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Comparative analysis of the breeding avifauna of Italian cities

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Abstract – We carried out a large-scale analysis on quantitative and qualitative composition of the bird communities living in Italian urban ecosystems, comparing them with the avifaunas of regional areas. The comparison between these two territorial levels makes it possible to identify the effects of urbanization in different biogeographical and ecological contexts. Particularly, we have analysed the variation of some diversity indexes, biogeographical and chorological categories according to latitudinal gradient. In contrast with the expected biogeographical peninsular effect, the decreasing in species richness for Italian cities is significantly less steep than that observed for their corresponding not urbanized areas. Moreover, Palearctic-Oriental species clearly prevail in cities, regardless of latitude. In the cities small Passerine species are more abundant than in the surrounding areas. The diversity found in the cities, relative to biogeographical categories, may be imputable to the typical ecological diversity of the urban ecosystems. This probable also is the reason of the small size of birds found in the cities and of the differences with surrounding areas.

Riassunto – *Analisi comparativa dell'avifauna nidificante nelle città italiane*. Questo lavoro presenta un'analisi comparativa in termini qualitativi e quantitativi tra le avifaune nidificanti in molte città italiane e le relative avifaune delle Regioni di appartenenza, al fine di evidenziare le differenze esistenti ed individuare particolarità ecologiche e biogeografiche che caratterizzano le avifaune urbane. In particolare abbiamo analizzato la variazione di diversi indici ecologici, alcune categorie biogeografiche e le categorie corologiche, secondo un gradiente latitudinale. Dal punto di vista biogeografico le avifaune cittadine sembrano non soddisfare alcuni andamenti generali, quale ad esempio la riduzione del numero di specie lungo il gradiente latitudinale peninsulare. Anche la similarità specifica tra le avifaune cittadine non si presenta in linea con le previsioni, data l'elevata percentuale di specie del Paleartico orientale nei centri urbani rispetto alle regioni nel loro complesso. Generalmente nelle zone urbane le specie ornitiche prevalenti sono Passeriformi di piccola taglia. La notevole diversità ecologica, riscontrabile nel mosaico ambientale urbano, potrebbe spiegare il discreto livello di diversità biogeografica rilevato nei biotopi cittadini. Ciò potrebbe giustificare anche la prevalenza di specie di piccola taglia e la maggiore diversità rispetto alle regioni circostanti.

In the 1960's, UNESCO research projects known as MAB 11 and MAB 13 were the first contributions towards an environmental analysis of cities, and the subsequent work of Numata (1976, 1990) and other researchers, such as Detwyler and Marcus (1972), Stearns and Montag (1974) and Duvigneaud (1974) provided a more complete knowledge of urban ecosystems. This was a launching pad for much researches on the various components of this ecosystem, including, of course, the biotic one (Caccamise and Luniak 1996, Barczaka and Indykiewicza 1998.

Within this framework, birds are undoubtedly one of the best studied taxonomic groups (Dinetti 1988), being they characterised by a high ability to colonize new habitats, interacting with them at various levels, thus becoming valuable biological indicators (Furness and Greenwood 1993, Boulinier *et al*. 1998).

Most researches have focused on the composition of urban avifauna, through the publication of ornithological atlases - available for at least 27 European cities - and checklists (Dinetti *et al*. 1995, Dinetti *et al*. 1996, Dinetti and Fraissinet 1998, 2001, Kelcey and Rheinwald 2005), on the analysis of temporal changes in urban bird communities (Luniak 1990, Konstantinov *et al*. 1996, Nowakowski 1996, Dinetti and Romano 2002, Fraissinet 2006), and on the study of "insularity" of urban parks for the conservation of birds in cities (Pompilio 1997, Fernandez-Ju-

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ricic and Jokimäki 2001). Recent aim of ecological analyses of urban avifauna was comparative analysis with avifauna living on adjacent not urbanized areas (Witt 1980, Clergeau *et al*. 2001, Jokimäki *et al*. 2002, Jokimäki and Kaisanlahti-Jokimäki 2003). Although these authors introduced some interesting topics, study cases were few and sometimes characterised by local problems, thus resulting difficult to use as models. However, all those comparative studies indicate that urban avifauna is quite homogeneous, irrespective of latitude (Clergeau *et al*. 2006, Sorace and Gustin 2008).

The aim of our research was a large-scale analysis on the effects of urban ecosystem on the structure of the bird communities, by comparing urban and non urban bird communities living in the same geographical region.

Analysis was carried out thanks to the availability of ornithological atlases or checklists for many Italian areas, including cities and larger surrounding areas (Fig. 1).

Figure 1. Study area, showing the location of the cities analyzed – *Area di studio, con evidenziate le città considerate nelle analisi*.

METHODS

Materials

We selected non urban communities inhabiting large areas surrounding the urban areas; comparison between these territorial areas - urbanized and larger surrounding one -allowed us to identify the effect of urbanization in different biogeographical and ecological contexts. On the whole, urban avifauna of 29 Italian cities was analysed, and compared with 11 wide surrounding areas (Fig. 1 and Tab. 1a and 1b, where further data and bibliographic sources are listed).

We did not consider the Atlases in which urban areas is smaller than overall territory studied, because we consider that the urban areas have a limited impact on the birds communities, as the case of Trento (LIPU 1998), Cossato (Bordignon 1997) and Marcon (Stival 1990). In other cases, like Cagliari, where areas include also interesting naturalistic area, we have used only urban bird communities (ICNUSA 1994).

Overall, we worked on 40 species lists belonging to different towns and surrounding areas.

Data analysis

The following community variables were used: *Species richness* (S), *Percentage of non-Passerines on total species* (%NP/Tot), *Ratio between non-Passerines and Passerines* (NP/P).

Since species richness is affected by the territory size, we analyzed only the general trend of latitude variation within each category, urban and non urban habitat. Regression analysis was performed using least-squares method. The *Average body mass*, an ecological indicator, was calculated for each species as suggested by Snow and Perrins (1998). Comparative analysis of the *Average Faunistic Value* (AFV) (Brichetti and Gariboldi 1992) was also carried out; it measures the faunistic value of each Italian breeding bird species with the aid of an algorithm including 15 parameters of different value, as biogeographical, conservation, ecological, naturalistic, recreational, scientific, etc. It was not taken into consideration for *Columba livia* var. *domestica* and some exotic species.

