

# Breeding Bird Atlas of the City of Milan: A Two-Decade Overview of Urban Avian Changes

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**Background:** Urban areas have undergone rapid and profound changes, strongly affecting biodiversity and bird communities. Sensitive to ecological shifts, birds are widely used as bioindicators and models in urban ecology. Intensified urbanization and land use transformations have caused marked declines of synanthropic species (e.g. sparrows, swifts), while opportunistic (e.g. crows, gulls) and non-native species (ring-necked Parakeet) have expanded. In a context of global urban growth and biodiversity loss, understanding drivers of bird distribution is crucial for sustainable urban planning and conservation strategies.

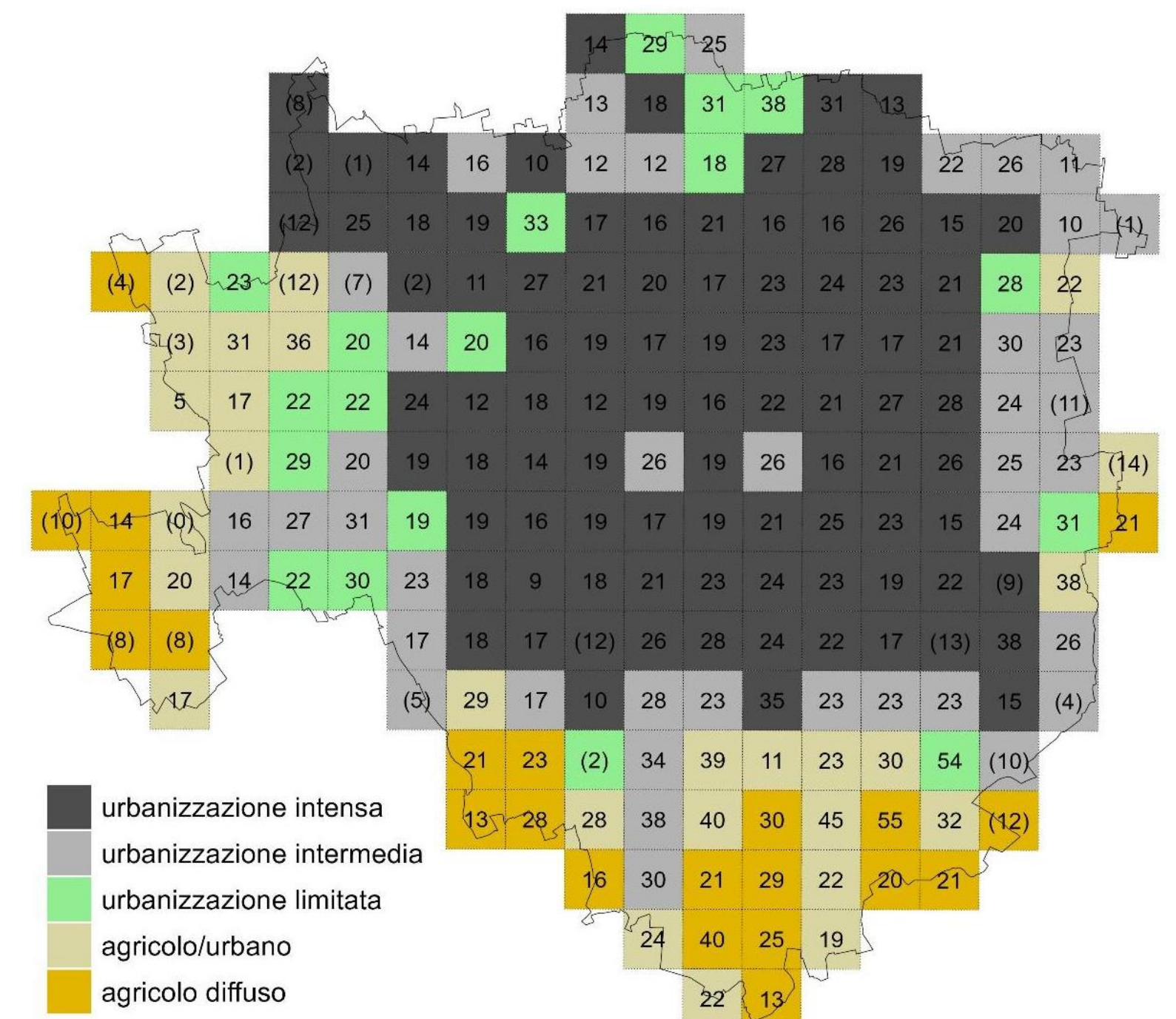
## Colombaccio (*Columba palumbus*)



