6. Wintering waterbirds in N Africa 1990-2017

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Summary

In N Africa, waterbird counts have been carried out since the 1960s but only became regular in the 1980s. However, the lack of stable funding, of suitable optical equipment, of a stable and reliable national network of counters in the five countries, and of facilities to cover large areas and move from one site to another, meant that surveys never covered all the sites and were not really carried out regularly. It was with the setting up of the Mediterranean Waterbirds Network in 2012 that a certain regularity of counts was established, with financial and technical support, and with the development of the Medwaterbirds database. This database contains 36,436,391 records but suffers from over 60% missing data for 1990-2017. In order to accommodate this missing data issue, a new imputation method, LORI, was applied to the Medwaterbirds data set using multiple site- and/or year-specific covariates. N African trends for 16 species were assessed and discussed with respect to the corresponding trends at the international level (AEWA CSR 8).

Because the issue of missing data is an acute one in ecological monitoring, we argue that our modelling tool could be useful for many studies on wildlife. The joint work with other Mediterranean countries, the possible monitoring of breeding birds in the Mediterranean, and synchronous counts with the East Atlantic Flyway countries could all be considered as lines of action to improve these analyses, but also their interpretation in relation to the status of populations.

Résumé

En Afrique du Nord, les comptages d'oiseaux d'eau sont effectués depuis les années 1960 mais ne sont devenus réguliers que dans les années 1980. Cependant, faute de financements stables, d'équipements optiques adaptés, d'un réseau national de compteurs stables et fiables dans les cinq pays, et de facilités pour couvrir de grandes surfaces et se déplacer d'un site à l'autre, les relevés n'ont jamais couvert tous les sites et n'ont pas vraiment été réalisés régulièrement. C'est avec la mise en place du Réseau méditerranéen des oiseaux d'eau en 2012 qu'une certaine régularité des comptages a été établie, avec un soutien financier et technique, et avec le développement de la base de données Medwaterbirds. Cette base de données contient 36 436 391 enregistrements mais souffre de plus de 60% de données manquantes pour la période de 1990 à 2017. Afin de résoudre ce problème de données manquantes, une nouvelle méthode d'imputation, LORI, a été appliquée à la base de données Medwaterbirds en utilisant de multiples covariantes spécifiques aux sites et/ou aux années. Les tendances africaines pour 16 espèces ont été évaluées et discutées par rapport aux tendances correspondantes au niveau international (AEWA CSR 8).

Comme la question des données manquantes est un problème majeur dans le suivi écologique, nous soutenons que notre outil de modélisation pourrait être utile pour de nombreuses études sur la faune sauvage. Le travail conjoint avec d'autres pays méditerranéens, le suivi éventuel des oiseaux nicheurs en Méditerranée, et les comptages synchronisés avec les pays de la voie de migration de l'Atlantique Est pourraient tous être considérés comme des pistes d'action pour améliorer ces analyses, mais aussi leur interprétation par rapport à l'état des populations.

6.1 Introduction

Given its position on the southern shore of the Mediterranean, NW Africa (a region comprising Morocco, Algeria & Tunisia) is of major importance for waterbirds of both the East Atlantic Flyway (EAF) and the Black Sea - Mediterranean Flyway (El Agbani *et al.* 1996, Isenmann & Moali 2000, Dakki *et al.* 2001, Dakki *et al.* 2002, Isenmann *et al.* 2005). In these three countries some of the largest Mediterranean wetlands, of tremendous importance for passing or wintering waterbirds, are found, e.g. the Merja Zerga, the Sebkha of Oran and the Ichkeul lagoon. During both autumn and spring migrations, wetlands in N Africa provide a 'last chance saloon' for migratory waterbirds before they cross the Sahara or the Mediterranean Sea; both crossings are energetically demanding for waterbirds. These wetlands also shelter hundreds of thousands of waterbirds during the winter. Managing these waterbird populations and the N African wetlands hosting them requires filling in various knowledge gaps on species' population sizes and distribution patterns (Samraoui *et al.* 2011).