In order to identify similarities among bird communities of different areas we used a Principal Component Analysis (PCA) using the full sample of cities and corresponding larger surrounding areas (N = 40).

Through a *Biplot Mixed Rohlf* strategy, we plotted on the same graph both community variables and objects (cities and larger surrounding areas), which consented us to identify homogenous groups of sites, along with the relative contribution of each variable used.

Then, we performed a cluster analysis (UPGMA method) using the qualitative Sorensen index (S = 2c/a+b, where a and b are the total number of species detected in each area, c is the total number of species in common in both areas) for cities and surrounding areas, which allowed us to identify homogenous groups among urban avifaunas. Biogeographical analysis was based on the percentage of species belonging to each chorological category living in each city and surrounding area.

Statistical analysis was performed using the Syntax 2000 software (Podani 2000).

Table 1a. Cities included in this analysis, ranked from North to South, including data source and geographic and human population data (region in parentheses) – *Le città incluse nell'analisi, ordinate da nord a sud, con informazioni sull'origine dei dati e sulla popolazione umana*.

City	*Data source*	*Population*	*References*
Varese (Lombardy)	Atlas	88,000	Viganò 1996, Viganò pers. com.
Brescia (Lombardy)	Atlas	199,000	Ballerio and Brichetti 2003
San Donà di Piave (Veneto)	Atlas	32,000	Nardo 2003
Biella (Piedmont)	Atlas	54,000	Bordignon 1999
Milan (Lombardy)	Atlas	1495,000	Nova 2002
Padua (Veneto)	check-list	226,000	LIPU Padova 1999 and ebnitalia updates
Crema (Lombardy)	check-list	35,000	Mastrorilli 2002
Cremona (Lombardy)	Atlas	77,000	Groppali 1994
Pavia (Lombardy)	Atlas	82,000	Bernini *et al*. 1998
Turin (Piedmont)	Atlas	1036,000	Maffei *et al*. 2001
Parma (Emilia Romagna)	check-list	140,000	Roscelli 2005
Reggio Emilia (Emilia Romagna)	Atlas	141,000	Gustin 2002
Genova (Liguria)	Atlas	700,000	Borgo *et al*. 2005
Modena (Emilia Romagna)	check-list	177,000	Fangarezzi *et al*. 1999
Bologna (Emilia Romagna)	check-list	435,000	Tinarelli and Boldreghini 1993
Savona (Liguria)	check-list	72,000	Galli and Spanò 2001
La Spezia (Liguria)	Atlas	109,000	Dinetti 1996
Florence (Tuscany)	Atlas	376,000	Dinetti and Romano 2002
Pisa (Tuscany)	Atlas	104,000	Dinetti in press
Livorno (Tuscany)	Atlas	100,000	Dinetti 1994
Grosseto (Tuscany)	Atlas	71,000	Giovacchini 2001
Viterbo (Lazio)	Atlas	59,000	Cignini *et al*. 1994
Rome (Lazio)	Atlas	2815,000	Cignini and Zapparoli 1996
Bari (Apulia)	check-list	342.000	Bux in litt
Naples (Campania)	Atlas	1200,000	Fraissinet 2006
Sassari (Sardinia)	check-list	120,000	Delitala com. pers.
Cagliari (Sardinia)	Atlas	223,000	ICNUSA 1994
Agrigento (Sicily)	check-list	55,000	Grenci com. pers.
Gela (Sicily)	check-list	75,000	Mascara 1992

Table 1b. Regions (larger surrounding areas) included in this analysis ranked from North to South, including data source and geographic and population data – *Aree geografiche vaste utilizzate nelle analisi, ordinate da nord a sud, con informazioni sull'origine dei dati e sulla popolazione umana*.

Larger surrounding area	*Data source*	*Population x1,000*	*References*
Lombardy	Atlas	8876,787	Brichetti and Fasola 1990
Veneto	check-list	4372,869	Sighele 2004
Piedmont	Atlas	4389,430	Mingozzi *et al*. 1988
Emilia Romagna	check-list	3933,203	Bagni *et al*. 2003
Liguria	Atlas	1758,961	AA.VV.1989
Tuscany	atlas	3571,538	Tellini Florenzano *et al*. 1997
Lazio	atlas	5116,125	Boano *et al*. 1995
Apulia	check-list	4026,151	Moschetti et al. 1996 and updates
Campania	check-list	5667,000	Fraissinet *et al*. 2001
Sardinia	check-list	1643,789	Grussu 1995 - 1996
Sicily	atlas	5112,073	Lo Valvo *et al*. 1993

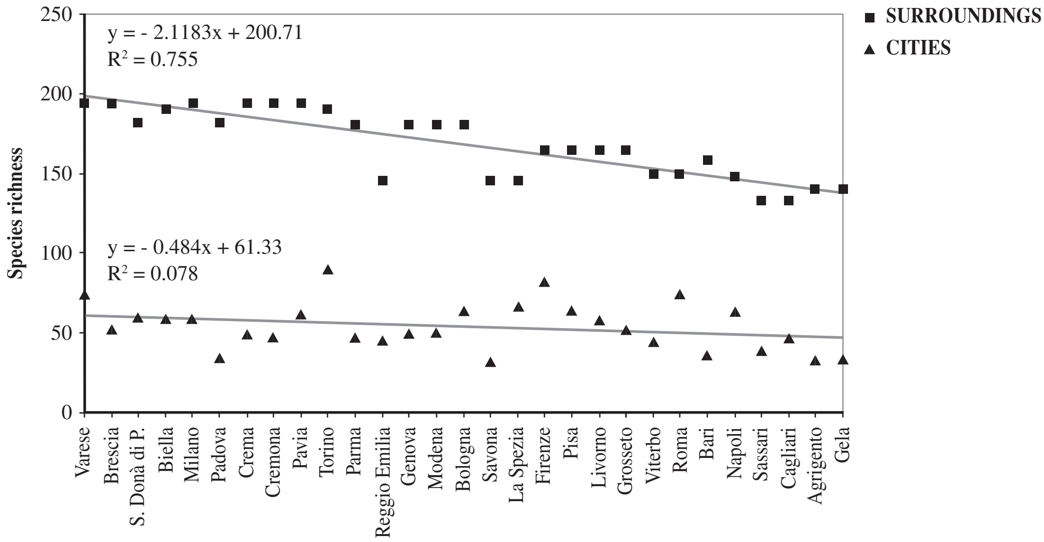


Figure 2. Species richness gradients according to latitudinal gradient (North on the left) of all the cities and larger surrounding areas analysed – *Gradienti di ricchezza in specie al variare della latitudine (nord a sinistra) di tutte le città e delle aree vaste utilizzate nelle analisi*.

