Wintering range of western yellow wagtail *Motacilla flava* in Africa and Europe in a historical perspective

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Abstract - Over the past few centuries, some subspecies of the western yellow wagtail *Motacilla flava* have shown changes in their reproductive ranges. The aim of this research is to verify if changes have occurred also in the wintering range of the species in Africa and Europe from 1848 to 2017. The data, collected through the consultation of over 840 bibliographic sources, 184 travel reports, 38 databases (including 25 relating to museum collections) and some website, shows an expansion of the wintering range to the north. The analysis is also extended to the single subspecies (*flava*, *iberiae*, *cinereocapilla*, *flavissima*, *thunbergi*, *pygmaea*, *feldegg*, *beema*, *lutea*, *leucocephala*). The factors that can affect the conservation of the species during wintering are examined and the oversummering range of *Motacilla fla*va in sub-Saharan Africa is also discussed.

Keywords: Europe, Africa, Sahel, climate change, northward range expansion, farmland expansion, agrochemical impact, oversummering in sub-Saharan Africa

Riassunto - Areale di svernamento della cutrettola *Motacilla flava* in Africa ed Europa in una prospettiva storica.

Dal 1848 al 2017 l'area di svernamento della cutrettola *Motacilla flava* in Africa è rimasta sostanzialmente stabile, con una probabile riduzione quantitativa in South Africa, forse legata al complessivo declino della specie nell'area di riproduzione europea. Dalla metà degli anni 1980 l'areale di svernamento si è significativamente espanso verso nord occupando in Europa l'area con temperature medie in gennaio superiori a 0 °C. L'ampliamento verso settentrione dell'area utilizzata per lo svernamento da parte della Cutrettola è coerente con l'analoga tendenza manifestata da altre specie migratrici trans-sahariane, soprattutto non-Passeriformi. L'attuale distribuzione della specie durante l'inverno boreale può essere così sintetizzata: nei Paesi sud occidentali d'Europa (Spagna, Portogallo e Italia) è scarsa, ma regolare; è invece presente in modo più occasionale e limitato in Grecia, nelle isole del Mediterraneo sud-orientale (Malta, Creta Cipro), in Europa occidentale (Francia, Svizzera, Austria, Germania, Olanda, Regno Unito) e in Scandinavia. In Africa settentrionale è presente in modo consistente in Morocco ed Egitto e più limitato invece in Algeria, Tunisia e Libia. Sverna in modo localmente abbondante dal Sahel fino alle aree umide del Botswana; regolare, ma scarsa, più a sud fino a Città del Capo e ancor più occasionale in Angola e Namibia. Presenze sporadiche nelle isole dell'Oceano Indiano (Seychelles, Réunion, ecc.). Assente dalle zone africane prettamente desertiche. A livello di sottospecie nel periodo di studio si sono rilevate le seguenti variazioni: aumentata presenza della sottospecie *flava* in Egitto a partire dagli anni 1970; minore ampiezza dell'area di presenza di *iberiae* rispetto a quanto indicato in pasato, in particolare nell'Africa Occidentale la sottospecie resta confinata fra la costa dell'Atlantico e il meridiano 2° Ovest anziché raggiungere il 14° Est come precedentemente indicato; espansione di *cinereocapilla* verso occidente, con significative presenze numeriche in Senegal e Gambia; maggiore ampiezza dell'areale di *flavissima* nell'Africa Occidentale con possibili presenze anche in Nigeria e Cameroon (s'ipotizza per questa sottospecie la presenza di una rotta migratoria minoritaria che, in modo più intenso in primavera, passa attraverso il Mediterraneo centrale); crescente presenza di *thunbergi* nei Paesi che si affacciano sul Golfo di Guinea ed estensione delle presenze lungo la costa atlantica in Gambia, Senegal e, con individui isolati, anche Marocco; espansione verso Ovest della *feldegg* nella fascia sub-sahariana e, dall'inizio del XXI secolo, in Egitto lungo il Nilo; apparente aumento numerico di *beema* in Ethiopia. Non si sono invece riscontrate variazioni significative nelle distribuzioni di *pygmaea*, *lutea* e *leucocephala*. Nuovi dati suggeriscono un possibile incremento delle presenze di *Motacilla flava* nell'Africa sub-sahariana durante l'inverno australe (giugno-agosto) e, a partire dagli anni 1990 (limitatamente alla parte orientale del continente) l'espansione verso nord dell'ambito geografico interessato da questo fenomeno. Le quattro aree sub-sahariane identificate come prioritarie per la conservazione dei passeriformi paleartici sono perfettamente idonee anche per la specifica protezione della Cutrettola. Ai fini della conservazione della specie, particolare attenzione merita la relazione fra Cutrettola e agricoltura in Africa: l'incremento della frequenza della specie nelle aree coltivate, specialmente in quelle allagate o nelle risaie, è evidente. Dal 1970 al 2000 l'area agricola nell'Africa sub-sahariana è aumentata del 4%, l'impiego dei fertilizzanti è più che triplicato e l'importazione di pesticidi è più che quintuplicato. Soprattuto quest'ultimo aspetto è preoccupante considerando i molteplici effetti che i prodotti chimici impiegati in agricoltura possono avere sugli uccelli. Il più pericoloso sembra essere il Carbofuran che è ancora usato nelle risaie africane per contrastare la presenza di locuste e uccelli. Come documentato in Senegal, tra gli uccelli che muoiono avvelenati nelle risaie a causa dell'uso di Carbofuran c'è la Cutrettola. Il Carbofuran è anche usato intenzionalmente per avvelenare e catturare animali selvatici (inclusa la Cutrettola) utilizzati come cibo dalle popolazioni locali o impiegati per la medicina tradizionale. Anche nell'Europa occidentale l'utilizzo dei prodotti chimici in ambito agricolo durante la stagione riproduttiva può costituire un serio pericolo, soprattutto in considerazione degli elevati livelli quantitativi impiegati per unità di superficie.