The first waterbird counts in N Africa took place in the

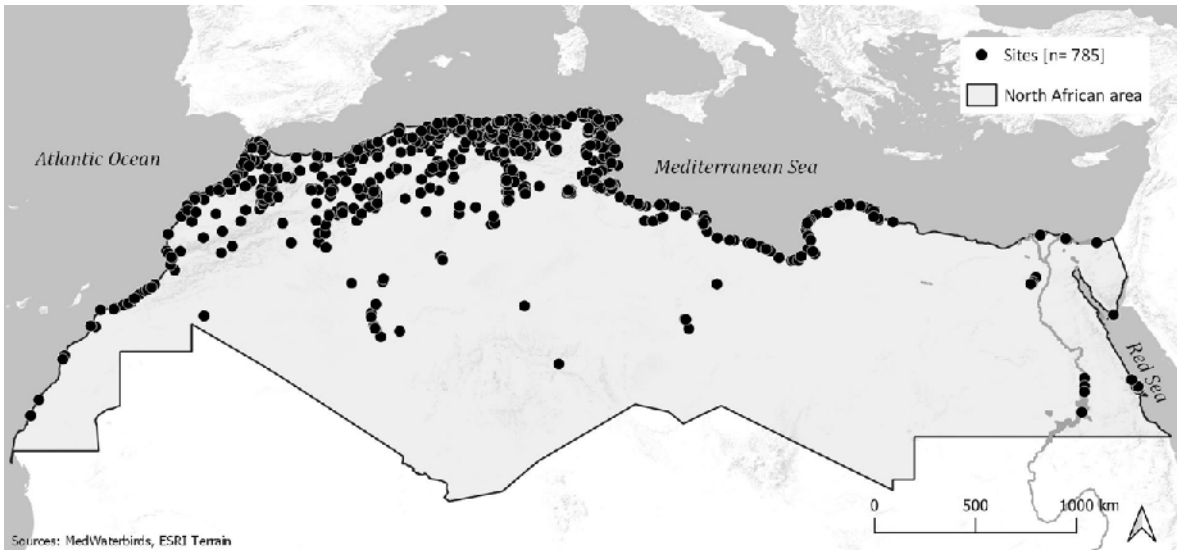


Figure 6.1. The 785 IWC monitoring sites surveyed for at least two years between 1990 and 2017.

1960s. Initial counts were carried out in 1964 in Morocco (Blondel & Blondel 1964), in 1967 in Tunisia (Isenmann *et al.* 2005) and in 1971 in Algeria (van Dijk & Ledant). The censuses 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 it is estimated that up to 60% of the wintering populations were not covered at that time.

The Mediterranean Waterbirds network (MWN) for waterbird monitoring started from 2012 (Dami & Gaget 2021), initially as a cooperation between all N African International Waterbird Census (IWC) coordinators, the French Agency for Biodiversity and Tour du Valat. The MWN developed different tools to strengthen the capacity of partners and organised annual international training sessions on waterbird censusing in Tunisia. Nowadays the network also includes cooperation with other countries from the northern coast of the Mediterranean. In 2014 the first coordinated N African winter census took place (Sayoud *et al.* 2017). To analyse the complex dataset, the MWN developed a new methodology to estimate trends for the region (Dakki *et al.* 2021), characterised by a large proportion of missing data.

This chapter presents trends of a selection of species with relevance for the EAF and with large populations in Morocco, Algeria and Tunisia.

6.2 Material and methods

Biodiversity monitoring datasets, emerging in particular from citizen-science monitoring programmes, potentially allow answering many important ecological or conservation questions (Pereira *et al.* 2013, Stephenson *et al.* 2017). However, they are challenging to analyse when they display many missing values. This gap is particularly problematic in the monitoring of rare or threatened species, and in regions where data surveys are difficult to carry out for financial, political or logistic reasons.

The overall IWC dataset for N Africa includes up to 60% of missing values. Various statistical methods already exist to handle missing data or sparse datasets (van Strien *et al.* 2004). However, because of the high percentage of missing values we applied a new modelling tool, using a lasso approach and which allows both imputation and inference from predictors over sparse data (Robin *et al.* 2019). This LORI method is well suited to analyse multi-site and multi-year matrices of wildlife counts including many missing entries. We applied this method on the analysis of time series of count data for 16 waterbird species over 785 N African wetlands between 1990 and 2017. Twenty-one temporal, spatial and spatio-temporal covariates (qualitative or quantitative), extracted from GIS and taken from the web, were used to help imputing missing values in this dataset (Dakki *et al.* 2021).

6.3 Results

During the waterbird mid-winter counts in N Africa, from 1990 to 2017, data were collected at 785 wetland sites (Fig. 6.1). Of these, 21% were in Morocco, 47% in Algeria, 17% in Tunisia, 12% in Libya and 3% in Egypt (Dakki *et al.* 2021). This coverage reflects the relative abundance of wetlands in the region, although, especially in Egypt, coverage remains incomplete. Coverage varied over the years but has increased and became more consistent recently.