RESULTS

Cities resulted poorer in species than surrounding areas (Fig. 2; t-test $p < 0.001$). Species richness shows a negative latitudinal trend from North to South, much more evident in surrounding areas ($y = - 2.2x + 200.7$; $R^2 = 0.755$. $p < 0.05$) compared to their close cities ($y = - 0.5x + 61.33$; $R^2 = 0.08$. $p < 0.05$). According to previous studies (Jokimäki and Suhonen 1993, Jokimäki *et al*. 1996, Clergeau *et al*. 2001, McKinney 2006) our results confirm that the effect of latitude on urban bird communities can be reduced in the towns as compared to surrounding areas.

The proportion of non-Passerines (%NP/Tot) varied according to latitudinal gradient, being always significantly greater for the larger surrounding areas (pairwise t-test $p < 0.001$, Fig 3a). Non-Passerines to Passerines ratio (NP/P) generally confirmed the above difference between larger surrounding areas and cities (pairwise t-test $p < 0.001$, Fig 3b), with the only exception of La Spezia. The same pattern emerged for Average body mass of species, which was always higher in larger surrounding areas than in cities (pairwise t-test $p < 0.001$, Fig 3c). Additionally, Palearctic-Oriental species are clearly prevalent in cities, regardless of latitude (pairwise t-test $p < 0.001$, Fig 3d); we did not find any difference for the other chorological categories.

Finally, the Average Faunistic Value in urban habitats was always significantly lower than in surrounding areas (pairwise t-test $p < 0.001$, Fig 3e).

Multivariate analysis

First two Principal Components explained 90.11% of the total variance and showed a clear distinction between cities and their surrounding areas (Fig. 4) mainly depending on the higher percentage of Palearctic-Oriental species, species richness and Average body mass.

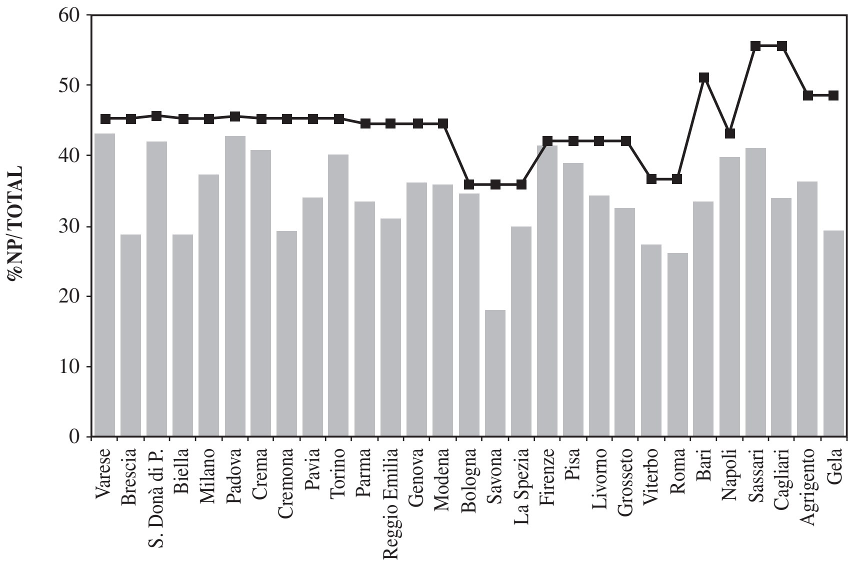
Cluster analysis (Fig. 5) clearly recognised four main groups: cities of Sicily and Sardinia (62% similarity), Tyrrhenian cities between Naples and La Spezia (76% similarity), the Po Plain cities, with the exclusion of Padua (74% similarity), and Alpine cities, including Turin, Biella and Varese (76% similarity). Remaining cities (Bari, Viterbo, Padua and Grosseto) were not grouped and seem independent from each other.

The same analysis applied to habitats surrounding cities (Fig. 6) grouped central Mediterranean areas, including Sardinia, Sicily and Apulia (76% similarity), Tyrrhenian cities (84% similarity) and North Italy (85% similarity).

DISCUSSION

While it was expected to find a much lower species richness index on the cities than on their surrounding areas, it is interesting to observe that avifauna of Italian cities do not follow the peninsula effect rule, and it is not possible to find a clear decrease in species richness along a North-South gradient, while this phenomenon is clearly evident in the surrounding areas.

a



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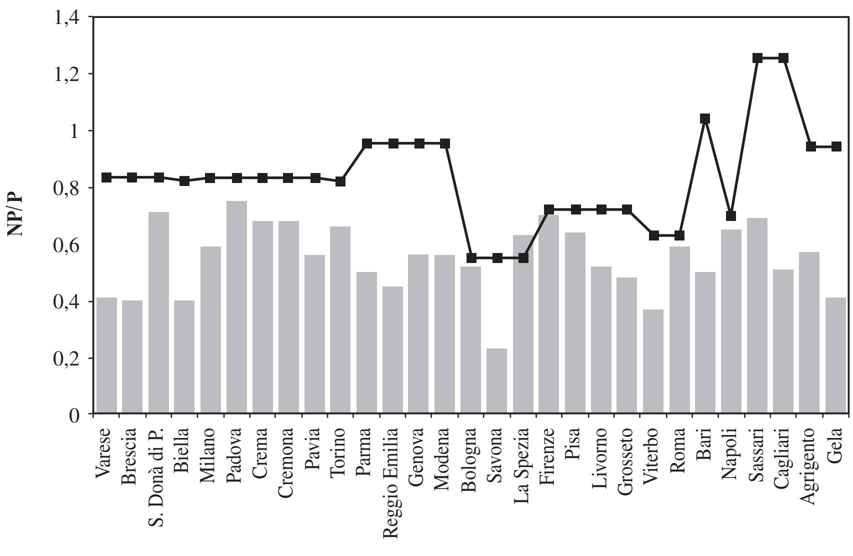

Figure 3. a) Percentage of Non-Passerines on the total number of species (%NP/Tot); b) Ratio of Non-Passerines to Passerines (NP/P). Cities are represented as istograms and larger surrounding areas as line – *a) Percentuale di non-passeriformi sul totale delle specie (%NP/Tot); b) rapporto tra non passeriformi e passeriformi (NP/P). Le città sono rappresentate dagli istogrammi e le corrispondenti aree vaste dalle linee*.

