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Effects of protection status, climate, and water management of rice fields on long-term population dynamics of herons and egrets in north-western Italy

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Abstract

The long-term population trends (1972-2015) of the herons and egrets breeding in NW Italy were analysed spatially and temporally in relation to environmental and human-related variables. *Ardea cinerea* and *Egretta garzetta* increased till 2000 but then began to decrease, mainly in the region of intensive rice cultivation, where the trend was likely driven by reduced flooding of the paddies, the main foraging habitat. Colony site availability is currently not limiting. These results are being applied to develop a strategy for the conservation of the colonies in the remaining wetlands of NW Italy.

Keywords

Grey heron, little egret, population trends, flooded rice fields.

Introduction

The breeding populations of herons and egrets in north-western Italy have sharply increased in the past decades (starting from 1980-1990) thanks to more favourable climatic conditions, the reduction of direct human-induced mortality, and the protection of colony sites (FASOLA et al. 2010). Since 2000, the number has decreased in some areas, coinciding with a change in diet and with the diminished availability of flooded rice fields, due to the spreading of new agronomic techniques that include a partially dry cultivation of rice (FASOLA & CARDARELLI 2015). We took advantage of a long-term monitoring program carried out from 1972 on a guild of seven species of Ardeinae, and the availability of remote sensing images from 2000 (from which the fraction of flooded area in rice fields has been derived), to investigate the effect of changes in agricultural practices on the population dynamics of the two most abundant heron and egret species.

Methods

The nesting populations of seven species of herons and egrets (grey heron *Ardea cinerea*, purple heron *Ardea purpurea*, little egret *Egretta garzetta*, night heron *Nycticorax nycticorax*, great egret *Egretta alba*, squacco heron *Ardeola ralloides* and cattle egret *Bubulcus ibis*) have been monitored annually throughout north-western Italy (a breeding range of 57,600 km2, see FASOLA et al. 2010 for details on census techniques) from 1972 to 2015. Each heronry was characterized by its protection status within a nature protection area ('protection' yes/no) and by the main foraging habitat ('habitat' rice fields / major rivers / small upland streams).

A method to estimate the presence of standing water in rice fields using MODIS satellite data (RANGHETTI et al. 2016) was applied to estimate the fraction of flooded area from 2000 to 2016 within the total area covered by rice fields (rice district). In order to take into account the spatial variability of water management, the rice district was divided into ten sub-districts following the boundaries of irrigation areas, and ten time series of yearly flooding fraction were consequently computed (RANGHETTI et al. 2017).

We estimated the long-term population trend of the two most abundant species, grey heron and little egret, by means of the TRIM software (PANNEKOEK & VAN STRIEN 2001) that allows the analysis of time series of counts with missing observations. We performed a series of models including different sets of covariates (protection, habitat, rice sub-districts) and we selected the best model using the Akaike Information Criterion (AIC). We then assessed the shape of temporal trend by fitting a series of models with 'year' as explanatory variable (linear, second-, third- and fourth-order polynomial, logarithmic, logistic, power and exponential), and again we selected the best model through AIC.

Results

The best TRIM model for grey heron included habitat and rice sub-districts, while the best model for little egret included protection and rice sub-districts. Both populations showed a marked increase until 2000-2006 and then a decrease. The overall trend is best described by a third-degree polynomial in both cases (Fig. 1).

The decreasing phase was more pronounced in rice fields (for grey heron, Fig. 2), in sub-districts with a lower average fraction of flooded area (for both species) and in protected areas (for little egret).