Parole chiave: areale di svernamento, Europa, Africa, Sahel, cambiamento climatico, espansione verso nord, espansione agricola, impatto dei prodotti agrochimici, estivazione nell'Africa subsahariana

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INTRODUCTION

One of the creation myths of Ancient Egypt from the Pyramid Texts of the Old Kingdom (ca. 2400-2300 BC) tells of the western yellow wagtail *Motacilla flava*: the Benu bird, the oldest and self-created living creature. It gives an account of the first dawn: the shining Benu bird skimming over the desolate waters of Nun (the dark water of chaos) until it came to rest on the primeval mound (Benben, a pyramid shaped stone) (Pinch, 2002; Redford, 2002; Wilkinson, 2003). As it did so, it opened its beak and cried out through the eternal silence of Nun. This was the first sound. The world was filled with *«that which it had not known»*; the cry of the Benu bird *«determined what is and is not to be»*. Thus, the western yellow wagtail, as a manifestation of the sun god Atum and his ability to regenerate, brought life and light to the world (Quirke, 2001; David, 2002; Allen, 2016). Starting from the Middle Kingdom, the Benu bird was no longer described in the form of a western yellow wagtail, but of a heron (Quirke, 2001; David, 2002; Allen, 2016).

The Pyramid Texts is the oldest written source that refers to the behavior of a bird; in fact, this myth probably originates from the observation of the western yellow wagtails as they flew low over water snatching insects from surface (Kishchinski, 1980) and then alighted on the first outcrops of silt and stones at the end of the flooding of the Nile in late September; after this, life manifests itself in all its forms where previously there was only dry land. The sense of regeneration of the species, from which the Greek myth of the Phoenix originated, could be related to the change in color in western yellow wagtail that the Egyptians, at that time of the year, noticed with the arrival of individuals of the migratory subspecies. The western yellow wagtail *Motacilla flava*, in fact, is a polytypic species which includes ten subspecies distributed as indicated in Tab. 1 (Alström & Mild, 2005; Gill & Donsker, 2017).

Similar to what is known, for example, for European pied flycatcher *Ficedula hypoleuca* (Chernetsov *et al*., 2008; Ouwehand *et al*., 2016) and willow warbler *Phylloscopus trochilus* (Chamberlain *et al*., 2000; Newton, 2008), during the boreal winter, all the subspecies of western yellow wagtail overwinter in Africa with a distribution that reflects, at first glance, their position in the Palearctic: the subspecies nesting in the East, in Asia, mainly overwinter in Easten Africa, and the subspecies nesting in the West, in Europe, mainly overwinter in Western Africa (Fig. 1). In reality, the subspecies in most of the African continent are mixed throughout the winter period, but follow some distribution patterns: the subspecies that nest further north, winter more to the south (leap-frog migration), and for the same subspecies, the males overwinter, on average, farther north than females (Curry-Lindahl, 1963; Wood, 1975; 1992; Bell, 1996; Alström *et al.*, 2003; Rappolle, 2013).