Species richness likely reflects local situations, such as the size of urban areas and available ecological niches. Large cities, as Rome and Naples, are located in the central-southern part of the Italian peninsula, while small cities, as Padua and Savona, are in the northern part, and as a consequence of it, there was the shift in trends recorded in Fig. 2. A similar example of "biogeographic anarchy" is reported by Clergeau *et al*. (2001) in cities of North America and North Europe, where species richness does not decrease with increasing latitude. Conversely, in suburban areas impoverishment of species richness follows the latitudinal gradient. Possibly, in urban ecosystems some factors exist which in natural ecosystem are lacking, as thermal effects, the overall urbanized size of the area, the percentage of parkland and built-up areas, and a high availability of artificial trophic systems; all these may act on the structure of avian communities and probably modify biogeographic patterns.

Clergeau *et al*. (2001) also noted that species richness in urban parks located in the centre of the French cities did not vary significantly with the size of the city or the distance between the urban park and the city's periphery.

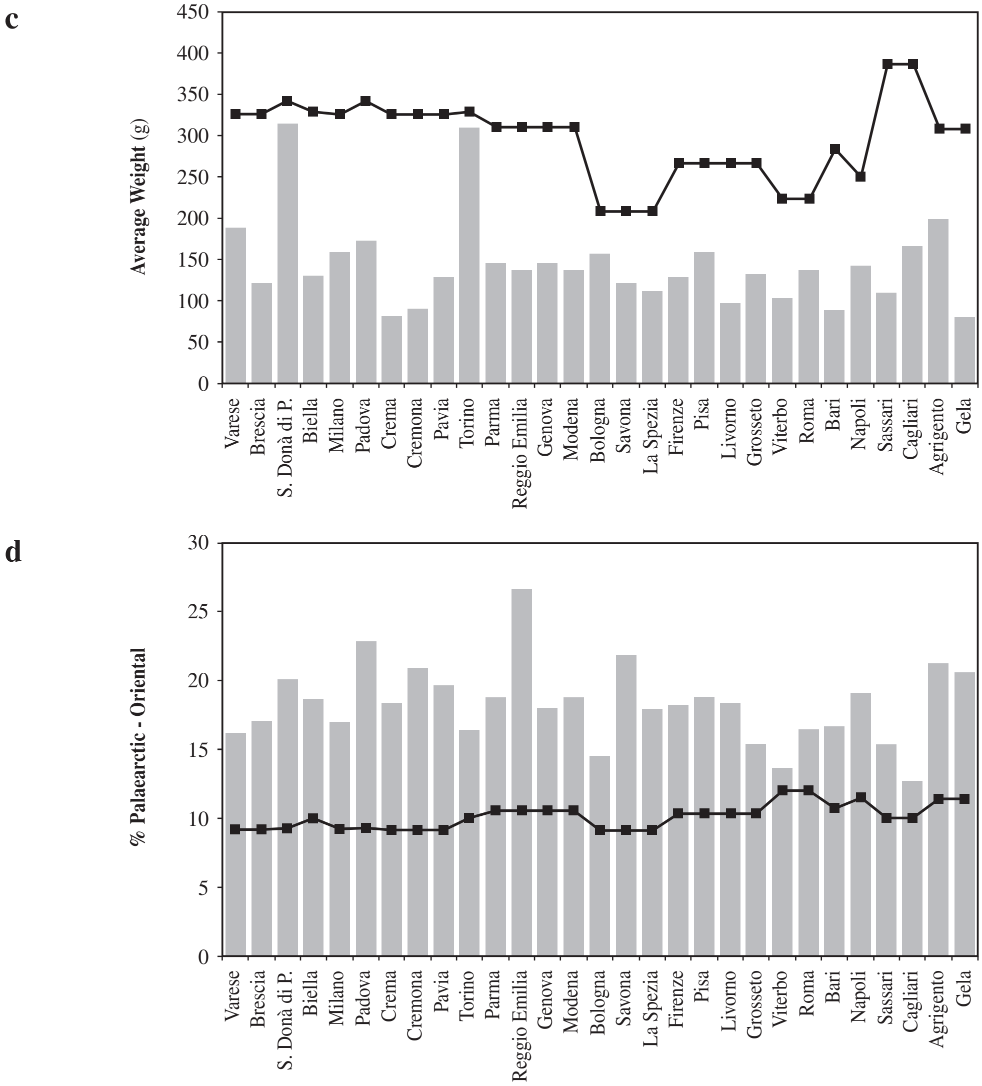

Figure 3. c) Average body mass of species (AWS); d) Percentage of breeding species belonging to the " Oriental-Palearctic" chorological category. Cities are represented as istograms and larger surrounding areas as line – *c) peso medio delle specie; d) percentuale di specie appartenenti alla categoria corologica paleartica-orientale. Le città sono rappresentate dagli istogrammi e le corrispondenti aree vaste dalle linee.*

These significant anomalies could be due to the numerous man-made influences on trophic availability and on the structural and vegetation diversity of the area.

