Centro Internazionale per gli Antiparassitari e la Prevenzione Sanitaria
International Centre for Pesticides and Health Risk Prevention (ICPS)

UNIVERSITÀ DEGLI STUDI DI MILANO
Dipartimento di Scienze Biomediche e Cliniche
Luigi Sacco

Dipartimento di Scienze dell'Ambiente e della Terra

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

B-Rice: Bird focal species identification in rice paddy

Alessandra Caffi[1], Flavio Marchetto[1], Francesco Galimberti[1], Alessio Riva[1], Stefano Ubbiali[1], Luciano Bani[2], Valerio Orioli[2]

[1] ICPS – International Centre for Pesticides and Health Risk Prevention, Milan
[2] Dipartimento di Scienze dell'Ambiente e della Terra-Università degli Studi Milano Bicocca, Milan

Ospedale Luigi Sacco POLO UNIVERSITARIO
Sistema Socio Sanitario
Regione Lombardia
ASST Fatebenefratelli Sacco

e-mail contact: flavio.marchetto@icps.it

Key Words: Pesticide, Birds, Rice paddy, Ecotoxicology.

Introduction

- The risk assessment for birds required by the European registration of pesticides is performed considering a series of diet exposure scenarios, for which the relevant food items are identified in order to estimate the uptake of residues.
- The exposure scenarios reported in the GD (EFSA Journal 2009; 7(12)1438) are inconsistent for rice and consequently the indicator and generic focal species are unlikely representative and protective for the vertebrate communities exposed in rice fields.
- Bird communities related to paddy fields are consistently different from those characterising the other crops, due to the presence of a water layer in the rice fields and the lack of several food items compared to other crops. An analysis of bird community is necessary to assess the risk for pesticide application on rice.
- The EFSA GD suggests how to identify relevant species for specific exposure scenarios from field studies, estimating the spatial frequency and the temporal evenness of occurrence of a species and its dominance.
- This analysis can be performed using data from specific field studies conducted for the registration of active substances, or from studies reported in the open literature.
- The two kinds of studies are however characterised by deep differences since the aims are different, and the method described in the GD can be inadequate to identify relevant species from literature studies; so in the present project, data from a monitoring program conducted in Lombardy (from 1992 to 2017) [1] is used, proposing an alternative method to predict the spatial frequency of species recorded in areas with rice fields using a Generalised Additive Model (GAM).
- The predicted spatial frequency of the species is then compared with GIS to land use maps to assess its spatial relevance to rice cultivation areas.
- The analysed species are classified in diet guilds according to the food items available in rice fields.

Materials and Methods

- Data gathered from the monitoring program of breeding avifauna in Lombardy [1].
- A screening was conducted excluding species not recorded in survey areas containing rice paddies and species recorded <25 times; a visual check of the homogeneity of records during time was performed.
- Species were assigned to "feeding guilds" according to literature data [5] in insectivorous, benthophagous, carnivorous and herbivorous.
- The bodyweight was associated to each species according to literature data [5].
- A Generalized Additive Model was applied to obtain the occurrence probability of species.
- GIS approach: the map of land use in the Lombardy region (SIARL: Agricultural Informative System of Lombardy Region) was overlapped to obtain the estimated occurrence in areas with rice cultivations.
- Temporal trend of population is a further criteria applied to reinforce the species representativeness.

Generalized Additive Model

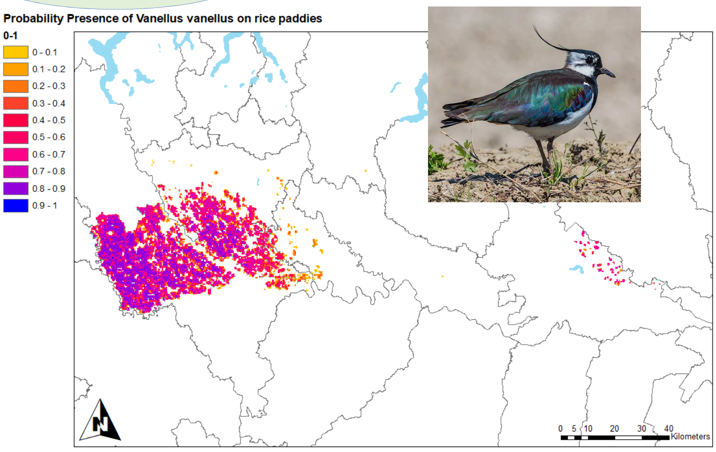
Species presence was estimated by predicting a spatially explicit generalized additive model (GAM) on the digital cartography of land use of Lombardy (DUSAF, 2015; 20 m resolution) :

