Urban wetlands: wastelands or hotspots for conservation? Two case studies from Rome, Italy

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Abstract – Urbanization is one of the main causes of the loss of wetlands today. Current urban planning and management rarely consider tthe value of wetlands despite the wide acknowledgement of the important ecosystem services they provide, particularly in terms of biodiversity conservation. Here, we provide data on bird communities wintering in two urban wetlands of the city of Rome, Italy, focusing on waterbirds and raptors in order to assess the importance of these areas for wildlife conservation and education. The field survey was conducted on January 2016 and January 2017. The first site comprised a section of the Tiber river and the surroundings open areas and host an average of 1041.5 ± 486.5 of birds belonging to 16 species of waterbirds and four raptor species. The other one is a flooded flint quarry where we counted an average of 440 ± 56 of birds belonging to 13 species of waterbirds and 3 species of raptors. Some species of conservation concern were regularly observed at both sites. Our results show the importance of these two sites for bird conservation but also for environmental education given their location inside the urban area of the largest Italian city.

Keywords: urban wetlands, waterbirds, urbanization, conservation, IWC.

INTRODUCTION

Over the last century the landscapes of Italy have been profoundly modified with changes in land use induced by industrialization, agricultural intensification and urbanization processes. These processes were the major causes for the loss of wetlands that were extensively drained and developed for production needs. Until the 1950s wetlands were perceived as unhealthy, dismal areas that were an obstacle for economic development (Vileisis 1997). Today it is widely acknowledged that wetlands provide ecosystem services (benefits that human obtain from ecosystem functions, Boyer & Polasky 2004) of paramount importance such as: biodiversity conservation, water purification, flood control, ground-water recharge, pollutants degradation, nutrient retention, recreation and aesthetics (Boyer & Polasky 2004). Moreover, urban wetlands can act as cold-islands, mitigating urban heat islands (UHI) effect that is one of the prominent characteristics of urban climate. Indeed, presence/absence of wetland can determine a temperature difference of up to 9.3 °C in cities, in a calculated buffer of 200 metres (Zhang *et al.* 2015). The value of these ecosystem services is often difficult to quantify, however Ibarra *et al.* (2013) in a rural-urban sector south of Mexico City calculated that biodiversity conservation was the highest in term of monetary value. Research that investigated the relationship between people and wetlands in urban environment showed that residents identify wetlands as part of their neighbourhoods, appreciating the aesthetic attributes and habitat for wildlife (Adams *et al.* 1984, Manuel 2003). Another study showed that there is a significant correlation between property prices and distances to wetlands and new housing developments in Australia have created artificial wetlands to add extra environmental appeal to their properties (Tapsuwan *et al.* 2009). However, and despite the growing understanding of their importance, wetland areas are still under threat. In particular, urbanization is still nowadays a major cause of the loss of wetlands (Boyer & Polansky 2004, Li *et al.* 2010) also because more than half of the world's population now live in cities. Available international agreements, such as the Ramsar Convention's (Matthews 1993), have several conceptual drawbacks that weaken their effectiveness in complex urban contexts (Hettiarachchi *et al.* 2015). Urban eco-

systems are highly fragmented, heterogeneous landscapes dominated by buildings, roads and often lacking in substantial vegetation cover (Jokimaki 1999). Therefore, several studies focused on urban wetlands to evaluate their importance in hosting bird communities both in relation to the degree of development and in comparison with wetlands in rural areas or in the wild. Generally speaking, bird diversity and abundance in urban ecosystems are usually altered when comparing with wildlands, some species increases thanks to high resource availability but local diversity tends to decline with increasing urbanization (Melles *et al*. 2003, Shochat *et al.* 2006). However most of the studies pointed out that urban wetlands host bird communities showing higher species richness than rural wetlands (McKinney *et al.* 2011, Traut & Hostetler 2004) and large urban wetlands support higher densities of waterbirds than rural wetlands of the same size (Murray *et al.* 2013). Moreover, waterbirds use all available urban wetlands, no matter how small or isolated they are, while adjacent small wetlands act similarly to larger wetlands in supporting waterbirds (Pearce & Green 2007).

Scientific literature is still lacking a deep comprehension of the ecology of urban wetlands and consequently also lack a response to the question of how to manage these areas for both humans and wildlife needs. Generally, urban planning and management practices consider only the economic impact of urbanization. Decision makers, both private landowners and public institutions, seldom have a clear idea of the impact of their decisions on urban wetlands and on the ecosystem services that their management decision may affect. We show and discuss here two-years data on wintering waterbirds in two urban wetlands in Rome, the largest town of Italy, in order to provide a broader perspective on the unique value of these sites, currently under threat.

