



The first coordinated trans-North African mid-winter waterbird census: The contribution of the International Waterbird Census to the conservation of waterbirds and wetlands at a biogeographical level



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ABSTRACT

The International Waterbird Census (IWC) is one of the most widespread biodiversity monitoring programs, assessing waterbird populations in the framework of several international agreements including the African-Eurasian migratory Waterbirds Agreement and the Ramsar Convention. In 2013, the IWC was coordinated for the first time across the whole of North Africa with the aim of developing recommendations for methodological improvements to current design in North Africa, as well as to update the conservation status of certain waterbird populations and wetlands of international importance. We show that coordinating the IWC across all five North African countries significantly improves knowledge of waterbird population sizes and distribution and confirmed that current North African Ramsar wetlands perform well in conserving waterbirds. Nevertheless, biodiversity conservation could potentially be further enhanced by designating additional Ramsar sites, which this study contributes to identifying. We show that reducing sampling effort by half over the entire region would have been sufficient to cover 100% of the species richness of wintering waterbirds recorded and >98% of the total abundance. Finally, we show that larger wetlands are insufficiently sampled. These findings call for revised sampling design in a coordinated, region-wide framework. The maintenance, optimization and reinforcement of the IWC program over time on a regional scale, with the collected data made available in a shared database, seems essential in order to make appropriate conservation decisions for waterbirds and wetlands in the future. Adding a temporal dimension to these analyses will be critical to confirm the patterns observed in the 2013 census.

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1. Introduction

Large-scale datasets on the Earth's biodiversity are today increasingly useful for answering important ecological or conservation questions of global concern (Pereira et al., 2013). For example, two recent studies

use large-scale biodiversity datasets: one indicates that although the effectiveness of birds as biodiversity surrogates can be improved by using other taxa, birds alone perform fairly well (Larsen et al., 2012). The other shows that increased monitoring efforts, notably of waterbirds, are required in the southern half of the Mediterranean Basin despite being one of the most important biodiversity hotspots in the world (Galewski et al., 2011). Waterbird monitoring is one of the oldest, largest and most internationally widespread environmental surveillance

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systems. The monitoring of waterbirds has become of even greater global concern as the role of waterbirds in wetland ecosystems is increasingly understood. Waterbirds are today recognized as important ecosystem service providers, acting for instance as a biological proxy for the condition of wetlands, as dispersers of seeds or as sentinels of potential epidemics (Amat and Green, 2010; Green and Elmgberg, 2014).

The long-term monitoring of waterbirds is managed on a global scale by Wetlands International (www.wetlands.org) through the International Waterbird Census (IWC). The IWC was launched in 1967 and today covers over 25,000 sites in >100 countries, making it one of the largest global monitoring schemes based largely on citizen science. The objectives of the IWC are (i) to estimate and monitor the size of waterbird populations, (ii) to describe changes in the number and distribution of waterbirds and (iii) to assess the importance of individual wetlands for waterbirds through synchronized counts (Dodman and Diagana, 2003 for Africa, Wetlands International, 2012 for the whole African-Eurasian region). These results are used to inform international agreements especially the EU Birds Directive, the Convention on Biological Diversity, the Conservation of Arctic Flora and Fauna, the Ramsar Convention on Wetlands and the African-Eurasian migratory Waterbirds Agreement (AEWA) and may bring about new policies and regulatory measures regarding the conservation or use of these populations within AEWA Contracting Parties (AEWA Secretariat, 2013).

With a potential 2 million wintering waterbirds belonging to >150 different species (a total reached by adding up historical maximum annual counts for each of the five countries; Wetlands International, 2014) and despite hosting only 1.5% of the total surface of wetlands worldwide (Mediterranean Wetlands Observatory, 2012), North Africa (a region comprising Morocco, Algeria, Tunisia, Libya and Egypt) is of major importance for waterbirds of the African-Eurasian flyways (Meininger and Atta, 1994; Dakki et al., 2002; Isenmann et al., 2005; Samraoui and Samraoui, 2008; EGA - RAC/SPA waterbird census team, 2012). During both autumn and spring migrations, North African wetlands provide a last refuelling stopover for millions of migratory waterbirds before they cross the Sahara or the Mediterranean Sea (Green et al., 2002); both crossings can be energetically demanding. These wetlands also shelter hundreds of thousands of waterbirds during the winter. Conserving and managing these waterbird populations and the North African wetlands hosting them requires among other actions filling in various knowledge gaps on species' population sizes and distribution patterns on a region-wide scale (Samraoui et al., 2011; Galewski et al., 2011).