Another biogeographic pattern emerging from our data analysis refers to the high percentage of species belonging to the Oriental-Palearctic chorological category in urban avifaunas compared to those in the surrounding areas. We find this kind of pattern only for this chorological category, as previously observed by Fraissinet (2000); if this will be confirmed in future analyses, an interesting perspective on the urban ecology of avifauna opens. The Oriental-Palearctic category includes species whose distribution spans the Palearctic and Oriental regions, the latter also known as the Indo-Malaysian region (Brichetti 1997, Newton 2003); thus, species belonging to this category show a very wide distribution and must be highly adaptable to occupy such large ranges, with very diverse ecosystems and climates. This high degree of adaptability possibly allows them to colonize a peculiar environment, such as the urban area. Furthermore, the tendency of cities to host a high percentage of wide-ranging species is confirmed by the chorological analysis of Rome's flora, in which "wide-ranging" and "Euro-Asian" species together account for 47% of the city's flora (Celesti Grapov 1995).

e

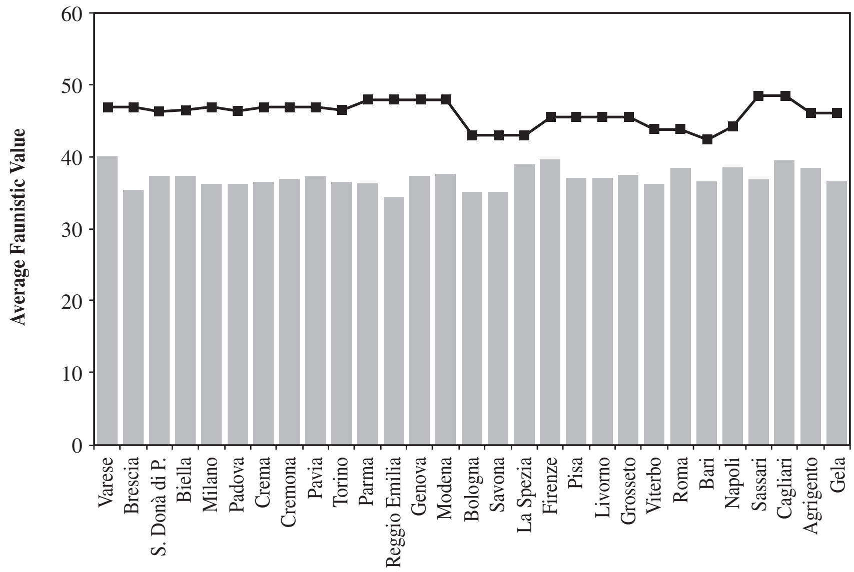

Figure 3. e) Average Faunistic Value (AFV), for the selected cities (bars) and surrounding areas (lines) – *e) valore faunistico medio, per le città selezionate (barre) e per le corrispondenti aree vaste (linee).*

Out of 22 species belonging to the Palearctic-Oriental chorological category, 14 (63.6%) resulted to be common in urban areas: *Fulica atra, Charadrius dubius, Streptopelia decaocto, Alcedo atthis, Dendrocopos major, Delichon urbicum, Motacilla alba, Monticola solitarius, Turdus merula, Periparus ater, Parus major, Sitta europaea, Garrulus glandarius, Passer montanus*. They contributed in a likely important way in discriminating the avifauna of cities and surrounding areas, as shown in Fig. 4.

An additional factor showing the phenomenon defined by us "bio-geographic anarchy" emerge in similarity analysis that group together all the cities and all the surround-

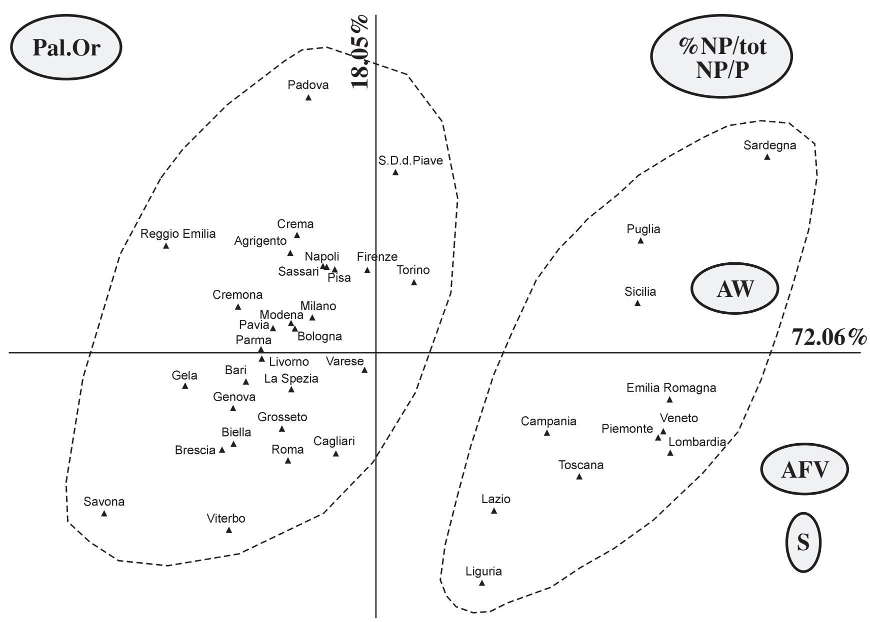

Figure 4. PCA *Biplot Mixed Rohlf* showing community variables (see Fig. 3 for acronyms), utilised for ordination, and objects (cities and large surrounding areas) – *Grafico biplot (PCA Mixed Rohlf), mostrante le variabili di comunità (cfr. Fig. 3) e gli oggetti (città e aree vaste).*