MATERIALS AND METHODS

The urban area of Rome extends for a surface of about 1.300 km^2, however the municipality comprises important agricultural areas with large patches of woods and Mediterranean bush. The town was built along the Tiber river which is the longest river of central Italy. Along the river valley as well as along the coast line, that is about 25 km from the city centre, there were huge wetlands that were drained and dried in the first half of the 20th Century. Today, the presence of wetlands is reduced to the river itself, to small residual areas of ancient wetlands and to some flooded quarries. For this survey we considered two different sites located at the southern border of the urban area: the southern part of the Tiber river inside the GRA (Ring Road of Rome) and a flooded flint quarry along the Laurentina road. Both sites are partly surrounded by neighbourhoods, roads, and infrastructures of different kinds. However, both are also still surrounded by fields and semi-natural areas partly comprised within two Protected Areas managed by RomaNatura Regional Authority. Nevertheless, both sites are considered by land owners as well as local institution as marginal wasteland devoted to become part of the urban fabric.

Tor di Valle Tiber river

The river in this last part, before running off the town, makes a meander and pass along a wide open and flat area where the building of a new stadium is planned together with many other buildings and infrastructures. Open areas (arable lands, pastures and grasslands) extend for more than 200 ha and part of these areas are floodplain meadows becoming feeding sites for herons and other birds during winter (Fig. 1A). Both shores of the river show fragmented presence of tree cover mostly with poplars (*Populus* sp.) and willows (*Salix* sp.) covering a surface of about 22 ha. In the study area the river receives a couple of tributaries and there is also one of the largest water purification system of the town extending for about 64 ha. A small part of the area (about 5 ha) is included inside the Natural Reserve of "Tenuta dei Massimi". In the Protected Area zoning the section along the river is considered general reserve, limited development zone. This site is comprised into the IWC (International Waterbirds Census) macro-zone RM0300.

Vallerano flooded quarry

This site extends on about 22 ha and is located few hundred metres outside the GRA (Ring Road of Rome). It is a former flint quarry where mining stopped in 2012. In 2013 the quarry was flooded with aquifer water that now cover about 6 ha (Fig. 1B). Since 2013 the site has been rapidly colonized by wild plants and animals. The site is entirely included into the Natural Reserve of "Decima Malafede" that was already known for its wintering waterbirds before the flooding of the quarry (Panuccio 2009). There is no zoning for this Protected Area where safeguards rules are still in force. This site is comprised into the IWC (International Waterbirds Census) macro-zone RM00818.

The survey

We counted wintering birds during January 2016 and 2017, focusing on waterbirds and raptors. Each site was visited at least twice during the month with the aim of counting all waterbirds and raptors occurring at the site during each visit. Here we report the maximum number observed for

