosis, and salmonellosis.

- Epidemic zoonosis is those that typically occur as outbreaks like anthrax, rabies, Rift Valley fever or leishmaniasis. They are much more sporadic in temporal and spatial distribution than endemic zoonosis but may be more feared because of their unpredictability and in some cases, severity.

- Finally, there are the emerging zoonosis newly appearing in a population or have existed previously but are rapidly increasing in incidence or geographical range.

Ethiopia is among the top 20 countries in the world; for prevalence of endemic zoonosis (2nd), livestock keepers’ poverty (3rd) and protein energy malnutrition (2nd). The two other countries from the RVRSF region present within these rankings are Sudan and Egypt. Human workers at slaughterhouses have been considered as sentinels against the spread of the Rift Valley Fever Virus (RVF) because the high prevalence among that group (Al-Azaqui et al. 2013). In some domestic animals, the mortality attributable to RVF can approach 10%. In addition, spontaneous abortion occurs in almost all pregnant livestock if infection occurs during pregnancy. It is transmitted by contact with contaminated body fluids of infected livestock during animal husbandry or processing.
- Carcasses or remains from slaughterhouses directly into water courses:

There is at least one known case of a carcass incineration plant in Spain that was fined for dropping processed meat collected under the BSE surveillance programme into a stream (A. Camiña, pers. obs.).

Sick animals often die near water sometimes carcasses may lay inside the water streams or wetlands (Figure 16).

- Poisoning and veterinary drugs:

This considers both intoxication (unintentional) and poisoning (intentional). Intoxication of MSB’s is likely less common within the RVRS flyway. However, unintentional may be more widespread because the different nature of the lethal substances for birds. These substances involve rodenticides or poison employed to fight against small rodents and other pest supposed species present on rubbish dumps or veterinary drugs used for livestock treatment. The use of Diclofenac in India (Oaks et al. 2004) reduced the population of Gyps vulture species by 99% within a few years (Cuthbert et al. 2011). A low percentage of that drug in a corpse was enough to kill vultures feeding on it leading to the decimation of local colonies. Within the RVRSF twenty five probably poisoned raptors have been reported at slaughterhouses in Sudan (Hasnim 2013).

a) Positive impacts

- Ecosystem services:

It is probably the best example of how MSBs in large numbers may contribute to the removal of large amounts of meat at minimal costs for humans whilst also avoiding the emission of greenhouse gas that otherwise would be generated by means of incineration. In Spain, Camiña (2004) calculated that the entire Griffon Vulture population required 23% of the total amount of carcasses (tons of meat) available in the entire country for surviving and rearing their offspring each year.

After the appearance of BSE in Europe in 2000, the European Commission established several mandatory regulations to the EU Member States in order to control the use of animal by-products. BSE was considered a health problem for people. It included control of any carcass remains from both slaughterhouses and livestock producers that must be destroyed at specific incineration plants. The main reason was to prevent the prion (pathogenic cause of the disease) entering into the food chain and thus the potential spread to humans.

Carcass removal programmes were established at regional level with the purpose of destroying corpses through incineration. Well designed trucks collected all remains from farms or specific locations where producers brought their carcasses. In the case of slaughterhouses; due to the higher amount of residuals generated, a specific vehicle was devoted for each single facility. Carcass removal affected cattle, sheep, goats and pigs. Costs of all this process was subsidized by the EU, National and Regional Governments. This system was blamed on encouraging zoonosis spread via trucks displacement between different locations and farmer producers, and also affecting biodiversity by reducing food available for scavengers (Tella 2001) and increasing GHG emissions through incineration. Robles (2010) compared the costs of destroying carcasses at incineration plants –despite being subsidized- with those provided by vultures.
BOX 5. MANAGEMENT OF RUBBISH DUMPS AND FEEDING SITES IN RELATION TO WIND ENERGY DEVELOPMENT AND ENVIRONMENTAL IMPACT ASSESSMENT (CASTELLON PROVINCE, NE SPAIN)

This is an example of the interaction of several key productive sectors into the waste management. It involves EIA process, wind energy development and the management of both rubbish dumps and feeding sites for vultures involving local communities. In 2004-2005, 265 turbines were deployed at Castellon province (NE Spain). The area hosts an important Griffon Vulture (Gyps fulvus) population of nearly 250 breeding pairs. The EIA and preconstruction studies predicted a low collision risk and impact on vultures. Turbines became operational in early 2006. However, by time of deployment, BSE had appeared and the carcass removal programme was under implementation. Since late 2005 all livestock carcasses were collected and transported to an incineration plant. After two years of operation of the turbines in early 2008, up to 360 Griffon Vultures had collided and a decrease in the local breeding vulture population recorded. Suggested reasons for this there were 1) lack of available food for vultures in the field because of carcass removal 2) closure of all the feeding sites –illegal or not- in the area 3) vultures had started to feed on a rubbish dump just located a less than 800 metres from the turbines. As a consequence the Court of Justice in the region decided to shut down the turbines until mitigation measures would be implemented. The existing fatality rates were illegal under the Birds Directive in Europe. Mitigation measures involved: the sealing of the rubbish dump covering the waste to deter vultures from feeding close to the wind farm; and the opening of two vulture restaurants far from the turbines to avoid collisions and attract birds away from the site. It also included a daily monitoring programme of birds feeding at vulture restaurants, using the rubbish dump and breeding surveys to assess the effectiveness of these measures. It took 2.5 years for the developer to get the permit to put the wind farm operational again. Since then, the vulture restaurants are provided with a 3,000 kg of pigs per week. After provision and vultures being feeding there, all the remains of carcasses such skins and bones are removed.

By 2010 the Griffon Vulture breeding population already recovered to the levels previous to the deployment of turbines. The percentage of fatalities has been reduced by 68%. The rubbish dump has been partially sealed and the number of griffons feeding there was almost zero.

Sealing the rubbish dump required key decisions regarding its closure and its placement in a different location. It also affected local communities as taxes would be levied to pay for the additional costs of waste management into the new location.

Source: Camiña et al. (2011) and unpublished data.
5.6 Other waste impacts: sanitary, military, toxic and hazardous waste

As it has been described in 5.3 solid waste is mainly disposed of at landfills, and mixing hazardous and non-hazardous waste has very dangerous consequences on human health and the environment (Table 4). This waste type must be properly disposed in special hazardous waste landfills, and specialized disposal or incineration may also be practiced for healthcare wastes. However, in many parts of the world, where uncontrolled open dumps are still common, all waste tends to be dumped together, regardless of its origins or its hazardous nature. Given this mixture of material, it is possible for MSBs to ingest food that is contaminated with toxic substances and succumb to poisoning elsewhere, though this has not been recorded yet within the RVRSF. They can poison birds causing sub lethal impacts on physiology, behaviour and fitness, so MSBs can be intoxicated along the flyway and suffering consequences on breeding areas. This impact could be underestimated because some birds of prey may have died from biologically accumulative and persistent toxic chemicals (especially heavy metals) which were in intoxicated prey species. In the case of obsolete pesticides, they are extremely toxic chemicals and are improperly stored or discarded in abandoned sites, posing serious risks to human health and the environment. Through soil, water, and the food chain, the pollutants accumulate in the fatty tissue of both humans and animals, and residues find their way into the blood stream. Some of these chemicals are proven to cause cancers, birth defects, and neurological problems (Lagnaoui et al. 2010).