## ATLAS FRAMEWORK

- ☐ 200 cells - 1 × 1 km grid
- ☐ 9 ornithological databases
- ☐ 2 periods: 2020-24 & 2009-13
- ☐ 130,015 avian records
- ☐ 79 confirmed breeding species
- ☐ 20 uncertain or summer visitors

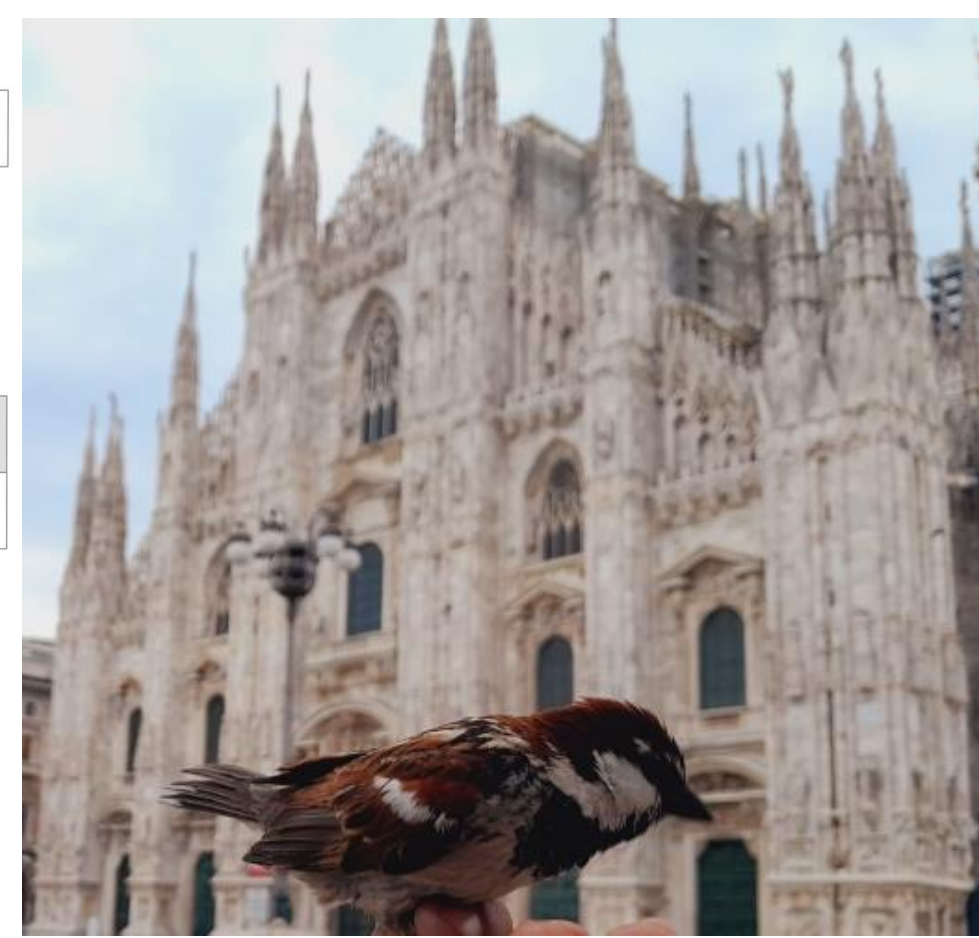
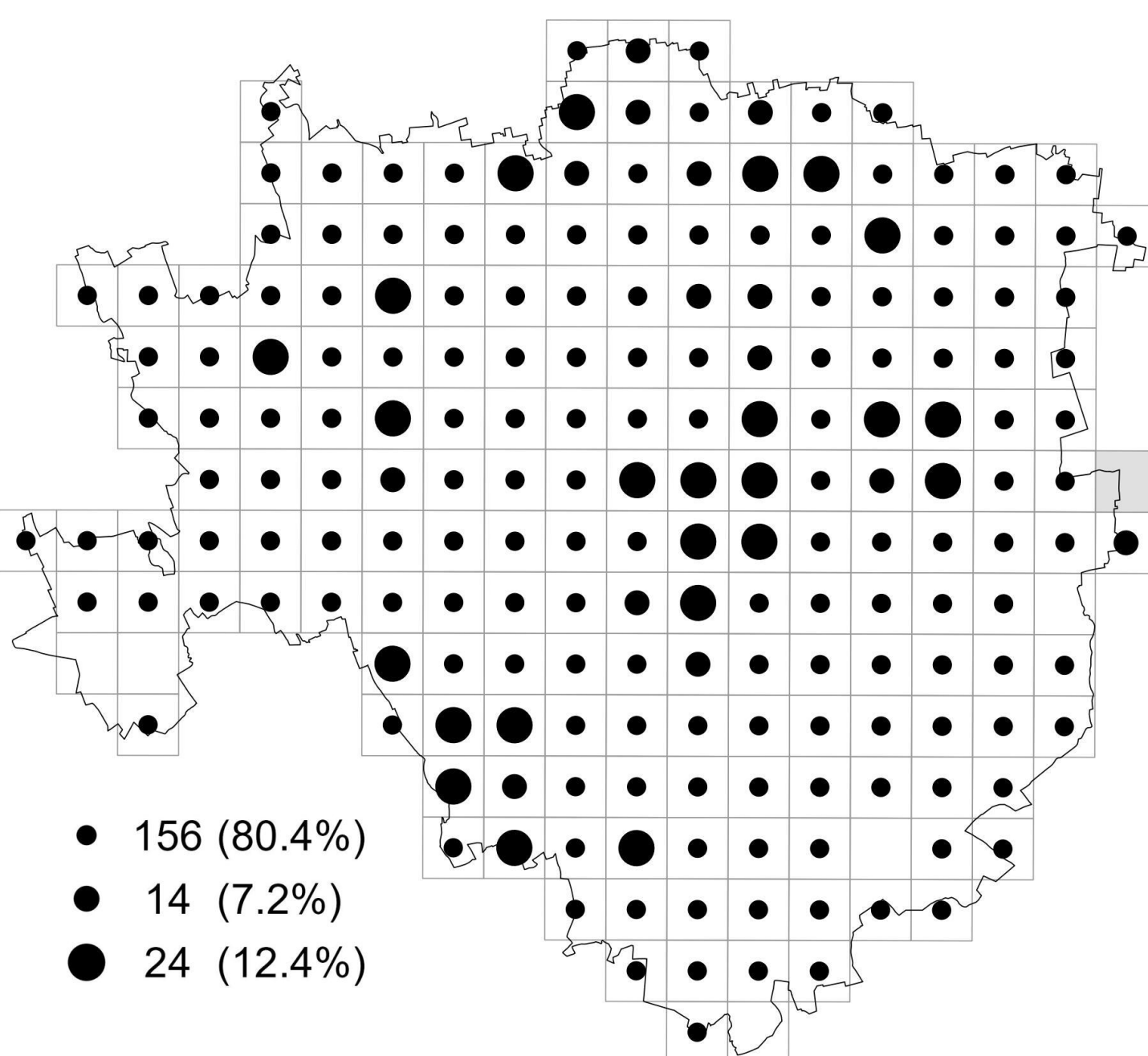
## Avian community species richness