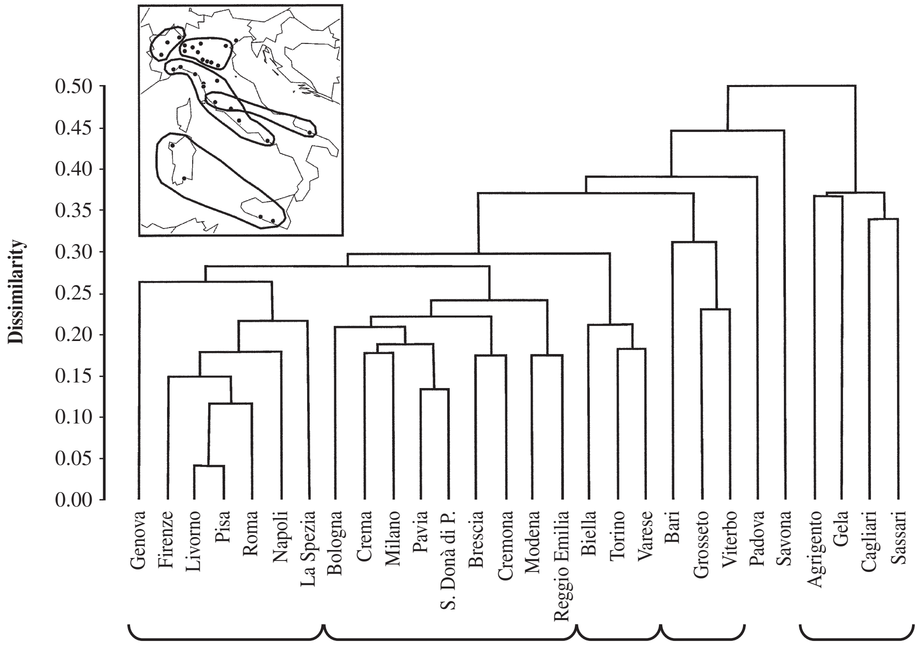

Figure 5. Dendrogram based on Sorensen similarity between the species recorded in each city, performed using a UPGMA agglomeration strategy – *Dendrogramma di similarità (indice di Sorensen, metodo UPGMA) tra le città, basato sulle specie ornitiche nidificanti*.

ing areas. In this analysis the latter clusterize coherently with its geographical context (southern Mediterranean, central Mediterranean, Tyrrhenian coast, North Italy) (Fig. 6). Differently, the cities do not seem to follow this rule, Padua and Bari seem to fall outside its expected geographic group (Fig. 5). This might appear to disagree with the results obtained by Clergeau *et al*. (2006), who showed a certain uniformity degree among urban avifaunas. We should point out that we compared avifauna of cities with that one of surrounding areas, while Clergeau *et al*. (2006) analysed a gradient from outside towards the centre of the cities. However, the values of the similarity distances between North and South cities recorded by Clergeau *et al*. (2006) are similar to those reported by us.

The community structure parameters observed in this study are in line with it has been observed in other urban areas (Fraissinet 2000, Kelcey and Rheinwald 2005). As shown in Figs. 3 and 4, most of the species inhabiting cities are small Passerines. This probably occurs because larger species cannot find non-fragmented territories wide enough in urban areas, to accomplish their biological cycles (with the exception of waterbirds living in urban wetlands), or are in some way disturbed by direct and indirect human influence (Fraissinet 2000, 2006).

Another significant result of this study is that the Average Faunistic Value of avian communities breeding within cities is lower than in the corresponding surrounding areas. Rare and stenoecious species are lacking in urban areas; because this index comprises conservation, faunistic and naturalistic importance of each single species, rare and less generalist species have more specialised ecological needs, showing higher AFV value.

In conclusion, we demonstrated that species breeding in the Italian cities are mostly Passerines of small size, show low AFV, are highly adaptable, and are often very wide-ranging. At the same time, from a biogeographic point of view, the composition of avian communities within cities is very heterogeneous and reflects the specific complexity of each single city, not following clear biogeographic rules.

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REFERENCES

AA.VV. 1989. Atlante degli uccelli nidificanti in Liguria. Regione Liguria, Genova.

Bagni L, Sighele M, Passerella M, Premuda G, Tinarelli R, Cocchi L, Leoni G 2003. Check-List degli uccelli dell'Emilia Romagna dal 1900 al giugno 2003. Picus 56: 8-107.

Ballerio G, Brichetti P 2003. Atlante degli uccelli nidificanti nella città di Brescia. 1994-1998. Natura Bresciana 33: 133-167.

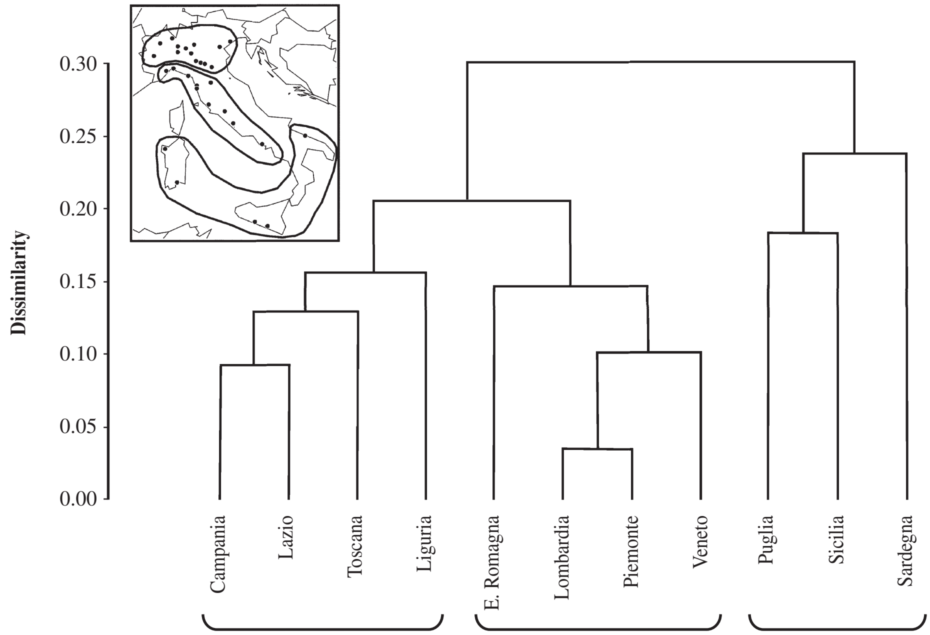

Figure 6. Dendrogram based on Sorensen similarity between the species recorded in each larger surrounding area, performed using a UPMGA agglomeration strategy – *Dendrogramma di similarità (indice di Sorensen, metodo UPGMA) tra le aree vaste, basato sulle specie ornitiche nidificanti.*

Barczaka T, Indykiewicza P 1998. Fauna Miast. Urban fauna. Wydawnictwa Uczelniane Atr., Bydogoszcz.

Bernini F, Dinetti M, Gariboldi A, Matessi G, Rognoni G 1998. Atlante degli uccelli nidificanti a Pavia. Comune di Pavia e LIPU, Pavia.

Boano A, Brunelli M, Bulgarini F, Montemaggiori A, Sarrocco S, Visentin M 1995. Atlante degli Uccelli nidificanti nel Lazio. Alula (volume speciale): 1-224.