Primarily, high-volume generators of industrial hazardous waste are the chemical (including solvents), petrochemical, petroleum, metals, wood treatment, pulp and paper, leather, textiles and energy production plants (coal-fired and nuclear power plants and petroleum production plants) and pesticides waste. Small- and medium-sized industries that generate hazardous waste include auto and equipment repair shops, electroplating and metal finishing shops, textile factories, refrigerators, paint, a range of cleaning products, batteries and such automotive products as lubricants, hospital and health-care centres, dry cleaners and pesticide users. Uncontrolled dumping of industrial waste can be stored on permeable ground, and aquifers underlying dump site can be heavily polluted by toxic chemicals as heavy metals or high chloride, nitrate and sulphate compounds. Some of the countries within the RVRSF have industries that frequently dispose of their wastes into rivers, lakes and or wetlands directly or indirectly through the drainage lines (Birdlife 2013, UNDP 2006).

Health-care facilities can contaminate groundwater through wastes and wastewater containing infectious pathogens and pharmaceuticals (Taylor & Allen 2006). Research institutions may also employ solvents, other chemicals and radiochemical, some of which are very hazardous to human health. If these wastes are dumped in open landfills, they could intoxicate or infect feeding birds, which could be then vectors of diseases.

Military waste includes fuels, solvents and other chemicals, and with the possible exception of high explosives and ammunition, a large number of potential organic and inorganic impacts for these types of waste are coincident with industrial waste (Teaf et al. 2006). Military waste also includes groundwater and surface pollution resulting from deployment of explosives in military conflicts, including damages to industry, traffic facilities, water supply infrastructures and municipal sewage.

Finally, plant treatment, agricultural and pest control products were used in large quantities as defoliants or to keep strategic militarily sensitive areas clear of vegetation or nuisance insects. And on many military properties, illegal and/or uncharacterized waste dumps were established, so that no information is available about the chemical composition of the waste dumped or the length of time the dumps were in use and they could be being used by MSBs with consequent risk of intoxication.

A number of activities associated with mining operations could produce high impacts to birds using wetlands through direct impact on groundwater quantity and quality for open pit o surface mines, as well as oil and gas mining (via wells) because mobilization of metals and metalloids due to low pH values in acid mine drainage, leaching of toxic substances and activities directly linked to mining operations, often in their direct vicinity, such as inappropriate usage, handling, storage or spillage of chemicals employed in ore treatment, underground or surface traffic, heavy mining machinery, workshop or refining work operations. Waste rock piles from halite mining commonly contain large amounts of easily dissolved salt and groundwater and surface water bodies are commonly impacted by salty waste water during active mine operations (Teaf et al. 2006). Likewise, when an open mine is fully excavated and subsequently closed, it often fills with groundwater, forming a lake that can attract waterbirds. It can be a serious problem when water with dissolved toxic waste from metal mining is deposited in non-sufficiently waterproofed or well-constructed ponds. Breaking toxic waste ponds can produce toxic sludge avalanches which can destroy several kilometres of rivers and natural wetlands, affecting many species, including MSBs, as it happened near Doñana National Park in Spain in 1998 (Box 6).
BOX 6. AZNALCOLLAR MINING ACCIDENT NEAR TO DOÑANA NATIONAL PARK (SOUTHERN SPAIN)

In the early hours of 25th April 1998, a failure of the tailing dam wall occurred at "Los Frailes" open-pit pyrite mine, near to the Doñana National Park. A spill of 5-6 million m³ of toxic tailings (sludge and acid water) flowed down through the courses of the Guadiamar and Agrio rivers. About 4,500 ha of agricultural land were affected by the pollution. Major fish mortality occurred and birds died as a result of consumption of polluted fish. It took a month for the river water to recover to its original state. After the wastewater flow had entered the river a major cleanup operation started, including the installation of walls to prevent further spreading of contaminants and the removal of contaminated sludge. The pH values of the soil were restored by liming and arsenic was removed by adding iron oxyhydroxides, causing a precipitation reaction. The rupture of the residual dam was caused by a deep landslide, which provoked the movement of a certain section of the wall. Authorities also researched the cause of the disaster. Apparently the dam had a weak construction and warnings of possible breakthrough were neglected. Ecological restoration lasted from May 1998 to December 1999 and it was made through: 1) Clean-up operations removing mechanically toxic sludge and a variable layer of topsoil (10-30 cm) and 7,106 m³ of sludge and topsoil were removed, 2) Organic matter and calcium-rich amendments giving priority to the immobilization of the contaminants, 3) Re-vegetation of Guadiamar River basin, implementing the 'Guadiamar Green Corridor' programme with the aim of providing a continuous vegetation belt for wildlife to migrate along the Guadiamar River basin between the Doñana (south) and the Sierra Morena mountains (to the north). The application of calcium rich alterations for immobilization of trace elements and improvement of soil conditions and the development of plant cover played an important role in the restoration of the physical, chemical and biological properties of these contaminated soils. Assisted natural remediation was used at a large-scale to solve a serious trace element pollution problem. A few years later the affected area was apparently recovered, but short and long-term wildlife monitoring reported levels of metals and metalloids, which produced costly sub-lethal effects with a clear potential impact on population dynamics. The cost of restoring the environment reached almost € 90M. The mining company responsible mining of the spill didn’t pay anything of the restoration costs.

Extracted information from Madejón et al. (2009), Baos et al. (2012) http://www.lenntech.com/environmental-disasters.htm#9__Spains_major_waste_water_spill#ixzz2ys6yQJ00
6. BEST PRACTICES GUIDELINES ON ADDRESSING MIGRATORY BIRD CONSERVATION IN THE WASTE MANAGEMENT SECTOR

6.1 Introduction and Legal framework

Due to the complexities with legal and regulatory frameworks across the flyway it has not been possible to undertake a complete review of all legal and regulatory regimes in regards the differing waste management sectors of concern. We were reliant and informed and direct interested parties to the local reports by the country Birdlife Partners such as Al-Duais (2013), Zaid (2012), Al Mengistou (2012), Atrash et al. (2012), Hashim (2012) or comprehensive reviews for the whole region (El-Moghrabi 2014). However, we have included all the agreements and conventions signed by all the countries (Birdlife 2014), Appendix C.

6.2 Site selection of waste disposal sites, treatment and the strategic approach: Environmental Impact Assessment.

Environmental Impact Assessment (EIA) is the process which identifies the both positive and negative environmental effects of any development proposal. It aims to avoid, mitigate, reduce and offset any adverse impacts. Its effectiveness is relevant to individual projects as it is site specific, which allows little opportunity to consider the cumulative impacts. There is a need to consider trans-boundary issues and mechanisms for intergovernmental co-operation at a flyway scale.

Strategic Environmental Assessment (SEA) offers the opportunity to address cumulative and landscape level impacts and ensures strategic development which integrates environmental, social and economic considerations at a regional or national scale. SEA is a ‘plan-level impact assessment’. Its purpose is to ensure that the environmental consequences of a proposed policy, plan or programme, such as a regional development strategy, are appropriately addressed at the earlier stages of the decision-making process together with social and economic considerations. It provides an opportunity to incorporate the outputs of biodiversity and nature conservation policy-making into the planning of infrastructure development.

SEAs and EIAs are mandatory in much of the world and are required by many international donors and financial institutions as part of their loan approval processes. They are also recommended actions under the principal biodiversity conventions (see Annex 1). A common constraint of both EIAs and SEAs is the adequacy of reliable baseline information on the biodiversity importance of sites (such as a site's flyway importance for a migratory species).

The Migratory Soaring Bird Project has a sensitivity map for assessing sites of significance for soaring birds. This map can generate all know information about soaring birds within a set distance of the site. Please see http://migratorysoaringbirds.undp.birdlife.org/en/sensitivity-map

Often they fail to take into account the indirect impacts of a project or a project “area of influence” i.e. impacts that would not have occurred without the presence of a project.