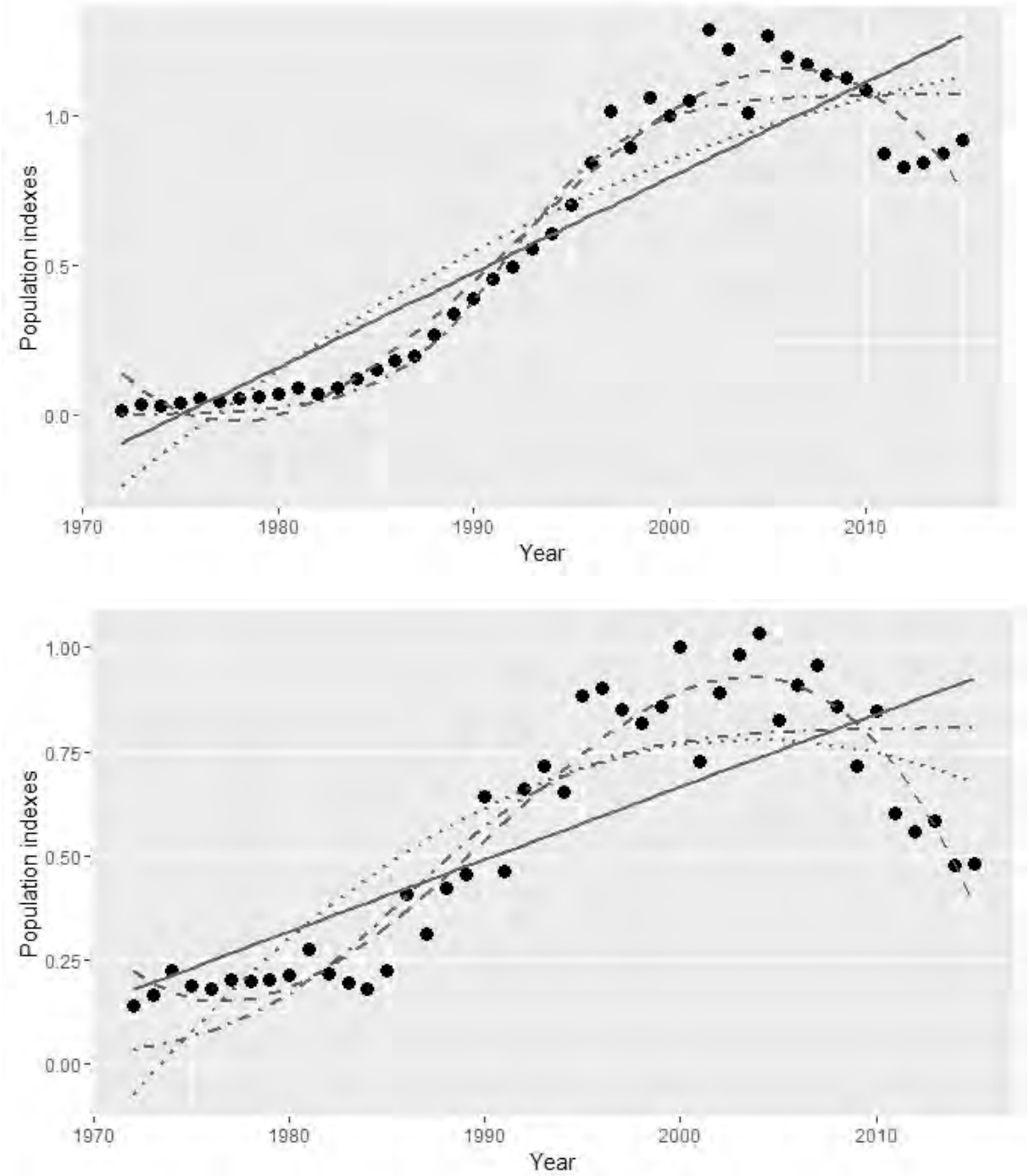

Figure 1: Fitting of some curves for temporal trend of a) grey heron and b) little egret populations. Solid line: linear; dotted line: quadratic; dashed line: cubic; dash-dotted line: logistic.

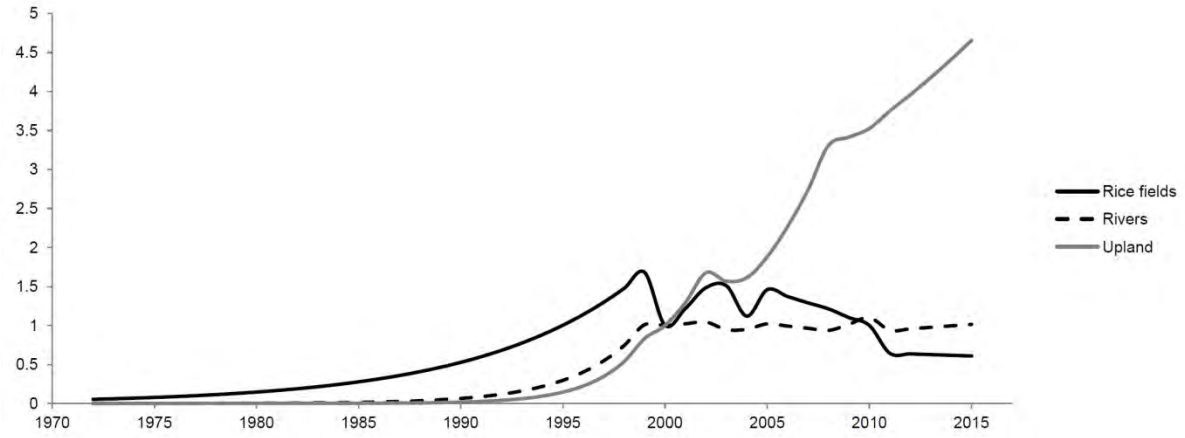

Figure 2: TRIM model indexes for grey heron for each habitat type.

Discussion

Rice fields remain the main foraging habitat for herons and egrets in north-western Italy, despite changes in prey types (FASOLA & CARDARELLI 2015) and a decrease in feeding success (CARDARELLI et al. 2017). However, the reduction in flooding of paddies due to the change in rice cultivation methods is likely driving the post-2000 decrease of their breeding populations in the rice fields area. On the contrary, the breeding populations foraging mainly in rivers and small upland streams remained stable or continued to increase (Fig. 2). Colony protection didn't seem to positively affect population trends after the species reached a full protected status.

The time series resulting from the best TRIM models has been used to analyse the effect of climate and fraction of flooded area in rice fields on the population dynamics of the two species. These results are being used to develop a sound strategy for the conservation of the colonies in the remaining semi-natural wetlands in NW Italy within the Action A.11 – EU LIFE 'GESTIRE 2020' in collaboration with Lega Italiana Protezione Uccelli and Regione Lombardia.

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