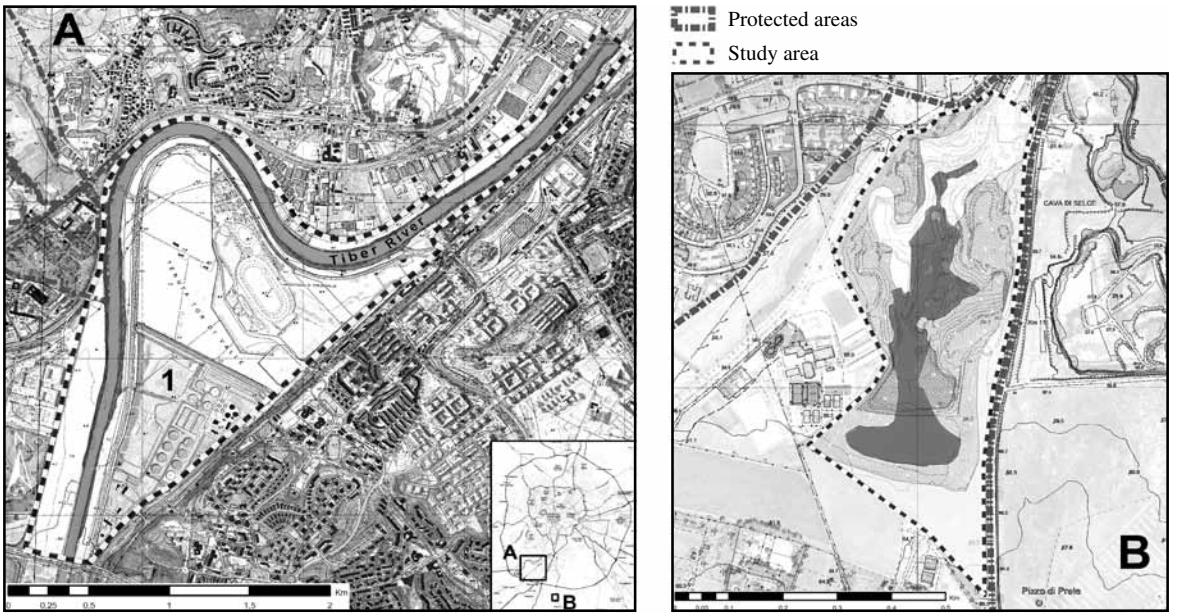

Figure 1. The study areas. Panel A - Tor di Valle Tiber River, 1) water purification system. Panel B - Vallerano flooded quarry. In dark grey the river and the pond inside the former quarry. The paler areas indicate open area with rank ground vegetation (i.e. arable land, pasture land). The small box in the lower right corner of panel A shows location of the two sites in Rome.

each species during each season. We conducted observations in the afternoon, waiting until sunset to count roosting birds (the largest flocks) from vantage raised points (Bibby *et al*. 2000) Binoculars 10X42 and telescopes were used to detect, identify and count birds that, apart roosting birds, were counted walking along the edge of the two areas (Bibby *et al.* 2000). Fieldwork was carried out by rangers in charge of wildlife monitoring activity of RomaNatura Regional Authority. We used chi square tests to compare number of counted waterbirds across the two years for each site (Fowler & Cohen 1992) while we calculated the community similarities (what the communities have in common in terms of species) using Sørensen's Coefficient (CC) = 2C/(S1 + S2), where C is the number of species the two communities have in common, S1 is the total number of species found in community 1, and S2 is the total number of species found in community 2.

RESULTS

The communities of waterbirds observed account for 16 species in the area of Tor di Valle and 13 species in the Vallerano flooded quarry, considering the two years together (Tab. 1). The Sørensen's Coefficient (CC = 0.71) shows that these communities have quite a bit of overlap or similarity.

Recorded numbers greatly vary among the two years, with higher numbers recorded at both sites in 2017 (Tor di Valle: χ^2 = 460.3, d.f.= 1, P<0.0001; Vallerano: χ^2 =14.2, d.f.= 1, P<0.001). Along the river the commonest species were Great Cormorant *Phalacrocorax carbo*, Cattle Egret *Bubulcus ibis* and the two species of gulls (Yellow-legged Gull *Larus michahellis* and Black-headed Gull *Chroicocephalus ridibundus*). In this area birds were observed both along the river water as well as over the large open area located on the left shore of the river, north of the water purification system, but also along the river bank although to a lesser extent. Several gulls at Tor di Valle were attracted by concrete ponds of the water purification system. At the Vallerano flooded quarry the Cattle Egret was the most abundant observed species. At this site birds were observed mostly on the water because of the steep banks of the pond. Nevertheless, herons were regularly observed feeding on pastures and cultivated fields surrounding the quarry both inside and outside of the protected area. At both sites Great Cormorant and Cattle Egret were counted at roost. The first species uses for roosting the largest *Populus* trees along the left shore of the river while Cattle Egret prefer Giant Cane rushes *Arundo donax* along the shore of the river and dead trees in the water of the flooded quarry.

Among observed raptors, only the Eurasian Kestrel *Falco tinnunculus* winters with more than one individual per site, while Common Buzzard *Buteo buteo* was regular

Table 1. Birds observed during the present survey in the two study areas.

Species	Tor di Valle Tiber river		Vallerano Flooded quarry	
	2016	2017	2016	2017
Podiceps cristatus	-	2	-	-
Tachybaptus ruficollis	-	1	18	11
Phalacrocorax carbo	66	306	-	-
Casmerodius albus	1	3	-	-
Ardea cinerea	2	5	1	-
Bubulcus ibis	68	275	320	417
Egretta garzetta	3	1	1	-
Anas platyrhynchos	32	81	2	2
Anas crecca	4	3	1	1
Anas clypeata	-	-	-	7
Aythya ferina	1	-	4	15
Aythya nyroca	-	-	4	12
Gallinula chloropus	3	7	8	6
Fulica atra	-	5	21	21
Actitis hypoleucos	1	-	-	-
Chroicocephalus ridibundus	142	804	-	-
Larus michahellis	231	34	2	3
Alcedo atthis	1	1	2	1
Tot. waterbirds	**555**	**1528**	**384**	**496**
Buteo buteo	1	1	1	1
Circus aeruginosus	-	1	-	-
Falco peregrinus	1	1	1	-
Falco tinnunculus	2	3	2	1
Tot. raptors	**4**	**6**	**4**	**2**

in winter at both sites and the Peregrine Falcon *Falco peregrinus* was a regular wintering only along the river. The only Western Marsh Harrier *Circus aeruginosus* observed wintering in Tor di Valle was a 2nd CY bird.