When EIAs have been carried out effectively and have identified a necessary mitigation and compensation, such measures may not be implemented effectively and there may often be an inadequate long-term management plan and proper post-construction monitoring. Such problems may be exacerbated by limited capacities and resources within governmental organizations to manage and review EIAs and for NGOs and other stakeholders to scrutinize and contribute to them.
6.2.1 Criteria for Environmental Assessment

All projects and strategies should adhere to the mitigation hierarchy to ensure impacts are avoided or reduced, impact assessments are essential in this process. EIA procedures and methods generally include the following steps:

1. Project screening

All waste management projects should be screened to determine whether they are likely to have a damaging effect on MSBs and the surrounding environment. These projects should be subject to a detailed EIA, and then this should be carried out to the highest standards using the most up to date best practices. Screening should consider all possible types of impact (both direct and indirect).

Screening is generally based on the existing information and as a minimum, use existing lists and maps for identifying protected areas and other important areas for MSBs (e.g. Ramsar Sites, IBAs), and the most up to date information regarding the flyways and bottlenecks (i.e. the Migratory Soaring Bird Sensitivity Mapping Tool developed by Birdlife International, available at: http://migratorysoaringbirds.undp.birdlife.org/en/sensitivity-map

Decision makers and competent authorities should consider the entire area of influence of a project. The most threatening projects for MSB's would be those which have one or more of the following impacts:

- Impacts on sites that support large numbers of MSBs during certain time in the year; bottleneck IBAs (especially if the site gathers a high proportion of the national or flyway population; conventionally > 1%).
- Impacts on threatened MSBs species, especially those globally threatened (i.e. IUCN Red listed) and other MSBs considered of having an Unfavourable Conservation Status (see point 3. Glossary of species
- Impacts on site that may be of critical importance because they support MSBs species within an area that has limited alternative foraging and feeding opportunities.

2. Scoping

Scoping determines the content and extent of what needs to be investigated to generate the ecological information to be submitted by a developer to a designated national authority. Scoping should also provide a basis for participation and consultation with key stakeholders is important to focus on key issues. There are rarely adequate resources available to study all potential impacts and an all-inclusive approach can dilute key messages. However the potential impact on the ability of the flyway to function and on MSBs should always be considered in this region.

Scoping and impact assessment should be seen as two formal rounds of iteration, allowing the EIA process to be adapted as necessary to deal with any previously unforeseen issues as more information becomes available. Initial impacts will often have knock-on or indirect effects on MSBs populations because of the interconnected processes within ecological systems, (e.g. off-site, downstream impacts on water quality, indirect effects on prey biomass mediated through food-chains). Secondary induced effects are also common (e.g. effects of power lines).

The second aspect of scoping is to determine which potential impacts are likely to be significant to require attention in the assessment. This can be difficult because the actual impacts of a project will depend on the involved species (and in some cases populations) and this cannot be easily determined without further study. Assessment of the potential significance of impacts will be particularly difficult for new projects, or those in less studied regions or habitats. Thus, the scoping assessment will often need to take into account high levels of uncertainty and follow an appropriate precautionary approach.

It is also important that the scoping process should stipulate appropriate methods for determining baseline conditions and assessing impacts (see Steps 4 & 5). For example, surveys must incorporate seasonality and allow adequate lead-times for the study of biodiversity. Clear decision-making criteria with respect to biodiversity/MSBs should also be included in the scoping statement. (See also Step 6 on Evaluation).
3. Consideration of alternatives

EIAs should include a full consideration of alternatives as thoroughly as possible in an EIA. The principle aim at this stage is to avoid or minimise the most damaging impacts; whilst also looking for any opportunities for positive environmental benefits.

Consideration of alternatives should not be restricted to location and flyways. All options for reducing impacts such as the timing of construction, design, construction methods and operational management should be investigated; e.g., the selection of appropriate power-lines and deflectors can significantly reduce the risks of electrocution and bird collision. The no project option should also be considered to aid the decision making process.

4. Baseline review and MSBs population assessments

This step aims to define distribution (temporal and spatial) and their importance of MSBs populations. It is important to remember that baseline conditions are defined as the condition of biodiversity in the absence of the proposed project whilst taking into account likely trends.

The baseline assessment will need to assess the importance of the project site and its zone of impact in relation to local, regional, national, flyway and global populations, and the temporal nature of any importance, e.g., breeding, wintering and migratory seasons.

Baseline assessments for EIA should collate and analyse all relevant existing biodiversity data. This will normally need to be supported by detailed site-specific surveys. The appropriate design and implementation of adequate baseline surveys is therefore a key component of a good EIA. The bird survey and monitoring methods are relatively well tried and tested some standard texts (e.g. Bibby et al. 2000, Hill et al. 2005). It is critical that appropriate methodologies are employed to effectively evaluate the baseline.

Generally, the baseline field survey should include a minimum of 12 month to determine the seasonal bird significance of the site presence, covering an annual cycle, with a special focus to the migration periods. There may be justification for reviewing the needs for survey in specific periods of winter or sometimes even summer should the baseline habitat characteristics be extremely poor and barren. The case for this will need to be elaborated upon and explained fully with migration periods still in need of assessment.

5. Identification and prediction of main impacts

An EIA should assess impacts across the project’s combined ‘impact zone’ as estimated for all the proposed activities during construction, operation and decommissioning. This should take account of the geographic area affected (include on- and off-site activities) and the timing, frequency and duration of each activity. Impacts should then be compared with the baseline assessment, if possible quantifying impact magnitude, extent, timing, frequency, duration and reversibility in terms of ecological outcomes.

Predictions on the effect of an infrastructure, either involving solid or liquid wastes, on MSBs are quite difficult. The most challenging it is to evaluate those positive, negative or even global effects.

6. Evaluation and assessment of impact significance

It is important to relate any predicted impacts to legal obligations and environmental policies. Thus with respect to MSBs, the competent authorities should ensure that impacts will not conflict with obligations related with international conventions and processes such as Convention on Biological Diversity (CBD) the Ramsar Convention, Convention on Migratory Species (CMS), or Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) and national legislation, conservation priorities or biodiversity action plans.

Whichever the method employed for predicting impacts, there is likely to be considerable uncertainty, especially in relation to the long-term and large-scale impacts. Thus, a precautionary approach should always to be considered, setting thresholds for determining the significance and assuming that a reasonable prediction of an impact is valid until proved otherwise.
7. Recommendations for mitigation and compensation

Mitigation measures should normally firstly explore all options for avoiding negative and promoting positive impacts on MSBs before resorting to mitigation measures that seek to reduce impacts. This may entail desisting from specific activities that may be particularly damaging. Otherwise, there may be selected or seeking for alternative locations that avoid particularly important sites (e.g. those sites critical for MSBs) or sensitive times (e.g. nesting periods).

Compensation/Offset is the last resort and to address any residual impacts that may occur. For best practice on offsets please see the Business and Biodiversity Offsets Program (BBOP) principles and criteria (available at: http://bbop.forest-trends.org).

8. Production of Environmental (Impact) Statements from a MSBs perspective

An Environmental Statement (ES) is generally produced by the proponent and submitted to the competent authority for approval. The purpose of the Environmental Statement is to document the results of the EIA process and to highlight key issues.

The ES should be:

- Based on the best and most up-to-date scientific data.
- Clearly written in a language which a non-specialist can understand.
- Available for public review (including in other countries/jurisdictions where appropriate).

It should include:

- Information on goals/objectives for MSBs conservation at different geographic scales.
- Consideration of implications, which, for MSBs, should describe how any identified impacts relate to any legal obligations; international agreements (raptor MOU and AEWA, CMS) and broader relevant MSBs priorities and objectives.