Some studies have shown that the breeding ranges of some subspecies have undergone significant changes over time. Particularly, the ashy-headed yellow wagtail *Motacilla flava cinereocapilla* and the black-headed yellow wagtail *Motacilla flava feldegg* have shown a clear tendency to expand their breeding ranges northwards,

Tab. 1 - Breeding and wintering ranges of western yellow wagtail subspecies / Areale riproduttivo e di svernamento delle sottospecie della cutrettola (source / fonte: Alström & Mild, 2005; Gill & Donsker, 2017).

Scientific Name	**Authority**	**Breeding Range**	**Wintering Range**
M. f. flavissima	(Blyth, 1834)	Britain and coastal Europe	Africa
M. f. flava	Linnaeus, 1758	North and Central Europe to the Ural Mts.	Africa
M. f. thunbergi	Billberg, 1828	North Europe to Northwest Siberia	Africa and South, Southeast Asia
M. f. iberiae	Hartert, 1921	Iberian Peninsula, Southwest France and Northwest Africa	West and Northcentral Africa
M. f. cinereocapilla	Savi, 1831	Italy, Sicily, Corsica, Sardinia and Slovenia	Central Africa
M. f. pygmaea	(Brehm, 1854)	Egypt	Egypt
M. f. feldegg	Michahelles, 1830	Balkans and Turkey to Iran and Afghanistan	South Asia, Northeast, Central Africa
M. f. beema	(Sykes, 1832)	Southwest Siberia and Northeast Kazakhstan to West Himalayas	India, Arabia and East Africa
M. f. lutea	(Gmelin, 1774)	Southwest Russia to Northwest and Northcentral Kazakhstan	Africa and India
M. f. leucocephala	(Przewalski, 1887)	Northwest Mongolia, Northwest China and Southcentral Siberia	India and East Africa

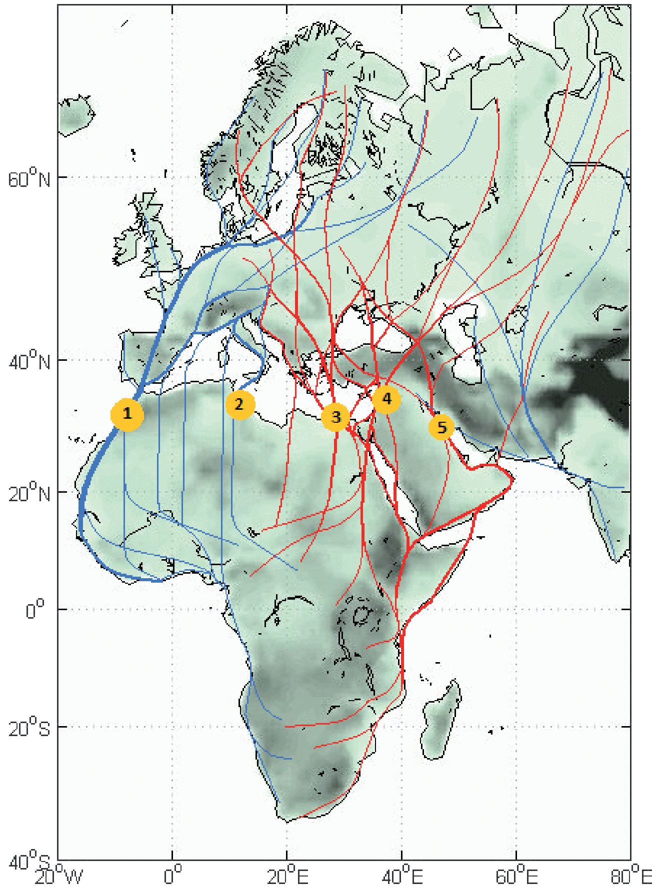


Fig. 1 - Bird migration routes in Europe, Africa, and Western Asia. / Rotte migratorie degli uccelli in Europa, Africa e Asia Occidentale. 1) Scandinavian-Iberian route (Western European) / rotta Scandinavo-Iberica (Europa Occidentale); 2) Central-Mediterranean route / rotta Centro-Mediterranea, 3) Balkan route / rotta Balcanica; 4) Eastern-European route / rotta dell'Europa Orientale; 5) Caspian route / rotta Caspica. (Source / fonte: SE European Bird Migration Network, www.seen-net.eu).

with an accentuation of the phenomenon during the second half of the 20th century (Ferlini, 2015; 2016). These expansions were probably favored by climate change (Ferlini, 2015; 2016).