The first IWC in North Africa took place in the 1960s, and the census has continued to develop since then. IWC became more regular from 1983 in Morocco, from 1985 in Algeria and from 2002 in Tunisia but for political and/or financial reasons the spatial coverage of wetlands has been variable, depending on the country (EGA - RAC/SPA waterbird census team, 2012; Etayeb et al., 2015; Wetlands International, 2014). Moreover, censuses were always conducted at a national level without region-wide coordination or joint analysis, although nomadic exchanges among migratory waterbird populations between North African countries are strongly suspected (Samraoui et al., 2011), of course in addition to even larger migratory exchanges between North and South Mediterranean. This has meant that only general overviews and trends could be drawn from results and datasets, restricting knowledge about regional waterbird distribution and impacting decision-making on conservation in North Africa.

In 2013, for the first time, waterbird counts were coordinated jointly between all five North African countries. They were conducted in January with extended spatial coverage (with the exception of Libya where coverage remained limited and 10 important wetlands were skipped due to security issues). The results were then analyzed at a trans-North African scale to improve knowledge on wintering population sizes and on the wetlands preferentially used within this region. This article presents the results of this first region-wide coordinated survey along four lines of analysis: (i) Methodological improvement: How

could coordinated streamlining of the current IWC sampling design at a region-wide scale improve IWC cost-effectiveness in a resource-constrained context? (ii) Assessment of North-African wetlands conservation policies through evaluation of the relative importance of sites for waterbirds: Do sites currently protected under conservation status host more waterbirds than others? (iii) Spatial distribution patterns of waterbirds: Could any environmental predictors help to evaluate and improve monitoring design and to develop hypotheses for future spatial analyses of waterbird distributional ecology? and (iv) Reassessment of population size estimates: how influential coordinated waterbird counts summed over North-Africa could be in updating latest published information on these population sizes from this region?

2. Methods

2.1. The 2013 North African IWC

This first coordinated trans-North African waterbird count took place between 1 January and 9 February 2013 at 411 sites (Fig. 1). Because IWC ideally takes place around 15 January, the coordinated effort of all teams of observers resulted in >86% of the 411 wetlands being surveyed between 5 and 25 January, most of the teams generally covering several wetlands in one field session or even one day (1). All teams included experienced observer(s) who had been trained specifically for IWC in their country by national and/or international training programs. All wetlands were then positioned on a geographical information system (Quantum GIS Development Team, 2015). Just over half the sites (215 sites, 52.3%) were located in Algeria, and the others were located in Tunisia (88 sites, 21.4%), Morocco (61 sites, 14.8%), Egypt (31 sites, 7.5%) and Libya (16 sites, 3.9%) (1). Despite important logistical, administrative and, sometimes, security constraints as well as very limited financial and material resources, each site was visited once, generally in one day from land (two wetlands were surveyed by boat and one over two days) by a small team of observers (mean = 3 observers, SE = 2). Each team applied the field protocol for waterbird counting recommended by Wetlands International (2010). The count data were obtained by scanning multi-species flocks of waterbirds with telescopes or binoculars as appropriate and counting individuals of each species, or by estimating species-specific abundance using 'blocks' of known size in the appropriate order of magnitude. Only waterbird genera to which the AEWA applies (AEWA Secretariat, 2015) are considered in this article.

2.2. Relative importance of sites for waterbirds

The most widespread and commonly accepted international conservation treaty devoted to wetlands is the Ramsar Convention on Wetlands of International Importance. Nine criteria are used to classify a wetland as a site of international importance under the Ramsar Convention, two of which are based on waterbirds (Ramsar Convention Secretariat, 2016): a wetland should qualify for Ramsar designation if it regularly supports (1) >20,000 waterbirds, or (2) >1% of a biogeographical waterbird population. These 1% thresholds are provided by the 5th Waterbird Population Estimates (WPE5) from the online database (wpe.wetlands.org) which defines a waterbird population as a distinct assemblage of individuals which does not experience significant emigration or immigration (Wetlands International, 2016).

We compared waterbird abundance in officially designated Ramsar sites with abundance in non-Ramsar sites (Kleijn et al., 2014). We scored the sites according to the Waterbird Conservation Value (WCV): this index "sums the ratio of each species' abundance to its published 1% threshold across all observed species" (Harebottle and Underhill, 2016). WCV thus provides in a single score an overall measure of the value of a given wetland based on its waterbird abundance and species richness. Waterbird abundance and species richness did not follow a normal (but a rather right-skewed) distribution over the

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