9. Decision making

This step has two phases:

a) EIA review. Decisions about whether or not to give consent for infrastructure projects may rest on the adequacy of the EIA process or the information provided in the ES. If ES is inadequate, the developer will be asked to provide additional information and the development consent decision process will be delayed until then.

b) Implications of results. EIA may provide evidence of irreversible and highly significant effects which cannot be avoided if the proposed project is undertaken. As a general rule, avoid pitting conservation goals against development goals. It is important to balance conservation priorities with economically viable, socially and ecologically sustainable solutions. For important biodiversity issues, the precautionary principle must be applied.

10. Post-construction monitoring, auditing and follow-up

It is important to recognize all predictions of biodiversity responses especially over long time frames. Management systems and programs, including clear management targets and appropriate monitoring, should be set in place to establish whether the agreed SMART (Specific, Measurable, Achievable, Relevant, Time-bound) biodiversity objectives have been achieved.

Provision should be made for emergency response measures and/or contingency plans.

Suitable post construction monitoring of impacts on MSBs must be undertaken, preferably using a Before-After Control-Impact (BACI) approach. Details of the monitoring programme must be set out in the project EIA. Monitoring feedback will inform whether further mitigation measures are required in the operational phase of the project. Post-construction monitoring needs to distinguish short- and long-term effects and impacts and to enable these to be satisfactorily addressed.
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6.3 Guidelines on Solid Waste

Solid waste management should ensure that there are no negative impacts on human health and the environment. Solid waste management may and must be challenged to help conserve MSB populations, the viability of the flyway to function, and to decrease risk of mortality during migration. However, it only shall be used as complimentary of a well guaranteed and managed network of protected areas, required to preserve MSBs.

Solid waste should be managed in order to decrease impacts on bird’s mortality, improve individual fitness and increase safe food availability. Despite all described negative impacts of solid waste to birds, to date most birds species feeding in rubbish dumps show high increasing populations along the world (see Point 4). In order to ensure conservation friendly solid waste management and to guarantee the efficiency of the conservation measures following guidelines are proposed, including recommendations of potential economic benefits of using well managed landfills as bird-watching localities.

Scavengers provide critical ecosystem services (Robles 2010) and can remove organic waste safely and economically than for instance burning or burying, also preventing the emission of GHG (see Point 4). Legislations should favour the role of scavenger birds in the management and elimination of animal by products. These sites favour strict and occasional scavenger MSBs along the flyway and they could be also used to recover resident populations during the rest of the year.

6.3.1 Solid waste management guidelines

There are a lot of specific solid waste management guidelines (see e.g. EPA 2002, Schmoll et al. 2006, OECD 2007, Soós et al. 2013a, 2013b) indicating that proper waste management helps to protect human health and the environment and preserve natural resources. Solid waste should be managed through planning in design or improving a waste management system that includes entire rural and urban areas and appropriate forms of collection and final disposal.

In many developed urban centres poor waste management is linked to uncoordinated institutional setup to implement the existing policies, strategies, legislations and development programmes. Effective legislation at national and regional levels regulating waste management should be implemented. In addition to this, there is a need to undertake intensive awareness campaigns targeted to specific stakeholders and decision makers. If waste management were handled properly, it could have been possible to generate significant amount of income and environmental benefits, including job opportunities for citizens and possible tax revenues.

Waste management policies, strategies and legislations are the basis for achieving a clean and healthy environment for the safety of humans, livestock, wildlife, birdlife and ecosystems.

Solid waste should be managed through an integrated solid waste management (ISWM) approach including how to prevent, reduce, recycle, and manage solid waste in ways that most effectively protect human health and the environment, helping also to reduce GHG emissions and the effects of climate change (EPA 2002).

An ISWM firstly involves evaluating the local needs and conditions identifying the most appropriate waste management activities. Disposal should take place at properly designed, constructed, and managed landfills. Each of these activities requires a careful planning, financing, collection and transport.

1) Recycling and Composting: organic materials are rich in nutrients and can be used to improve soils through composting. Recycling reduce solid waste and number of landfills and also leachate production. However, recycling and reuse are commonly more expensive to produce than the items they replace and in the most of RVRSF countries recycling is an exception, that occurs informally at landfills, uncontrolled rubbish dumps and even on streets (Table 4). Wastepickers often scavenge and collect materials for reusing or sale without any organization, supervision, or regulation. Involving the local community working within unregulated waste recycling in the process in moving toward an organized or formal water management programme can improve both the quality of their working conditions and the local environment creating a long-term employment strategy.
2) Disposal: In some RVRSF countries, waste that cannot be recycled use to be dumped indiscriminately, or disposed of in an uncontrolled manner without management (Table 4). Controlled waste disposal at well established and managed landfills can help to improve and protect the health while preserving valuable environmental resources.

*This highlights the need for engineered land fill solutions to prevent indiscriminate dumping of waste.*

They should be far from airports to reduce risks of plane crashes with birds, and from drinking water sources to avoid birds from feeding on rubbish dumps and roosting on water sources pollute water. *Hazardous waste should be collected and treated separately in specialized facilities and green and organic waste should be collected and separated from non-hazardous inorganic waste to enhance recycling and composting and to facilitate use by birds.*

3) Combustion: Another way to handle solid waste is through combustion or controlled burning which helps to reduce its volume. However, although burning green waste causes little nuisances, large scale open burning of municipal waste can be strongly harmful for the health of people and MSBs feeding on these waste disposal sites because dioxins emissions. Once generated, dioxin settles in vegetation and then accumulates in fats, having carcinogenic effect, immunological deterioration, disruption of reproductive ability, nervous and hormonal system breaks. *The combustion process must be properly managed because all the above.*

However, it is important to highlight that in many countries of the RVRSF, the proper integrated management of solid waste is generally hampered by technical, administrative and financial shortcomings (Al-Yousfi 2008).

### 6.3.2 Solid waste management guidelines to conserve MSBs

Solid waste disposal sites have to be managed in order to decrease impacts on birds mortality and increase fitness through ensuring a safe food supply as a complimentary measure of a well designed and properly managed network of natural protected areas. Three management approaches are proposed in open rubbish dumps (for detail recommendations, see Appendix A):

- Design the solid waste facilities ensuring safe food resource for birds. This requires to the *involvement of biologists with knowledge in MSBs ecology in the early planning and design of waste disposal sites.*
- *Due to economic and political situation within the RVRSF countries, a first step would be an inventory of existing dumping places and their categorization according to their relevance for MSBs. Such prioritization would let to prioritize those locations supposing a higher risk or having relevance in terms of conservation.*
- Closure of those dumping sites with poor sanitary conditions in order to produce a low impact on MSBs populations; recommendations to preserve MSBs only can be achieved when done in conjunction with an integrated solid waste management approach.

#### 6.3.2.1 Adapting solid waste facilities to integrate bird concerns

The appropriate guidelines to use landfills as feeding sites for birds are:

1) *Organic waste must be collected and separated from inorganic waste to prevent the ingestion of toxic substances, entangling in plastic, wire, or other debris, and injuring birds.* Disposal of organic waste at waterproofed sites with appropriate leachate collection systems to be treated. According to weather conditions the oldest organic waste can be removed to be used for composting. In other words, *organic waste (especially food discards) would be used to feed birds before being composted.*
2) There must be clean water ponds available for birds providing areas to drink and bathe. This water must be renewed periodically according to weather conditions and old water collected for treatment with leachate. It could be even come from appropriated waste water treatment of the leachate, such as the use of a Sustainable urban Development (SUDS) filtration system.