The first aim of this study was to verify whether, as in the case of breeding ranges, changes have also occurred in wintering ranges of the species and subspecies, taking into account Africa and Europe from 1848 to 2017. Ornithological books and articles provide distribution maps regarding the breeding ranges of the species (Cramp, 1988; del Hoyo *et al.*, 2004; Tyler & Christie, 2017) or also of the subspecies (Dementiev & Gladkov, 1954; Cova, 1969; Bernis, 1970; Ödeen, 2001; Alström *et al.*, 2003; Golovatin & Sokolov, 2017), while wintering ranges are recorded by general maps (Cramp, 1988; Alström *et al.*, 2003; del Hoyo *et al.*, 2004), including, with particular reference to Africa, continental (Keith *et al.*, 1992; Walther *et al.*, 2010) or regional maps (e.g. Harrison *et al.*, 1997; Parker, 1999; Stevenson & Fanshawe, 2002; Sinclair *et al.*, 2005; Hockey *et al.*, 2005; Sinclair & Davidson, 2006; Ash & Atkins, 2009; Redman *et al.*, 2009; Borrow & Demey, 2011), that include species information and indications about the distribution or presence of the subspecies only in textual terms. The only exception is the article by Grant & Mackworth-Praed (1952) that provide indicative maps of the wintering range for every subspecies.

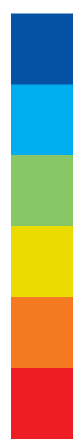
The second aim of this study was to provide current maps of the wintering ranges of the species and subspecies in Africa and Europe.

MATERIALS AND METHODS

The present study is based on data obtained from the consultation of bibliographic sources, travel reports, databases (including 25 relating to museum collections) and some website. However, given the impossibility of consulting all the reports published during the period under study, the data presented here should not be considered exhaustive; nevertheless, they are sufficient to obtain an understanding of the changes that have occurred, as well as the current situation and trends.

The first useful information dates back to 1848, since scientific publications from previous years do not mention the western yellow wagtail (Le Vaillant, 1799) or only refer to it in very general terms (Rüppell, 1845; Jardine, 1848-1852).

To try to give a quantitative indication of the distribution of the species in winter, transposition on distribution maps is made using colours according to the meanings below. The number of individuals is referred to as the maximum number of birds observed in each location. Obviously, these quantitative estimates are purely indicative given the different methodologies used by the various ornithologists to quantify the observed birds.



Single individual or presence without quantitative indication

2-10 individuals

11-100 individuals

101-1,000 individuals

1,001-10,000 individuals

Over 10,000 individuals

I considered winter data only observations recorded in December and January, because the subspecies composition of birds observed during migrations are not representative of wintering birds. I made exceptions to this principle only for periods or areas with limited availability of information and for rare subspecies (e.g. *Motacilla flava leucocephala*).

The findings of this study have been separated into four different time periods: 1848-1900, 1901-1945, 1946-1980, and 1981-2017.

Moreover, for the sake of simplicity, I divided the study area (Africa and Europe) into six geographical sub-areas:

- Southern Africa: Botswana, Lesotho, Namibia, South Africa, and Swaziland.
- Eastern Africa: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Mozambique, Réunion, Rwanda, Seychelles, Somalia, South Sudan, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe.
- Middle Africa: Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, and São Tomé and Príncipe.
- Western Africa: Bénin, Burkina Faso, Cape Verde, Ivory Coast, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Saint Helena, Ascension and Tristan da Cunha, Senegal, Sierra Leone, and Togo.
- Northern Africa: Algeria, Canary Islands, Egypt, Libya, Morocco, Sudan, Tunisia.
- Europe.

RESULTS AND DISCUSSION

Additional Supporting Information containing detailed results for the different geographical areas may be found online for this article.