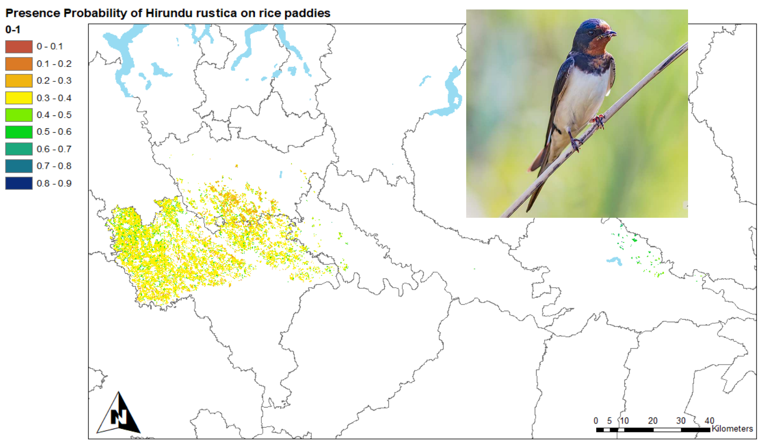
$$logit(E[Y_{s,i}]) = f_s(est_i, nord_i, t) + f_s(t) + \sum f_s(cl_{k,i}) + \beta_i river_i + \propto_s$$

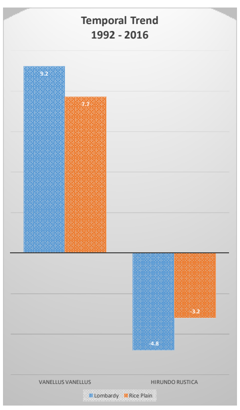
$E[Y_{s,i}]$:expected occurrence probability for the species *s* on point *i*;
cl_k : percentage of each of the *K* land use classes in a 250m-radius area around point count *i*;
$river_i$: dichotomous variable indicating the incidence of rivers and streams around the point *i*.
est_i, $nord_i$: spatial location of sampling points given by eastings and northings;
t: survey year.
$\propto_s$: model intercept for *s* species

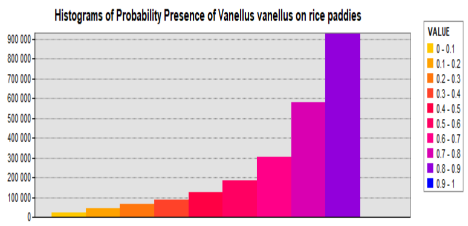
It was included the spatio-temporal smooth, $fs(est_i, nord_i, t)$ to account for the spatio-temporal autocorrelation of occurrences and the temporal smooth, fs(t), to account for the temporal trend in species presence. $fs(cl_{k,i})$ used to estimate non-linear suitability of different land-use classes [2], [4]
A backwards stepwise model selection was implemented based on significance at the 5% level. Variables with an EDF equal to one as parametric components were set [4]. GAMs were fitted to the data using the binomial family and the *logit* link function, by means of the *mgcv* package [4] in the statistical software R [3].

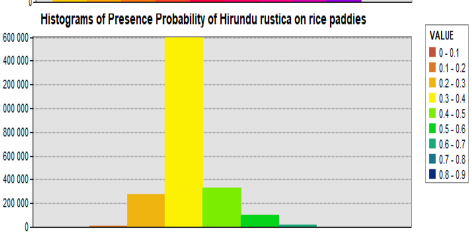
GIS approach[6]











Conclusions

Two different species were presented as elaboration data:
Northern Lapwing *(Vanellus vanellus)* - benthophagous species
Barn Swallow *(Hirundo rustica)* - insectivorous species.

The model predicted the occurrence probability distribution of the two species in the rice area of Lombardy Region.

- ✓ A high probability of occurrence is calculated by the model for the Northern Lapwing in the greatest number of rice paddies. The positive temporal trend suggests that Northern Lapwing can be considered as a good representative benthophagous species, also in the next future.
- ✓ A low probability of occurrence is predicted for the Barn Swallow. The negative temporal trend shows the decline in Swallow population, for these two reasons it cannot be considered a good representative insectivorous bird species.

References:

[1] **Bani L., Luppi M., Orioli V. (2016)** Monitoriaggio dell'avifauna nidificante in Lombardia. Relazione tecnica presso Regione Lombardia, DGAgricoltura Galimberti, F. and Marchetto, F. (2015)
[2] **Harrison P.J., Buckland S.T., Yuan Y., Elston D.A., Brewer M.L., Johnston A. & Pearce-Higgins J.W. 2014.** Assessing trends in biodiversity over space and time using the example of British breeding birds. Journal of Applied Ecology 51: 1650-1660.
[3] **R Core Team 2017.** R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.
[4] **Wood S.N. 2006.** Generalized Additive Models: An Introduction with R. Chapman and Hall/CRC.
[5] **Hamish Wilman, Jonathan Belmaker, Jennifer Simpson, Carolina de la Rosa, Marcelo M. Rivadeneira, and Walter Jetz. 2014.** EltonTraits 1.0: Species-level foraging attributes of the world's birds and mammals. Ecology 95:2027.
[6] **Spatial Temporal: ESRI ArcGIS 9.3.1**