At both sites, we recorded different kind of disturb to the birds caused by human activities that are poorly managed in the study areas (although hunting activity is strictly forbidden at both sites).

DISCUSSION

Despite the limited surface extension of the sites and the high disturb level, we recorded the presence of hundreds of birds belonging to different species. Six of these species are included in the Annex 1 of "Birds Directive" 79/409/CEE of the European Union: Ferruginous Duck *Aythya nyroca*, Great White Egret *Casmerodius albus*, Little Egret *Egretta garzetta*, Kingfisher *Alcedo atthis*, Western Marsh Harrier and Peregrine falcon. The new report on the European birds of conservation concern indicates population trends and national responsibilities (BirdLife International 2017). The report points out the crucial importance of Italy for the conservation of Ferruginous Duck and Common Pochard *Aythya ferina*; both species are regularly wintering in the flooded quarry. The presence of these species indicates that the two sites are not ''marginal'' areas but biodiversity rich wetlands hosting species of conservationist concern, even if no actions for wildlife management ever occurred at the sites and human activity is not controlled (except hunting). The number of Ferruginous Duck and Cattle Egret individuals observed during the present survey is relevant if compared to that reported in central Italy. The average number of wintering Ferruginous Duck individuals was 14.8 in Latium during the period 1999-2008 (Brunelli *et al*. 2009) and 11.3 individuals in Tuscany during the period 2001-2006 (Arcamone *et al*. 2007). Ferruginous Duck shows a positive trend both at regional and at national scale (Baccetti *et al.* 2002). The Cattle Egret counted during the winter in the whole Latium showed a

mean of 101.0 individuals with a maximum of 312 individuals in 2003 during the period 1999-2008 (Brunelli *et al.* 2009), while in Tuscany the average number of individuals was 496.8 in the period 2001-2006 (Arcamone *et al.* 2007). This species is increasing and it is likely that actual numbers of wintering Cattle Egret in Central Italy are much larger than those previously reported. In other regions of Italy flooded quarries and rivers host valuable concentrations of wintering waterbirds. In Lombardy, ponds in former quarries and rivers occur for 0.9% and 10.6% of the total regional wetlands surface but host, respectively, 6% and 29% of the total number of wintering waterbirds in that region, with densities that are inferior only to those of wild marshes (Longoni *et al*. 2014).

Difference in numbers across the two years may be caused by different weather temperatures in North Italy, where there are important wintering sites for waterbirds (Baccetti *et al.* 2002). For instance at Venice the average temperatures of January 2017 were 2 °C lower than in January 2016 with coldest recorded peaks of -7 °C (www.weatherunderground.com). The lagoon of Venice hosts an average number of about 200,000 wintering birds including thousands of Great Cormorants (Scarton & Bon 2009). It is possible that in January 2017 high number of waterbirds were forced to move south from their wintering quarters located in North Italy.

The two studied sites are by far the most important wetlands of the urban area of Rome for wintering waterbirds (see also Brunelli *et al.* 2009), despite the human activity that has usually a negative effect on the behaviour of waterbirds (Carney & Sydeman 1999). However the growing extension of the urban fabric seems to give little chance to these sites to remain available for waterbirds, as in the case, but at much a larger scale, of the huge Asian towns where wetlands are destroyed to allows for new settlements (Hettiarachchi *et al.* 2015, Li *et al*. 2010). Unfortunately most urban planning focuses on the effects on economic and commercial activities of the stakeholders while impacts on biodiversity and other ecosystem services is poorly considered (Marzluff *et al.* 2001). Private landowners could decide to drastically modify these wetlands because private benefits from development are far greater than the value captured by wetland conservation. However, from a different point of view, just the opposite may be true and researchers proposed that wetlands should be embodied in the development of the urban landscape (Hettiarachchi *et al*. 2015, Wang *et al.* 2008). In this perspective we suggest that remaining roman wetlands and surrounding agricultural areas in the urban context should be protected from further commercial and residential development for different reasons. First because communities of wintering waterbirds in these sites are of conservationist value. Second because opportunity to observe birds and other wildlife is already very limited in large towns like Rome and, last but not least, because flood-control protection provided by the large open areas comprised in the Tiber river meander of Tor di Valle is likely to be of greatest value for the surrounding neighbourhoods.

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