Bordignon L 1997 Atlante degli uccelli nidificanti a Cossato. Anno 1989-1995. Città di Cossato, Cossato (BI).

Bordignon L 1999. Gli uccelli della Città di Biella. Comune di Biella, Biella (Italy).

Borgo E, Galli L, Galluppo C, Maranini N, Spanò S 2005. Atlante ornitologico della città di Genova (1996-2000). Università degli studi di Genova. Genova.

Boulinier T, Nichols J D, Sauer J R, Hines J E, Pollock K H 1998. Estimating species richness: the importance of heterogeneity in species detectability. Ecology 79 (3): 1018-1028.

Brichetti P 1997. Le categorie corologiche dell'avifauna italiana. *In* Brichetti P and Gariboldi A (eds) Manuale pratico di ornitologia. Edagricole, Bologna, pp. 221-237.

Brichetti P, Fasola M (eds) 1990. Atlante degli uccelli nidificanti in Lombardia. Editoriale Ramperto, Brescia.

Brichetti P, Gariboldi A 1992. Un "valore" per le specie ornitiche nidificanti in Italia. Rivista italiana di Ornitologia 62*:* 73-87.

Caccamise D F, Luniak M (eds.) 1996. Birds in Urban and Suburban Areas. Selected contributions from XXI International Ornithological Congress. Acta ornitologica 31: 1-88.

Celesti Grapov L 1995. Atlante della flora di Roma. Argos, Roma.

Cignini B, Zapparoli M (eds) 1996. Atlante degli uccelli nidificanti a Roma. Fratelli Palombi, Roma.

Cignini B, Meschini A, Zapparoli M 1994. Progetto Atlante degli uccelli nidificanti a Viterbo: prima stagione di rilevamento (1991). *In*: Baldaccini NE, Mingozzi T, Violani C (eds). Atti del VI Convegno Italiano di Ornitologia. Museo Regionale Scienze Naturali, Torino, pp. 533-534.

Clergeau P, Jokimäki J, Savard J P 2001. Are urban bird communities influenced by the bird diversity of adjacent landscapes? Journal of Applied Ecology 38: 1122-1134.

Clergeau P, Croci S, Jokimäki J, Kaisanlahti-Jokimäki M L, Dinetti M 2006. Avifauna homogenisation by urbanisation: analysis at different European Latitudes. Biological Conservation, 127: 336-344.

Detwyler T R, Marcus M G 1972. Urbanization and environment. Duxbury, Belmont (California).

Dinetti M 1988. Rassegna bibliografica. Gli uccelli negli ambienti urbani italiani. Centro Italiano Ecologia Urbana, Firenze.

Dinetti M 1994. Atlante degli uccelli nidificanti a Livorno. Quaderni dell'ambiente, 5. Comune di Livorno, Livorno.

Dinetti M (ed.) 1996. La conservazione della biodiversità nel comune di La Spezia. Comune della Spezia, La Spezia.

Dinetti M, Fraissinet M 1998. Gli Atlanti ornitologici urbani in Italia. In: Bologna M A, Carpaneto G M e Cignini B (eds) Atti 1° Convegno Nazionale sulla Fauna Urbana, Roma, 12 aprile 1997. Fratelli Palombi Editori, Roma, pp. 37-39.

Dinetti M, Fraissinet M 2001. Ornitologia urbana. Calderini ed., Bologna,

Dinetti M, Romano S 2002. Atlante degli uccelli nidificanti nel Comune di Firenze. Comune di Firenze, Firenze.

Dinetti M, Cignini B, Fraissinet M, Zapparoli M 1995. Gruppo di lavoro "Atlanti ornitologici urbani italiani": standard per le ricerche sull'Avifauna di ambienti urbanizzati. Rivista italiana di Ornitologia 64 (2): 141-149.

Dinetti M, Cignini B, Fraissinet M, Zapparoli M 1996. Urban ornithological atlases in Italy. In: Caccamise DF e Luniak M (eds). Birds in Urban and suburban areas - selected contributions from the XXI International Ornithological Congress (Wienna, 1994). Acta Ornithologica 31 (1): 15-23.

Duvigneaud P (ed.) 1974. Etudes écologiques de l'écosystème urbain bruxellois. Mémoires de la Société royale de Botanique de la Belgique, 6, Bruxelles.

Fangarezzi C, Imperiale A, Selmi E 1999. L'avifauna nella città di Modena. Atti Soc. Natur. e Matem. di Modena 130: 287-318.

Fernandez-Juricic E, Jokimäki J 2001. A habitat island approach to conserving birds in urban landscapes: case studies from southern and northern Europe. Biodiversity and Conservation 10: 2023-2043.

Fraissinet M 2000. Elementi di analisi dell'avifauna italiana nidificante in ambito urbano. Rivista italiana di Ornitologia 70: 13-27.

Fraissinet M 2006. Nuovo Progetto Atlante degli Uccelli Nidificanti e Svernanti nella città di Napoli. Monografia ASOIM n. 6. ASOIM, Napoli.

Fraissinet M, Cavaliere V, Conti P, Milone M, Moschetti G, Piciocchi S, Scebba S 2001. Check-list degli uccelli della Campania. Rivista italiana di Ornitologia 71: 9-25.

Furness RW, Greenwood JJD 1993. Birds as Monitors of Environmental Change. Chapman & Hall, London.

Galli L, Spanò S 2001. Avifauna urbana di Savona. Rivista italiana di Ornitologia 71: 145-150.

Giovacchini P 2001. Atlante degli uccelli nidificanti a Grosseto. Atti del Museo di Storia Naturale della Maremma 17 (Suppl.): 1-221.

Groppali R 1994. Gli uccelli nidificanti e svernanti nella città di Cremona (1990-1993). Azienda Energetica Municipalizzata di Cremona e Museo Civico di Storia Naturale di Cremona, Cremona.

Grussu M 1995. Check-List of the Birds of Sardinia (First part). Rivista italiana di Ornitologia 65: 113-122.

Grussu M 1996. Check-List of the Birds of Sardinia (Second and last part). Rivista italiana di Ornitologia 66: 9-16.