3) Landscaping of the site should be designed with the use of native species of plants, using vegetation in order to reduce the visual impact and contribute to the landscape. Vegetation can provide roosting and feeding sites, and places for other facilities such as hides, over the last five years at Council of Vitoria-Gasteiz, (Northern Spain) promoted the use of the Gardelegi rubbish dump as a birdwatching point (see Box 8). Hides must be constructed avoiding bad odours, never facing dominant upwinds but downwinds.

4) Access to the landfill must be controlled to prevent injuries, disturbance and hunting. This can be done by building a fence around the site. A buffer zone around the site - should be also regulated in order to protect threatened MSBs from illegal hunting. Fences must also prevent the access to the dumping sites of mammalian scavengers. It will prevent human-predator conflicts. Similarly, fences will also help to prevent contact between domestic birds such as chickens or ducks with wild ones in order to prevent diseases transmission. Fences diverters must to be used to minimise the risk of bird collisions.

6.3.3 Closing solid waste facilities and MSBs conservation

It is possible that some current waste sites can’t be upgraded to ensure they are safe for people and birds, or are due to be decommissioned. If these sites are important for birds closure must be managed in order to minimise impact through following the guidelines below:

1) Closure of the dumpsite must be timed to coincide with a time when it is not extensively used. Some sites are important during Spring or Autumn migration while others are for wintering populations. The best time for the closure works is summer, when the most of migrants are out of the RVRSF area and the most of wintering populations have not yet arrived to the area.

2) If a proper managed area has not been guaranteed by the time of the closure of a site which is important for MSBs, a managed feeding station (see 6.5) should be created and sustained to feed birds. These feeding stations must be working until a new site will be created the closed dump site should through habitat restoration create a sustainable area to be used for wildlife and used for MSBs.
6.4 Guidelines on Sewage

The main goal of the sewage/wastewater plants is to reduce any harmful impact on human health and the environment. A few sewage/wastewater treatment systems are based on creating artificial wetlands suitable for gathering large amounts of birds (Fuller & Glue 1980, 1981; Frederick & McGehee 1994; Murray & Hamilton 2010).

Traditional water treatments do not provide for birds using these sites because the type of treatment and the associated infrastructures are not viable. Nevertheless, wastewater treatment wetlands are a valuable resource for waterbirds. Wastewater treatment wetlands could potentially have detrimental impacts on bird health due to pathogens, heavy metals, chemical contaminants and human disturbance. Despite these possible adverse impacts, it is noteworthy to recognize the value of wastewater treatment facilities as a suitable habitat for birds. Thus sewage/water waste should be managed in order to minimize risks for the birds and people. The sites can be enhanced by means of proper design, favouring appropriate habitats and food resources. The appropriate guidelines to use develop the potential of WSPs and CWs as good sites for birds are:

1) **CWs design must take into account as much habitat diversity as possible.** It will favour a higher diversity of bird species. It will have an irregular depth, irregular perimeter, islands, gradual slopes (for detail recommendations, see Appendix B).

2) **Native Shrub planting:** this can be targeted to areas of potential disturbance to wildlife balancing the needs of a barrier to disturbance against the need to maintain an open vista near water to attract water birds. 1) Organic waste must be collected and separated from inorganic waste to prevent the ingestion of toxic substances, entangling in plastic, wire, or other debris, and injuring birds.

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**BOX 8. USE OF A RUBBISH DUMP FOR MSB BIRDWATCHING AND PUBLIC AWARENESS CAMPAIGNS**

Rubbish dumps do not only provide direct conservation for MSBs. They may serve for public awareness and education. The development of facilities on site for birdwatching may contribute to this awareness due to the opportunity to watch the birds while feeding. This is the case of the city Council of Vitoria-Gasteiz municipality, a public body from the Basque Country, Northern Spain. In 2011 they reached an agreement with the private company managing the Gardelegi rubbish dump site. This landfill is visited by Griffon and Egyptian Vultures, White storks, both Red and Black Kites and many other species including mammals. The Environmental Council Department built hides. Monitoring staff guide groups and explain the role of landfill to birds and help to identify the species present. These birdwatching sessions have a small fee per person (2.5 to 4 €/person) lasting around two hours. The activity was launched for the first time in 2011 and it has had a great success to the point where now there is a need to book places in advance.

Source: Gorka Belamendia (Pers. Comm.) and
https://www.vitoria-gasteiz.org/we001/was/we001Action.do?idioma=es&aplicacion=wb021&tabla=contenido&uid=u_259de431_142a24af9c5___7fde
3) **Access to the landfill must be controlled to prevent injuries, disturbance and hunting.** This can be done by building a fence around the site. A buffer zone around the site should be also regulated in order to protect threatened MSBs from illegal hunting. **Fences must also prevent access to landfill sites from mammalian scavengers. It will prevent human-predator conflicts.** Similarly, fences will also help to prevent contact between domestic birds as chickens or ducks with wild ones in order to prevent diseases transmission. Fences diverters must be designed to reduce collision incidents.

4) **Carcasses from dead birds will be removed to prevent the spread of diseases.** Any carcass removal should be linked with a post-construction monitoring protocol and be recorded.

5) In case the facility is used with **birdwatching purposes**, hides for birdwatching should be designed and constructed to minimize where possible exposure to bad odours flows according to prevailing winds in the site.

### 6.5 Guidelines on Slaughterhouses

The following procedures are commonly followed when disposing of slaughterhouse remains at a landfill. However, it is possible to adapt the disposal of the remains to benefit MSBs by creating feeding stations or vulture restaurants (for detail recommendations, see Appendix C). These sites need to be assessed for the feasibility of each individual location to act as a feeding site. In the majority of cases such sites will not be open to the public).

#### Legal Framework

1) Governments will develop their respective regulations acknowledging the role of MSBs when providing essential Ecosystem services. These regulations will consider the following guidelines in such a way to establish a **legal conservation framework** ensuring the working procedures of these sites.

#### General

2) **Establish a Database of any disposal site within the RVRSF accounting for rubbish dumps / landfills / slaughterhouses.** Priority should be given to sites close to key bottleneck points, being increased as soon as information is completed.

3) **There is a need of some kind of veterinarian supervision** that ensures the carcasses or remains intended for feeding MSBs are free of medicines of poisons that could affect their survival.

#### Characteristic of the existing sites:

4) The first step will be to **gather information on those slaughterhouses and landfills currently important for the MSBs in terms of food supply and timing.** No new feeding site should be established with the purpose of eliminating carcasses and without taking into account the potential role of MSBs. It may occur that these sites will never be visited and carcasses or by-products decomposed by other means. It is important that during the initial stages of site selection consultation is held between traditional landowners and Councils and the Department of Lands and planning to ensure that the proposed site is a suitable location under the relevant planning and cultural controls. A clearance certificate may also be required. When feasible, locate the feeding sites as far as possible from human settlements or any water source.

#### Planning a new site:

5) **It must be located far from populated areas,** whatever their size, avoiding potential contamination to water courses or groundwater if they exist.

6) **It must be located far enough** to interact with power lines (causing electrocution or collisions), wind farms (collisions) or airports (bird strikes). Distances for each of these infrastructures could vary according to the flying paths of the MSBs and location of roosting and breeding sites.

7) **Feeding sites require of an open area** of 1 hectare wide. This is the size suggested for the vulture restaurants in Spain and Europe, permitting the birds safe landing and take-off.
8) **There is one single access point that remains closed.** Within the feeding site carcasses will be dropped off at a precise site of the facility.