Wintering range of *Motacilla flava* in Africa (Plate 1)

The distribution of the western yellow wagtail, here understood as species, does not seem to undergo large variations in Africa during the 170 years from 1848 to 2017 and remains mainly concentrated between the two tropics and using the same environments: lake shores, riversides, marshes, savannas, and cultivated fields often associated with grazing cattle, zebras, and antelopes, as already reported by various authors (Keith *et al*., 1992; Bell, 2006; Forget, 2010). Curry-Lindahl (1964) pointed out in the 1960s that:

«… in the African tropics this species has a much wider ecological range than on the Palaearctic breeding grounds. … In Africa, however, the Yellow Wagtail occurs in great numbers also in habitats that do not exist in Europe, for example, banana plantations at various altitudes, and rather arid savannas, where it associates with herds of elephants, buffaloes or various antelopes. Large banana plantations form a type of forest, the soil below the enormous leaves being almost always shaded and bare, for only very poor vegetation can, or is allowed to, grow there. In this dark world Yellow Wagtails may periodically be extremely common. I have also found them on small islands, where they run around basking crocodiles. The most unusual habitat beside that on Mount Nimba was in Lake Mwadingusha in the Katanga, where, in February 1963, the birds used to perch on the dense aquatic vegetation of floating islands out in the open lake, far away from the terrestrial habitats».

An example of what was stated by Curry-Lindahl (1964) is the case of the subspecies *thunbergi* and *beema*. They are sympatric in European Russia and Western Siberia, however there are strong indications for segregated breeding: *thunbergi* occurred in bogs as a breeding bird and *beema* was dominantly found breeding in floodplain meadows (van Oosten & Emtsev, 2013). This separation ceases when the two subspecies reach the African wintering areas where they share the same environments (e.g. shores of lakes and lagoons).

Compared to the past, the only novelty element that has emerged over the last few decades seems to be the growing use of cultivated fields (Bell, 2006), probably due to the more intensive use of irrigation techniques: in recent decades irrigated land is increasing in Africa at the rate of 0.88% per year (FAO, 2016). The total area equipped for irrigation in Africa is 13.5 million hectares of which 11.5 million ha are actually under irrigation (Siebert & Frenken, 2014). The regions with the highest density of irrigated land are located mainly in Northern Africa in the Nile Basin (Egypt, Sudan) and in the Mediterranean countries (Libya, Tunisia, Algeria, Morocco). The countries with the largest amount of irrigated areas are Egypt (3.6 million ha), Sudan (1.8 million ha), South Africa (1.7 million ha), and Morocco (1.5 million ha) (Siebert & Frenken, 2014). All of these countries face arid climate conditions. In Madagascar, where it is more humid, rice is cultivated on about 1.5 million ha of irrigated land (Siebert & Frenken, 2014; Ricepedia.org, 2017).

With regard to the distribution of the abundance of *Motacilla flava* in the African continent, the collected data suggest some changes that have occurred over time, which must however be interpreted with caution due to the different contexts in which they were acquired and the uneven methodologies used:

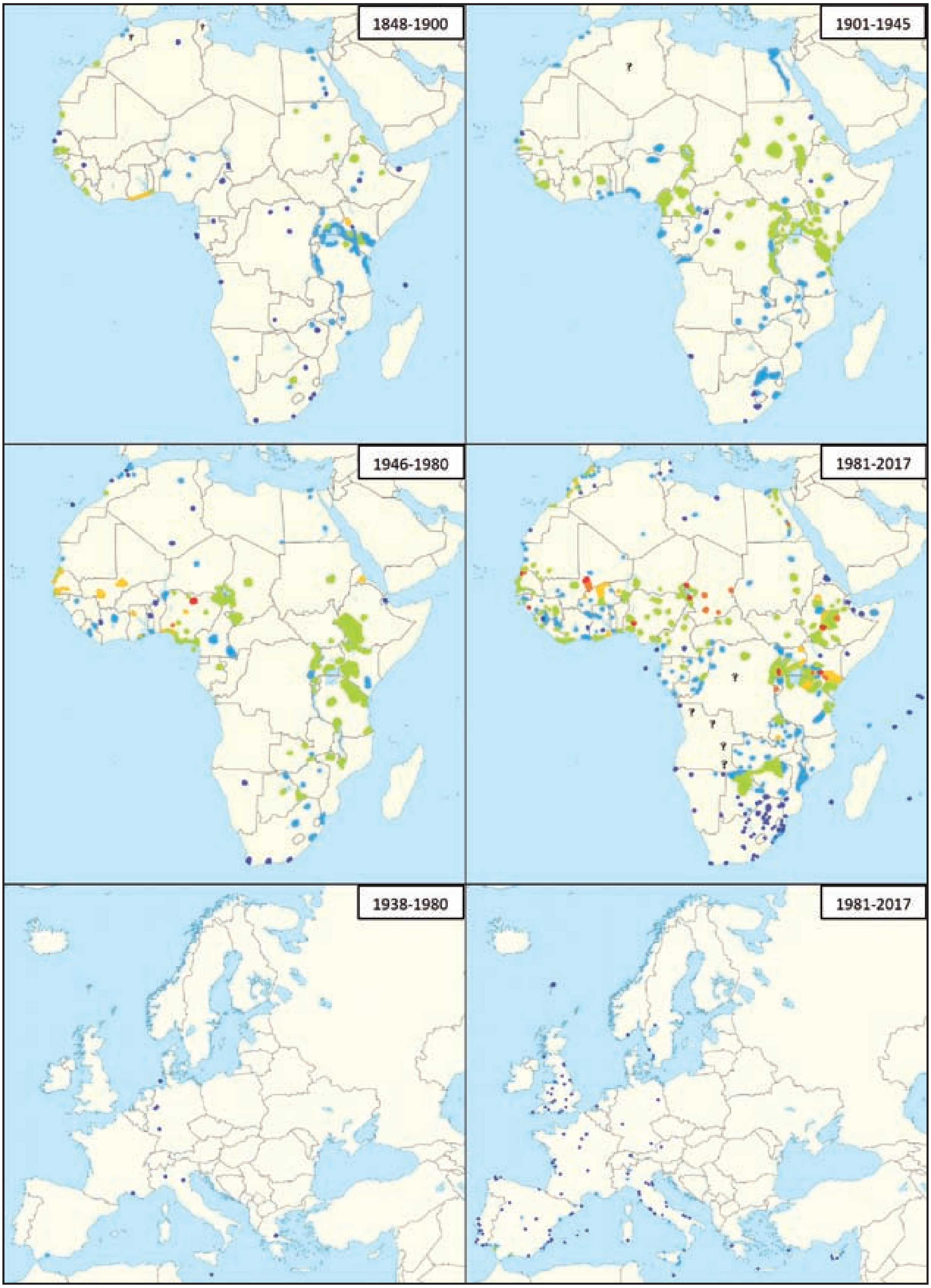
- During the first years of the study period, some areas of the African continent still had to be explored. In particular, it is important to mention that Heinrich Barth, starting from Tripoli, crossed the entire Sahara and explored Lake Chad, then reached Timbuktu, and from there he returned to Tripoli between 1849 and 1855; Richard Burton discovered Lake Tanganyika in 1858; John Speke discovered Lake Victoria and the rapids with which the lake flows into the River Nile in 1862; David Livingstone, starting from Cape Town, traveled throughout Southern Africa, discovering Lake Ngami (1849), the upper Zambezi (1854), Lake Malawi (also known as Lake Nyasa) (1858), and the upper Congo (1869).
- Over time the number of ornithologists or birdwatchers who have visited Africa has progressively increased, and it is therefore quite natural that the mass of information available has increased, making the intensity of data collection in different periods not directly comparable.
- In expressing the presence of the species in the various geographical areas, the authors have often used highly subjective qualitative terms (e.g. scarce, common, abundant) which makes the comparison of data uncertain.

Even with the criticalities described above, I want to provide an interpretation of the changes over time, as perceived by the data collected.

In the extreme southern part of Africa, the presence of the western yellow wagtail had always been regular, but relatively scarce and probably in a tendential numerical regression in the northern regions of South Africa. In

Plate 1 - Wintering range of / Areale di svernamento di *Motacilla flava*.