Using the LORI method to analyse the time series for 16 waterbird species, we estimated their trends at the N African scale over all 785 IWC sites for 1990 – 2017 (Fig. 6.2). Of the sixteen species analysed, only five are increasing strongly (Mallard *Anas platyrhynchos*, Glossy Ibis *Plegadis*

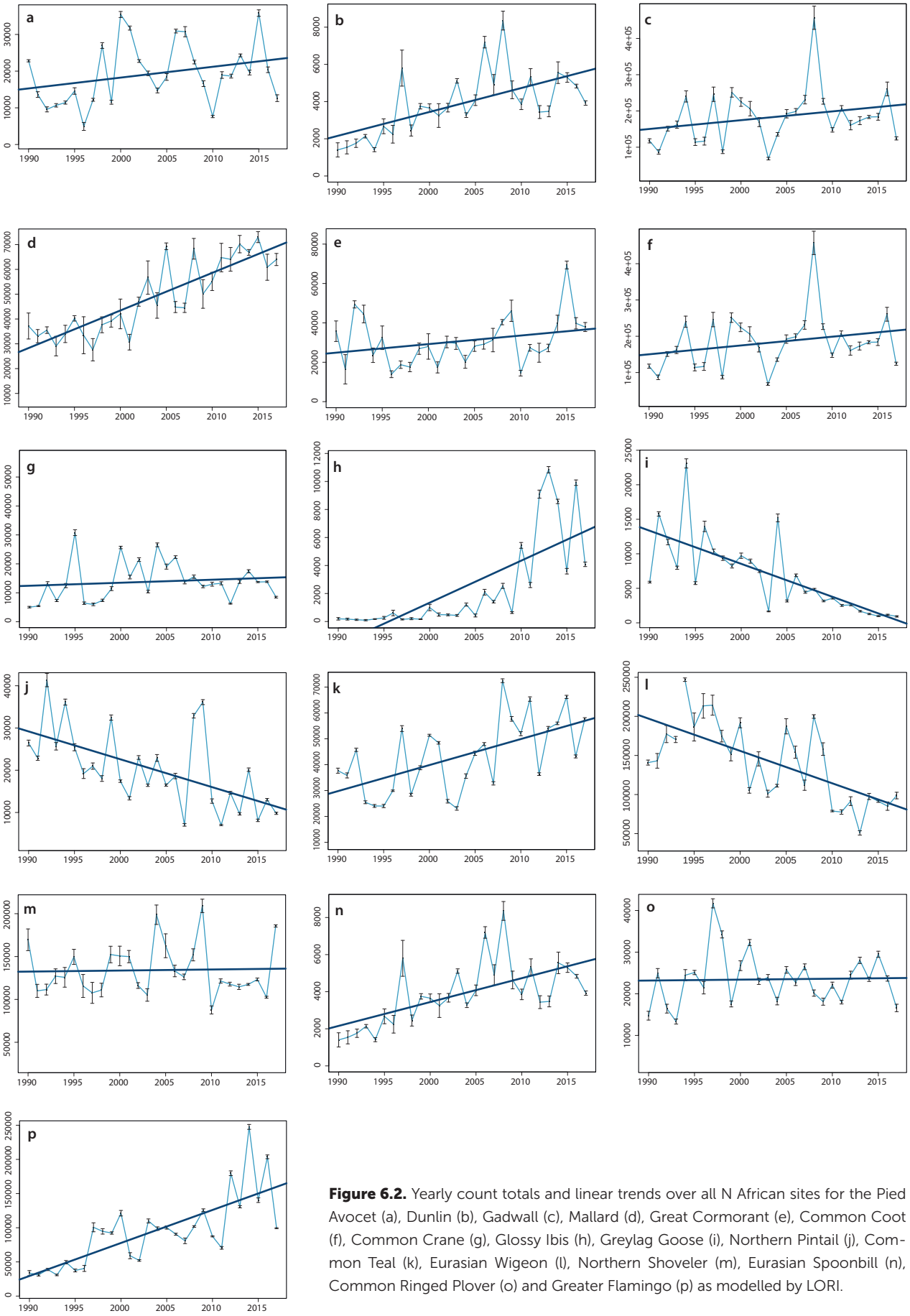


Figure 6.2. Yearly count totals and linear trends over all N African sites for the Pied Avocet (a), Dunlin (b), Gadwall (c), Mallard (d), Great Cormorant (e), Common Coot (f), Common Crane (g), Glossy Ibis (h), Greylag Goose (i), Northern Pintail (j), Common Teal (k), Eurasian Wigeon (l), Northern Shoveler (m), Eurasian Spoonbill (n), Common Ringed Plover (o) and Greater Flamingo (p) as modelled by LORI.