9) **All the feeding site must be fenced** to avoid mammals could enter inside. Fixing the wire underground is highly advisable to avoid these animals and also humans could enter. However, because the presence of i.e. baboons and other primates, feeding sites will not be 100% free of such or related easy climber intruders. Experiences of fencing already exist even reinforced by regulations as occurs in the EU. Other times, fences may be placed at a lower level compared to the disposal area in the feeding site. Usually, the site is placed on the top surrounded by a steep area favouring the MSB to enter and an easy take-off just spreading wings. The effect of fences on MSBs does not seem a serious problem of collision.

10) **It is important that all not consumed remains be removed.** The remains should be immediately covered after each disposition with sufficient soil to discourage odours, flies and vermin. Lime may be spread on the waste before covering to discourage vermin. All these operations should be done in a specific area within the feeding site.

11) **Perching sites:** complementary measures such as the plantation of some vegetation around the site as perching place may be implemented.

12) **Censuses:** All the information on the number of birds present, ages or re-sightings of marked birds should be gathered specific monitoring programs may also be implemented for the key migration periods.

**Operation and maintenance:**

13) **Carcass disposal** will be managed by the slaughterhouse staff. Care should be taken to avoid any other people could drop off carcasses, even those potentially contaminated or intentionally poisoned.

14) **The vehicle** for carcass transportation will be used for the only purpose of supplying the feeding site with food. After each disposal, it will be decontaminated and washed accordingly.

15) **The slaughterhouse** will be responsible of the operation of the entire infrastructure: cleaning of remains, fence maintenance, controlling the amount and type of carcasses dropped off.

16) **All the previous points 12 to 14** must be registered in some way (a book or other appropriate manner) to facilitate supervision.
BOX 9. “VULTURE RESTAURANTS”: IDEAL FUNCTIONING SCHEME

In 2001 the Bovine Spongiform Encephalopathy-BSE changed the way of carcass disposal within the European Union. Regulations forced all the carcasses and other livestock remains not intended for human consumption had to be destroyed at incineration plants. The same had to be done with entire animal corpses from the livestock dying at farms. As already explained in this report, this changed the way of carcass disposal as it was being done in Spain. The National and Local Governments established regulations to let the necrophagous bird could continue feeding from “vulture restaurants” (feeding sites).

These are ideal conditions that are all impossible to fulfil within the RSRVF but may provide details on how feeding sites work in other countries for consideration. In Europe there is a high level of Governmental supervision of feeding activity. Food provision is made either by the authorities, authorized organization (NGO) or private company in charge of maintaining the feeding site. Different levels of application of this guideline may be achieved, according to the specific country limitations within the Flyway.

Figure 21.
Scheme of the feeding site with all the elements.
Figure 22.
Different views of a feeding site. Top left: door, top right: fence, bottom left paved area for carcass disposal and bottom right leachate collection.

Figure 23.
Different views of carcass collection and disposal at the feeding site (up), feeding site, cleaning of non consumed remains and disinfection.

6.6 General Risk Assessment and Allocation of Risk and Mitigation Measures and Enhancement

**Table 7.**
Risk Assessment and Allocation of Risk and Mitigation Measures and Enhancement

<table>
<thead>
<tr>
<th>Risk</th>
</tr>
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<tbody>
<tr>
<td>• Authorities and the local private sectors do not possess the necessary practical experience required for the implementation and realization of a sustainable waste management system due to the following circumstances:</td>
</tr>
<tr>
<td>• Absence of qualified personnel on all levels</td>
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<tr>
<td>• Absence of knowledge for implementation and operating,</td>
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<tr>
<td>• Absence of public awareness and involvement,</td>
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<tr>
<td>• Absence of knowledge of the role of MSBs in ecological context</td>
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<tr>
<td>• Absence of knowledge of importance of sites for MSBs</td>
</tr>
<tr>
<td>• Proper integrated management of solid waste is generally hampered by technical, administrative and financial shortcomings.</td>
</tr>
<tr>
<td>• Solid waste dumped altogether at uncontrolled open rubbish dumps, regardless of its origins, hazardous nature</td>
</tr>
<tr>
<td>• Very dangerous consequences on human health and the environment.</td>
</tr>
<tr>
<td>• Resources constraints are mainly blamed for environmentally unsustainable waste management and inadequate public services only prevailing in developed urban centres.</td>
</tr>
<tr>
<td>• Poor waste management related with uncoordinated institutional setup to implement policies, strategies, legislations and development programmes.</td>
</tr>
<tr>
<td>• Solid waste disposal are significant sources of methane, one of the major GHGs.</td>
</tr>
<tr>
<td>• Waste sites are a significant available feeding habitat because natural habitats are highly transformed and capacity of resilience in natural ecosystems along the flyway has probably been exceeded to support the MSBs populations.</td>
</tr>
<tr>
<td>• Dangerous waste sites threat migratory species; hazards causing injuries, illness and death.</td>
</tr>
<tr>
<td>• Birds that land and consume organic materials are entangled in waste, ingest plastic bags, consume toxic materials, drink contaminated water from leachate or are injured by broken glass, barbed wire and other sharp materials.</td>
</tr>
<tr>
<td>• Increasing populations of other bird/mammal species may affect MSBs by displacement or transmission of diseases.</td>
</tr>
<tr>
<td>• Solid waste must be managed in order to decrease impacts on bird's mortality and fitness and to increase safe food, considering landfills as a challenge in order to preserve these populations.</td>
</tr>
<tr>
<td>• Decrease their risk of extinction during migration but also at wintering and breeding areas.</td>
</tr>
<tr>
<td>• Two main management measures to guarantee survival: 1) to design solid waste facilities in terms of being sanitary good to birds, and 2) closure of non sanitary open dumps in order to produce a low impact on MSBs populations.</td>
</tr>
<tr>
<td>• Implementation of safe waste management guidelines to guarantee conservation measures, including recommendations to the potential economic benefits of using MSBs at well managed landfills for bird-watch- ing activities.</td>
</tr>
<tr>
<td>• Actions for slaughterhouse waste management directed towards the creation of a network of feeding stations supplied sporadically with food.</td>
</tr>
<tr>
<td>• Avoid the concentration of resources in a few places, including:</td>
</tr>
<tr>
<td>(a) the need to provide small carcases, which will benefit the smaller facultative scavengers</td>
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<tr>
<td>(b) provide food at times at which dominant, abundant and more generalist species are absent</td>
</tr>
<tr>
<td>(c) Precise location of feeding station to maximize their use by certain species with clear patterns of habitat selection.</td>
</tr>
<tr>
<td>• Make appropriate management of open waste-water treatment plants turning waterbodies into international- ally IBA's as a result of hosting more than 1% of the global population for waterbirds, including some MSBs species.</td>
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<table>
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<td>• Raise and build capacity of municipalities and joint councils on solid waste management sites</td>
</tr>
<tr>
<td>• Training of personnel on waste safety and handling.</td>
</tr>
<tr>
<td>• Educational programmes on integrated waste management systems</td>
</tr>
<tr>
<td>• International waste disposal industry engaged through international cooperation in training and formation programmes.</td>
</tr>
<tr>
<td>• Solid waste management through proper planning. Waste management system that includes entire rural and urban areas and appropriate forms of adequate collection and final disposal of waste.</td>
</tr>
<tr>
<td>• Implementation of an effective legislations regulating waste management at both the national and regional level. In addition, undertake intensive awareness campaigns targeting the population and decision makers.</td>
</tr>
<tr>
<td>• Solid waste managed through an integrated management involving: evaluating local needs and conditions, selecting and combining the most appropriate waste management activities through waste prevention, recycling and composting, and combustion and disposal in adequate landfills. Each of these activities hence require raising and capacity building of local administrations on solid waste management sites and law enforcement in all aspects of the process.</td>
</tr>
<tr>
<td>• Hazardous waste collected and treated separately from the rest of the waste in specialized facilities, regulated and controlled for national legislation. Facilities located away from water resources and MSBs sites /routes.</td>
</tr>
<tr>
<td>• Green and organic waste collected and separated from non-hazardous inorganic waste to facility recycling and composting, and to facilitate use by birds.</td>
</tr>
<tr>
<td>• Abandoned and filled hazardous and non-hazardous industrial landfills should be cleaned up, environmentally remediated and periodically inspected. An effective legal and organization framework for waste services implemented.</td>
</tr>
<tr>
<td>• Legislations must include the Ecosystem Services provided by scavenger birds when removing meat wastes.</td>
</tr>
<tr>
<td>• Organic waste would be directly transformed in biodiversity, favouring the scavenger MSBs populations, decreasing emissions of methane.</td>
</tr>
<tr>
<td>• Guarantee a well managed network of natural protected areas to preserve the MSBs.</td>
</tr>
<tr>
<td>• Enhance the legal protection of at least the 28 bottleneck IBAs that support MSBs while migrating.</td>
</tr>
<tr>
<td>• Develop and implementation of management action plans of these IBAs.</td>
</tr>
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6.7 Assessment and Monitoring