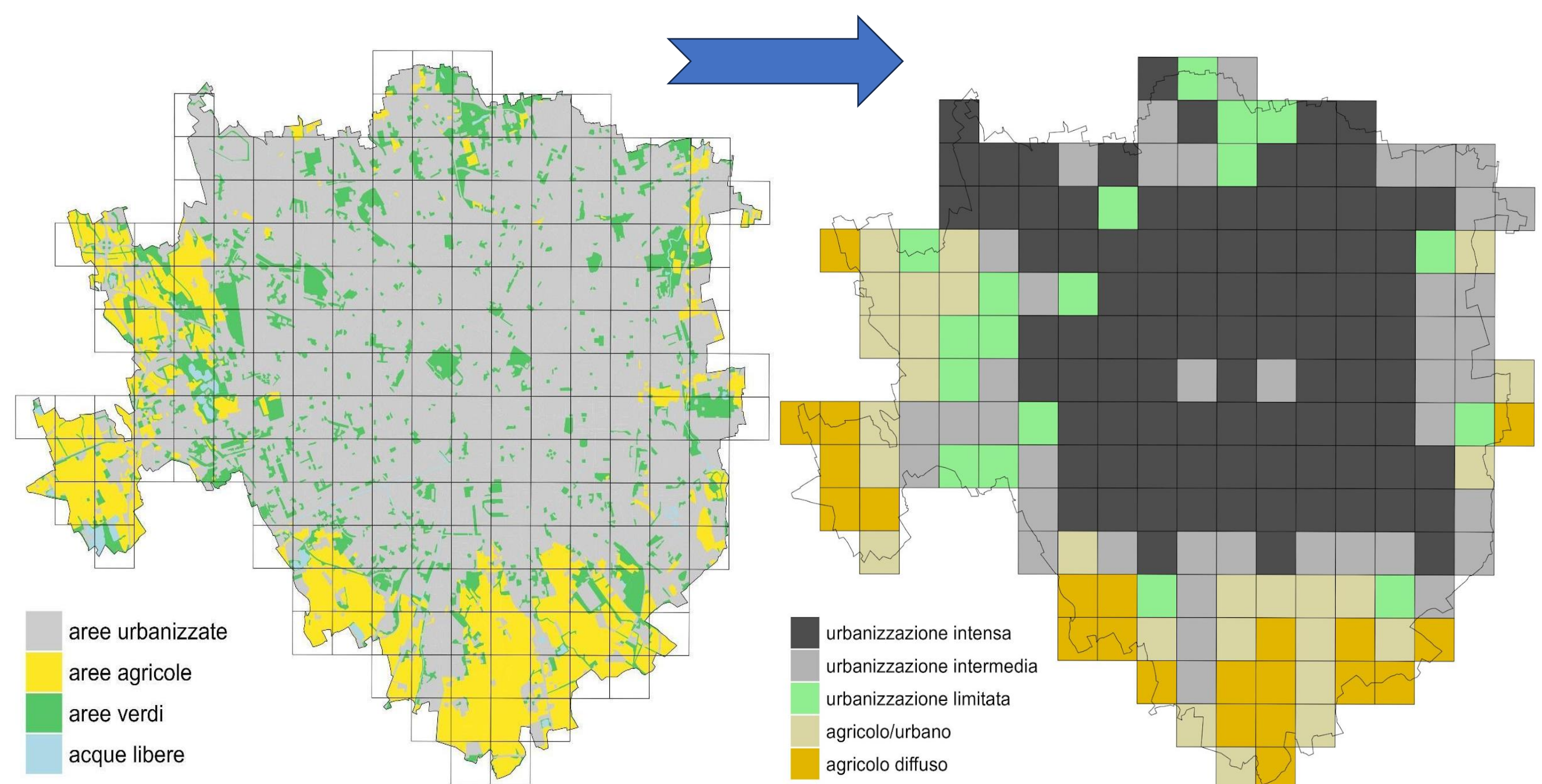
The first Breeding Bird Atlas of Milan was developed integrating nine integrated databases, combining citizen science and standardized surveys. Over 130,000 records across 200 grid cells confirmed 79 breeding species, plus 20 possible breeders or summer visitors. Distribution maps provide a comparative perspective between 2009–2013 and 2020–2024, highlighting two decades of change. Bird diversity shows highest values in cells with limited urbanization, substantial green areas, and balanced agro-urban mosaics. Beyond its descriptive role, the atlas is a strategic tool: it identifies species in decline, monitors invasive ones, guides urban planning, and fosters citizen engagement, education, and biodiversity-driven policies.