Gustin M 2002. Atlante degli uccelli nidificanti a Reggio Emilia. Comune di Reggio nell'Emilia, Reggio nell'Emilia.

ICNUSA 1994. Studio preliminare dell'Atlante urbano della città di Cagliari. Atti 6° Convegno italiano di Ornitologia: 535-536.

Jokimäki J, Suhonen J 1993. Effects of urbanization on the breeding bird species richness in Finland: a biogeographical comparison. Ornis Fennica 70: 71-77.

Jokimäki J, Suhonen J, Inki K, Jokinen S 1996. Biogeographical comparison of winter bird assemblages in urban environments in Finland. Journal of Biogeography 23: 379-386.

Jokimäki J, Clergeau P, Kaisanlahti-Jokimäki ML 2002. Winter bird communities in urban habitats: a comparative study between central and northern Europe. Journal of Biogeography 29: 69-79.

Jokimäki J, Kaisanlahti-Jokimäki ML 2003. Spatial similarity of urban bird communities: a multiscale approach. Journal of Biogeography 30: 1183-1193.

Kelcey JG, Rheinwald G 2005. Birds in European Cities. Ginster Verlag, St. Katharinen (Germany).

Konstantinov VM, Nowicki W, Pichurn AG 1996. Recent changes in the avifauna of cities in European Russia and Eastern Poland - results of a questionnaire. Acta Ornithologica 31: 59-66.

LIPU 1998. Atlante degli uccelli nidificanti nel comune di Trento. Natura alpina 48: 1-207.

LIPU (Padova) 1999. Le presenze ornitiche nella città di Padova. Ecol. Urbana,1-2-3: 6-7.

Lo Valvo M, Massa B, Sarà M 1993. Uccelli e paesaggio in Sicilia alle soglie del terzo millennio. Il Naturalista siciliano 17 (suppl.): 1-371.

Luniak M 1990. Avifauna of cities in Central and Eastern Europe. Results of the international inquiry. *In* Luniak M. (ed.). Urban ecological studies in Central and Eastern Europe: 131-149.

Maffei G, Pulcher C, Rolando A, Carisio L 2001. L'avifauna della città di Torino: analisi ecologica e faunistica. Monografia XXXI del Museo Regionale di Scienze Naturali, Torino.

Mascara R 1992. Uccelli in città (Caltagirone-Gela-Niscemi). Edizioni Lussografica, Caltanissetta.

Mastrorilli M 2002. La comunità ornitica nidificante nella città di Crema (CR) nel biennio 2000-2001. Rivista italiana di Ornitologia 72: 261-268.

McKinney ML 2006. Urbanization as a major cause of biotic homogenization. Biological Conservation 127: 247-260.

Mingozzi T, Boano G, Pulcher C (eds) 1988. Atlante degli uccelli nidificanti in Piemonte. Monografia n.VIII del Museo Regionale di Scienze Naturali, Torino.

Moschetti G, Scebba S, Sigismondi A 1996. Check-list degli uccelli della Puglia. Alula 3: 23-36.

Nardo A 2003. Atlante degli uccelli nidificanti e svernanti a San Donà di Piave. Amm. Com. di San Donà di Piave e LIPU, San Donà di Piave (Italy).

Newton I 2003. The Speciation and Biogeography of Birds. Academic Press, London.

Nova M 2002. Dal Moltoni al 2000: le conoscenze sugli uccelli nidificanti a Milano. Rivista Italiana di Ornitologia, 72: 127-149.

Nowakowski JJ 1996. Changes in the breeding avifauna of Olsztyn (NE Poland) in the years 1968-1993. Acta Ornithologica 31: 39-44.

Numata M 1976. Methodology of Urban Ecosystem Studies. In Science for Better Environment. Proceeding International Congress on the Human Environment: 221-228. HESC ed., Tokio.

Numata M 1990. Urban ecology in the broader context of ecological sciences. Natural History Research 1: 1-10.

Podani J 2000. SYN-TAX program package designed for multivariate data analysis. Department of Plant Taxonomy and Ecology, L. Eötvös University, Budapest, Hungary.

Pompilio L 1997. Analisi dell'avifauna dei parchi urbani: primi risultati di un approccio secondo la teoria della biogeografia insulare. In: Bogliani G, Galeotti P e Torre A (eds.). Atti IX Convegno italiano Ornitologia. Avocetta 21 (1): 20.

Roscelli F 2005. L'avifauna nella città di Parma. Ecologia urbana 17: 27-30.

Sighele M (ed.) 2004. Check List degli Uccelli del Veneto. Sito Web di EBN Italia (http://www.ebnitalia.it/).

Snow D W, Perrins CM 1998. The Birds of the Western Palearctic. Coincise edition. Oxford University Press, Oxford-New York, 2 voll.

Sorace A, Gustin M 2008. Homogenisation processes and local effects on avifaunal composition in Italian towns. Acta Oecologica 33: 15-26.

Stearns FW, Montag T (eds.) 1974. The urban ecosystem. A holistic approach. Hasted, Chicago.

Stival E 1990. Avifauna e ambienti naturali del comune di Marcon (Venezia). Uniongrafica, Marcon (VE).

Tellini Florenzano G, Arcamone E, Baccetti N, Meschini E, Sposimo P 1997. Atlante degli uccelli nidificanti e svernanti in Toscana. Quaderni Museo Provinciale Storia Naturale di Livorno, Monografia n.1., pp. 413.

Tinarelli R, Boldreghini P 1993. Avifauna delle aree urbane con particolare riferimento. alla conurbazione di Bologna. In Cencini C and Dindo ML (a cura di). Ecologia in città. Editrice Lo Scarabeo, Bologna.

Viganò A 1996. Il progetto Atlante degli uccelli nidificanti nel comune di Varese. In: Fraissinet M., Coppola D., Del Gaizo S., Grotta M. and Mastronardi D (eds). Atti del Convegno Nazionale "L'avifauna degli ecosistemi di origine antropica: zone umide artificiali, coltivi, aree urbane". Monografia n. 5 dell'A.S.O.I.M., Electa ed. Napoli, pp. 46-47.

Witt K 1980. Comparison of the avifaunas of London and Berlin based on atlas work. In: Oelke H. (ed.). Proceeding VI International Conference Bird Census Work, Gottingen: 292-297.