There is a need for an understanding of waste sites use by MSBs and how this changes over time. Such an approach can help identify potential negative effects on birds and other wildlife and to know how, when and where species are using waste sites.

This will help in the identification of these essential sites to MSBs conservation. It is also necessary a post-construction monitoring at new MSBs friendly waste sites to confirm they are safe and important to birds and that the best practices guidelines while addressing migratory bird conservation in the waste management sector have been effectively implemented.

Monitoring should be carried out through standardised study methods along one full year. It would include spring and autumn migration to ensure comparisons of bird distribution and abundance among waste and natural sites and before, while and after transformation of waste sites into new MSBs friendly ones. Standardisation in data collection allows the development of analytical methods which facilitate a consistent approach to risk assessment, aiding the identification of significant impacts while enabling comparisons among sites. Definition of a best practice on both study methods and data analysis should be made and proposed by BirdLife International.

Results of assessment and monitoring should be used to establish indicators to maintain regular environmental audits which will ensure the adoption of environmentally sound practices in waste management systems implementation, including the best practices guidelines on addressing migratory bird conservation in the waste management sector.
7. RECOMMENDATIONS ON OPPORTUNITIES TO ENGAGE WITH AND MAINTAIN MAINSTREAM MIGRATORY BIRD CONSERVATION INTO THE WASTE MANAGEMENT SECTOR

7.1 Integrated Planning Processes

The Benefits of Early and Pro-active Consultation and Joint Working

Any conflict between stakeholders must be solved through communication. Awareness and agreement for successful policies on the waste management sector must be implemented. Within this context, the role of BirdLife International could be essential to work closely with developers and policy-makers to promote MSBs-friendly waste disposal sites (WDS). The private sector should approach the BirdLife Partners before making a project proposal to find out if there are likely to be significant impacts on birds and other biodiversity. The public sector should transform existing non-sustainable WDS according to these best practices guidelines involving all related stakeholders.

Developers, scientists and government institutions should work pro-actively with relevant stakeholders, leaded by BirdLife International, to give tools to implement these guidelines. Among problems to address early and pro-active consultation and joint working are:

- Limited technical infrastructure, plans and strategies.
- Limited human capacities and financial resources.
- Lack of incorporation of stakeholders as complete partners in the conservation and waste management responsibilities.
- Lack of awareness about the importance of MSBs and even biodiversity and most projects use to be performed without an EIA.

The main tools to solve these problems should be application of appropriated legal framework, accurate guidelines on EIA, financial support and capacity building. It is first necessary to achieve that all stakeholders understand and agree the goals and benefits of getting a MSBs-friendly waste management. Active engagement could help to build capacity in institutions and developers to improve implementation of law and best practices and also by providing training and advice). According to Khatib (2011), it is clear that most of the generated solid waste constituencies in most countries of the area are decomposable and recyclable, so if properly managed, such solid waste would provide high opportunities for the development of the socio-economy of the countries, but also it would contribute to conservation of MSBs populations.

It should be clear in the process of planning and consultation that waste management shall:
- Ensure optimal use and protection of the environment.
- Clarify roles and responsibilities and separation between regulatory, monitoring, and executive duties.
- Clarify roles of each stakeholder.
- Facilitate availability of information and the transport exchange among stakeholders involved.
- Ensure transparency of institutional, financial, monitoring, and administration systems.
• Implement the principles of a) "polluter pays", b) self funding and providing services at reasonable prices to people and c) economy scale in planning and developing the services.
• Create incentives to encourage successful practices.
• Penalize parties that do not adhere to appropriate procedures in dealing with solid waste.

At project level, developers should start their engagement with relevant stakeholders as early in the development process as possible, especially with Birdlife International, to identify conflicts at different sites, some of which may not be apparent to the developer. They can also give advice on the baseline required surveys and suitable methodologies for impact assessment. If potential conflicts are identified at an early stage it is much easier to avoid or mitigate, or if necessary, avoid problematic sites altogether. Governments need to incorporate EIA as a priority during the planning and implementation phases of development projects within their boundaries to prevent or minimize the adverse impacts that may result from such projects.

Adopting such an approach makes development proposals more feasible, reduces unnecessary cost and delay, reduces risks of negative publicity and potentially forges long-term progressive relationships between industry and stakeholders to get a MSBs-friendly waste management.

7.1.1 Identifying stakeholders

Stakeholder’s analysis was already made in UNDP (2006) and El-Moghrabi (2014) in each of the eleven countries within the RVRSF.

The major stakeholders can be grouped into the following categories: national, regional and local authority, national and non-governmental organizations, service users and local community groups, private formal and informal sectors (consultancies, waste management business and tourist based on bird-watching enterprises) and donor national and international agencies (especially UNDP and World Bank).

For waste management to be effective all the stakeholders should consider their responsibilities adopting and playing decisive roles. Furthermore, there is a high need for co-ordination of activities between them in the process of planning, implementation, monitoring and evaluation of projects and development programs.

7.1.2 Decision-Making regarding Projects within the Rift Valley Red Sea Flyway corridor affecting designated sites (IBAs and EBAs)

The impact assessment for a WDS project will inform the decision-making process, in terms of whether consents should be given or not, and in terms of what mitigation, and potentially compensation, should be required as conditions according to the best practices guidelines on waste management sector (see point 6).

In this framework, any waste disposal site project should not be included in any designated site, especially those designated as IBAs (Important Bird and Biodiversity Areas) or along the RVRSF corridor, being vital that the precautionary principle of not to damage MSBs and their habitats is applied in decision-making. If it is not possible to select alternative sites to dispose or manage waste, then the Decision-Making process must require compensatory measures to be secured to protect the overall coherence of the goal for which an IBA was designated. Any permitted damage to designated sites is therefore fully justified only as a last option, after trying all other options to protect the site in situ.
7.1.3 Adaptive Management Frameworks

When a MSBs-friendly WDS is constructed, decision-makers should require monitoring of the efficacy of those measures through post-construction monitoring. Ideally, an iterative mechanism or ‘adaptive management’ should be adopted if the proposed adaptation and mitigation are not effective as previously predicted. For further guidance on this approach see Morrison-Saunders et al. (2007).

The adaptive management process only can be effectively implemented if all stakeholders share relevant information, in order to take into account MSBs-friendly waste management. Increased information exchange that is undertaken effectively may lead to greater opportunities for prevention problems and impacts.