## Italian sparrow (*Passer italiae*)

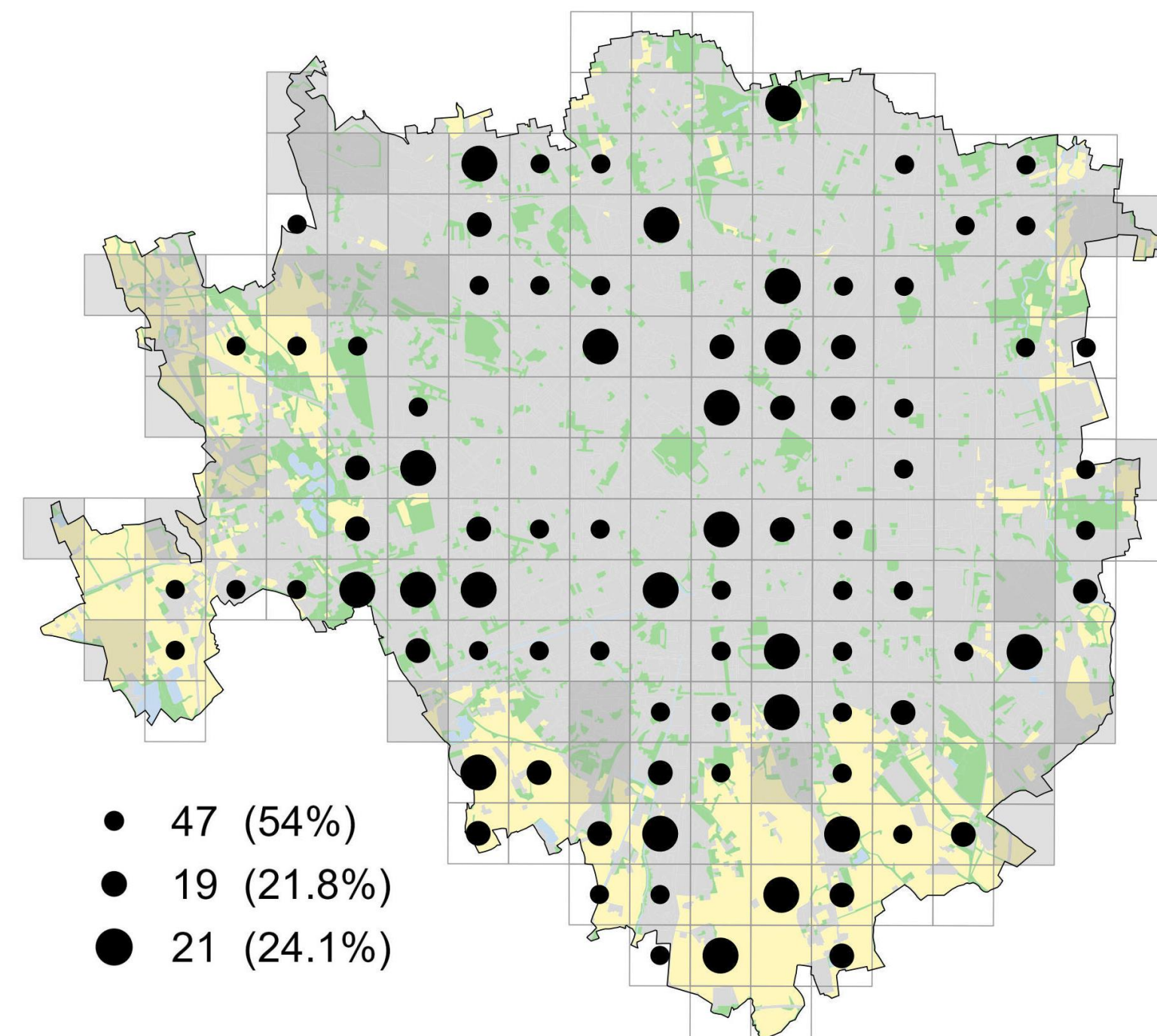
Past: 2009-2013 = 194 cells



## Landuse proportions of cells clustered into 5 habitat types