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Greater Flamingo | **Flamant rose** *(Phoenicopterus roseus)*

falcinellus, Common Teal *Anas crecca*, Eurasian Spoonbill *Platalea leucorodia* and Greater Flamingo *Phoenicopterus roseus*) in N Africa. Three are strongly declining (Greylag Goose *Anser anser*, Northern Pintail *Anas acuta* and Eurasian Wigeon *Mareca penelope*), while the others are more or less stable.

Among the species increasing in N Africa, the Mallard is on the contrary declining in the Mediterranean and Black Sea area (AEWA CSR8 results) and in the EAF, and the Common Teal is stable in the EAF after a long-term increase (Appendix 1). Among the species strongly decreasing in N Africa, Greylag Goose is increasing in the Mediterranean and Black Sea area, Eurasian Wigeon seems to be rather stable internationally, but also decreasing also at the EAF scale as well as Northern Pintail (AEWA CSR8 results). Among the species more or less stable in our study area, three (Pied Avocet *Recurvirostra avosetta*, Common Crane *Grus grus* and Northern Shoveler) are increasing in the Mediterranean and Black Sea area and Pied Avocet also in the EAF, as well as Great Cormorant *Phalacrocorax carbo* in this flyway. On the contrary, Common Coot *Fulica atra* is decreasing at the international scale, while Dunlin *Calidris alpina* and Ringed Plover *Charadrius hiaticula* decrease in the EAF.



Harvey van Diek

Ringed PLover | **Pluvier grand-gravelot** *(Charadrius hiaticula)*

6.4 Discussion

The three species displaying strong decline in N Africa may therefore appear of conservation concern for N African countries. However, their decrease may primarily be a response to climate change, notably to milder winter weather allowing populations to winter closer to their North European breeding sites (Pavón-Jordán *et al.* 2019, Fox *et al.* 2019). Greylag Geese have been shown to have shortened their migration (Podhrazsky *et al.* 2017; Ramo *et al.* 2015) through individual temperature-dependent decisions to remain closer to the breeding grounds, thus allowing birds to acquire breeding territories earlier. Northern Pintail may also respond to milder weather in its

northernmost winter quarters as shown in North America (Meehan *et al.* 2021). This is not in contradiction with the South European/W African flyway trend which remains uncertain. Eurasian Wigeon are impacted by loss of good breeding habitats (Pöysä *et al.* 2017). Possibly decreasing numbers of breeding Wigeon in the north may directly impact the number of wintering birds in N Africa, although the flyway trend remains uncertain overall.

Ecological datasets, notably those concerning wildlife monitoring, often suffer from missing data, for instance because of the difficulties to monitor remote sites every year, to find sufficient funding, to recruit field observers for all the sites or to benefit from the adequate weather at survey time. In this study, we used a new multiple imputation method for count data with supplementary covariates. Given the observed differences in imputation accuracy between LORI and other existing methods like MICE, MISSFOREST, TRIM, CA, MEAN and GLM (Dakki *et al.* 2021), this new method seems to perform better than other methods currently used, but it also might potentially indicate different trends. If differences between these methods appear over such a long time span (28 years), they could potentially be even stronger at a shorter time span of for example 10 years, which is the usual timescale for short- term waterbird trend assessment. As trend estimation is a major diagnostic tool in the conservation and management of wild species, we argue that LORI is a tool well adapted to supporting conservation decisions as it provides good imputation performance, and hence trend estimation that is more likely to be reliable, particularly when predictor covariates are available.

The consolidation of cooperation with other Mediterranean countries and the development of a joint database could contribute to a more consistent monitoring of the species' conservation status, but also a more accurate interpretation of the resulting trend estimates. Monitoring of colonial breeding birds could provide crucial additional information especially for pelagic or largely dispersing species inadequately monitored by mid-winter counts. Another action that could be taken to consolidate inference on population size and trend estimates would be to better synchronise field activities of the MWN with those of the EAF count, by increasing field effort and coverage in the same years. We believe such synchronous work could also bring benefits in terms of spatial coverage through better funding, as well as in communication both with decision makers and the general public.

Acknowledgement

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Temporary wetland, North Africa



January 2020 count in Tunisia (Hichem Azafzaf)