To carry out an effective adaptive management it should be recommended the choice of indicators focusing on measuring changes in the degree of use of WDS of MSBs after implementation of the best practices on waste management and measuring changes in the number of MSBs-friendly WDS in each country of the along the Rift Valley/Red Sea flyway corridor.

7.2 Framework to identify good waste disposal sites.

Solid Waste Facilities

• Landfills should be managed as a part of an integrated solid waste management (ISWM) including how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment, helping also to reduce greenhouse gas emissions and slow the effects of climate change.

• Landfill should be located in waterproof geological sites (or sealed by soil liner and artificial membrane), preventing or keeping to minimum vertical percolation of leachate into the ground, to prevent groundwater contamination.

• Organic waste should be collected and separated from inorganic waste; food discards should be used to feed birds in safety points and the oldest organic waste should be removed to be composted.

• Hazardous waste should be collected and treated separately from the rest of the waste flow in specialized facilities and this should be regulated and controlled by national legislation. Similarly, green and organic waste should be collected and separated from non-hazardous inorganic waste to facilitate recycling and composting and to ensure use by birds.

• There should be clean water ponds to birds can drink and bath, which should be periodically cleaned and water should be refilled and renewed.

• The perimeter of STP should be fenced to prevent the access of scavenger mammals and the contact between domestic and wild birds in order to prevent diseases transmission. Fence diverters should be designed to prevent collision incidents.

• The access to the landfill should be controlled to prevent injury, illegal dumping and hunting to avoid disturbing and killing birds.

• The control of rodents and insects populations should be conducted through non-poisoning methods in order to avoid secondary damage on MSBs.

• Dead birds should be removed in order to prevent diseases transmission.

• The vegetation structure near and around dump site should manipulate to avoid visual impact on the landscape and to attract potential birdwatching tourists. Birdwatching infrastructures should be designed and constructed to avoid disturbing of MSBs, avoid bad odours (never with dominant upwind but downwind) and avoid the watching of rubbish, leachate and gas collections systems watching.
Water Waste Facilities

- CWs should be designed to increase diversity of habitats and birds.
- The vegetation structure near and around CWs should be manipulated to avoid disturbing of birds and provide them roosting and breeding sites. New plantations require from autochthonous species and well adapted to the environment in the area. They will act as visual and noise screens against disturbances. At the quietest and safest places other species providing shelter and roosting or even breeding areas for other birds. For this purpose, islands are the most suitable places.
- The access to the CWs should be controlled to prevent the access of mammalian predators and injury, illegal dumping and hunting to avoid disturbing and killing birds.
- The perimeter of CWs should be fenced to prevent access to scavenger mammals and restrict contact between domestic and wild birds in order to prevent disease transmission.
- Hunting around CWs should be regulated and controlled in order to protect threatened MSBs.
- Dead birds should be removed in order to prevent diseases transmission.
- An epidemic-surveillance program might be implemented to detect emerging diseases.
- There might be control of generalist bird’s populations and also invasive species.
- The control of rodents and insects populations should be conducted through non-poisoning methods in order to avoid secondary poisoning on MSBs.
- Birdwatching infrastructures should be designed and constructed to avoid disturbing of MSBs.

Slaughterhouses and carcass disposal

- Feeding sites should be exclusively used for that purpose. No other waste can be disposed at these locations.
- All disposed carcasses should be free of pathogens, toxins, antibiotics and veterinary drugs.
- Mechanisms should be enhanced to be easy, fast and secure in terms of health transportation favouring the disposal of carcasses from slaughterhouses to livestock producers, i.e. providing with specific vehicles. Access to the site must be locked / not allowed for all other people not working there or the public.
- The perimeter of the feeding sites should be fenced to prevent access to scavenger mammals in order to prevent diseases transmission.
- There must be a periodical cleaning of the unconsumed remains (bones and skins and other non digestible material). For this purpose a pit would be advisable for burning and subsequent burial of this waste.
- Scrub vegetation around the feeding sites, should be encouraged and enhanced to provide roosting areas for birds feeding at the site.
- The extent of meat deposited needs to consider fluctuations in presence of scavenging birds and be managed accordingly to avoid non- consumption of meat.
- No hunting activity will be allowed in a buffer zone area around the site to ensure the protection of birds attracted to the site; a wheel wash area is advisable according to the feeding site characteristics but considering the climate conditions.
- If feasible, birds should be provided with water for drinking in a suitable site, avoiding any risk of contamination from the contaminated meat.
7.3 Bird watching sites at properly managed waste disposal sites on the Rift Valley Red Sea Flyway corridor

The large numbers of MSBs attracted to WWTPs and landfills have potential to become a tourist resource through the spectacle of birds that can attract both birdwatchers and a broader spectrum of tourists. Thus, some countries use the WWTPs as bird watching sites and there are specific programs and facilities. In the RVRSF the Aquba Bird Observatory (Box 2) of Jordan is outstanding, as there is an infrastructure and a specific plan to develop Bird watching tourism. Waste sites are often visited by travelling birdwatchers to watch concentrations of birds.

Any birdwatching initiative could lead to the following benefits:

- Generate economical revenues for local communities, organizations and authorities managing Waste Disposal Sites with conservation purposes.
- Providing alternative employment and income opportunities for local communities.
- Increasing awareness towards the conservation of MSBs, both among local and tourist community.
- Develop environmental educational programmes on waste management and MSBs conservation.

There is the potential to create a network of MSBs observatories at different WDS along RVRSF, forging links with other plants and the promoting the flyway concept and the need to conserve MSBs to visitors The inclusion of WDS within a network of MSBs observatories, forging partnerships with other sites along the flyway should be an aspiring criteria for MSB friendly waste disposal site and Birdlife partners can help to facilitate this process.
8. ACKNOWLEDGEMENTS

We want to acknowledge the following people and/or organizations for their help providing with documents and information regarding any aspects related with the MSBs in the RVRSF and wastes: Richard Porter for some comments and introducing us with FEW (the Foundation for Endangered Wildlife) Yemen, especially to David Stanton. Yilma Abebe from the ETHIOPIAN WILDLIFE AND NATURAL HISTORY SOCIETY (EWNHS) for meeting him in person, the information he provided to us and the authoring of several of the pictures. Ibrahim Alhasani, former Regional Officer of the Migratory Soaring Birds Project provided with the most updated reports for the individual countries.
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10. USEFUL WEBSITES

10.1 Websites

BirdLife International
www.birdlife.net/sites/index.cfm

Sensitivity Map for MSBs
http://maps.birdlife.org/MSBtool

AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds)
www.unep-aewa.org

Migratory Soaring Birds Project
http://migratorysoaringbirds.undp.birdlife.org/en

United Nations Environment Programme-World Conservation Monitoring Centre
http://www.unep-wcmc.org/

Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)
www.ramsar.org
http://ramsar.wetlands.org/

Convention on the Conservation of Migratory Species of Wild Animals
www.cms.int

10.2 Online reports (Environmental Assessment)

European Union

Convention of Biological Diversity (COP)
http://www.cbd.int/decision/cop/default.shtml?id=11042

Convention on the Conservation of Migratory Species of Wild Animals (CMS)
Impact Assessment and Migratory Species (Resolution 7.2)

International Association for Impact Assessment (IAIA)
Biodiversity in impact assessment

Agreement on the Conservation of African-Eurasian Migratory Waterbird (AEWA)
Guidelines on how to avoid, minimize or mitigate impact of infrastructural developments and related disturbance affecting waterbirds. AEWA Conservation Guidelines No. 11.
http://www.unep-aewa.org/sites/default/files/publication/cg_11_0.pdf

http://www.unep-aewa.org/sites/default/files/publication/cg_7new_0.pdf