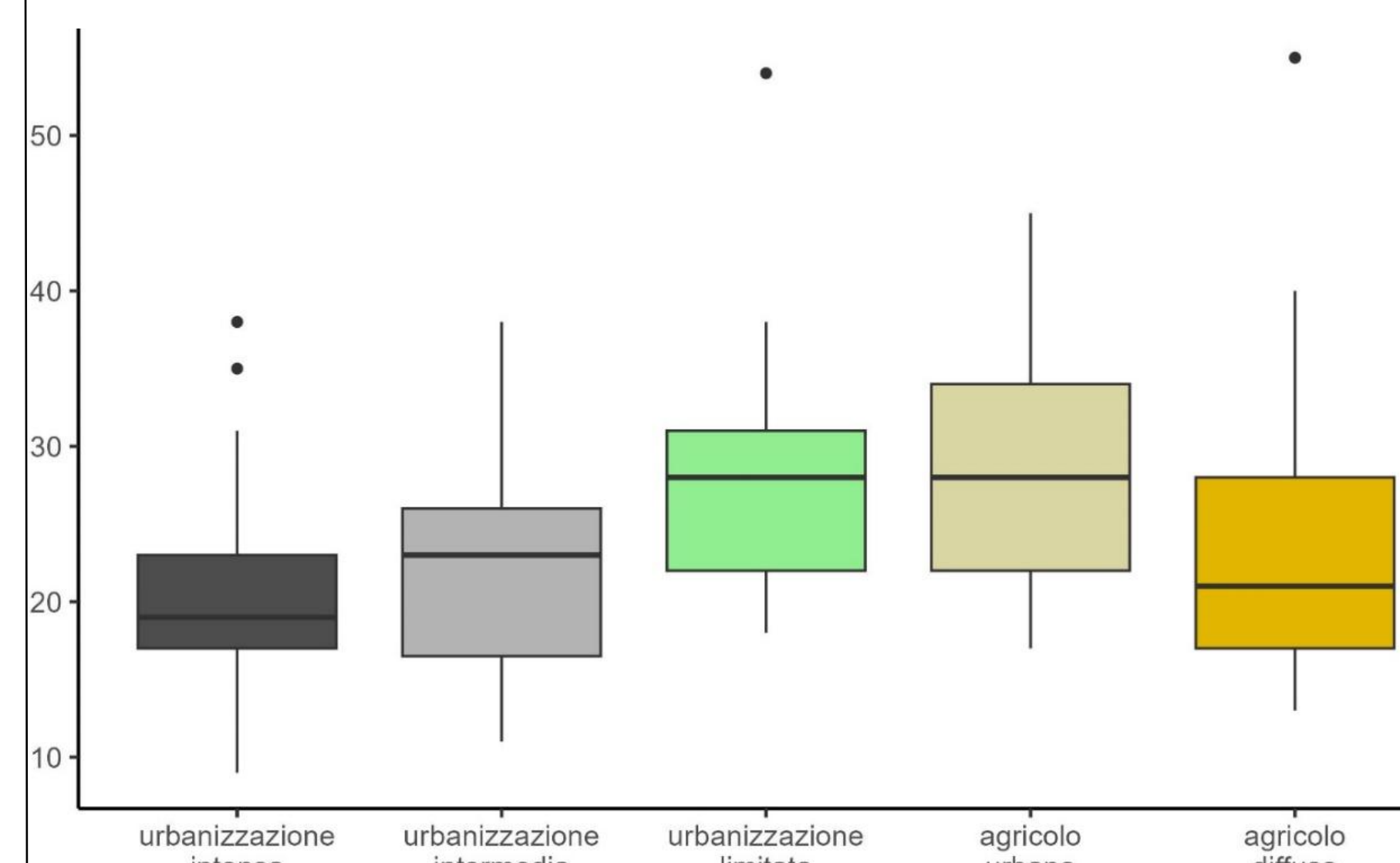


Current: 2020-2024 = 87 cells



Decline in occurrence = -55.2%

## Cells' species richness in relation to the habitat types



Gradient: urban -> agricultural