Single ind.	2-10 ind.	11-100 ind.	101-1,000 ind.	1,001-10,000 ind.	Over 10,000 ind.



fact, while Ayres (1871) defined the species common in Transvaal, as early as the first decades of the 20th century, western yellow wagtail was considered only a regular visitor with discontinuous distribution (Roberts, 1911; Haagner, 1912; Haagner & Ivy, 1923; Meinertzhagen, 1921; Austin, 1942). In the following decades, while increasing data has been available concerning small groups or, more commonly, isolated individuals, I did not find other studies in which the species was defined common, with the sole exception of the Pilanesberg National Park where recently it was judged fairly common (Mankwe Wildlife Reserve, 2014). The hypothesis that there has been a progressive decrease in the number of individuals reaching the South African regions is confirmed for the Transvaal by Tarboton *et al*. (1987), which in the 1980s already reported a decrease of the species during the last century. Both in the period 1946-1980 and in the following one until 2017, the most southern area where the species was common is constituted by the Okavango and Zambezi river basins and, even further south, by the wetlands of the Central District of Botswana (Smithers, 1964; Clancey, 1966; Sinclair, 1994; Harrison *et al.*, 1997; Carruthers, 2000; Mundy, 2000; Newman, 2002; 2003; Sinclair *et al.*, 2002; 2005; Hockey *et al.*, 2005; Sinclair & Davidson, 2006; Gall, 2017; Grant & Marks, 2017; Orrell & Hollowell, 2017).

Apparently, the species has never been observed in the area that includes Cape Plateau (South Africa), Northern Cape Province (South Africa), the northern part of Western Cape Province (South Africa), Karas Region (Namibia), Kalahari Desert, and Namib Desert. For this area, the limiting factor is certainly the arid or semi-arid climate, unsuitable for hosting the species.

In Eastern Africa steadily over the past 170 years, there is a progressive increase in the number of wintering individuals going up, from Mozambique to the north, the East African Rift and the surrounding territories. In particular, the species has high concentrations along the lakes and the craters of the Eastern Rift Valley (including the Main Ethiopian Rift), the Western Rift Valley, and Lake Victoria. This could also be related to the increase in cultivated areas of Eastern Africa passed from 11.5 million ha in 1850 to 111.3 million ha in 2016 (Goldewijk, 2001; Xiong *et al*., 2017). The species is also reported at high altitudes: in the Central Region of Malawi at 1,500-1,700 m a.s.l. (Benson, 1940), on the slopes of Mount Kilimanjaro at about 2,250 m a.s.l. (Cordeiro, 1994), on the Kinangop Plateau at 2,400-3,000 m a.s.l., in the Trans-Mara Forest (Narok County) at about 2,100-2,400 m a.s.l. (Bennun, 1991) and Mount Kahuzi and the Virunga volcanoes at altitudes between 2,100-2,600 m a.s.l. (Curry-Lindahl, 1965).

With regard to the Malagasy Region, the total absence of western yellow wagtail in Madagascar is surprising considering: the great increase in arable land on the island (from 1.9 million ha in 1961 to 3.5 million ha in 2013), the considerable area cultivated with rice (from 0.8 million ha in 1961 to 1.5 million ha in 2014) (Ricepedia.org, 2017), and the repetition of observations (even numerically scarce) in the surrounding islands. The presence of the species in the Malagasy region is attributed to birds that detach themselves from the African continent heading towards east (*flava*, *feldegg*, *beema,* and *lutea* are, in fact, the subspecies present in that part of the African coast). Considering that the Seychelles archipelago is about 1,500 km from the coast of Eastern Africa, the effort required by the western yellow wagtails to reach it is comparable to that required for the Sahara overflight (width 1,500-2,000 km). The total absence from Madagascar is even less plausible after the reporting of a specimen on Réunion in February 2017 (Riethmuller, 2017) as Madagascar is physically interposed between the African coast and this island. Réunion is about 750 km from Madagascar and over 2,000 km from the nearest mainland coast; it seems unlikely that the bird that reached Réunion did not stop in Madagascar before, since it is unlikely that the specimen arrived directly from the island closer on which the species has already been observed (Providence) with a flight of over 1,300 km. Areas of Madagascar potentially suitable for hosting the species are those cultivated with rice distributed in six zones of the island: the north, northwest, and central-western regions; the central part of the Malagasy highlands; the east; and the central-eastern part, including Lake Alaotra with its swampy areas, plains, and valleys.

On the west coast of the African continent, detailed data concerning Angola are extremely scarce over the whole period considered; this probably shows a very limited presence of the species that appears most likely in the south and along the coast (Mills & Melo, 2013), as well as in the northern and eastern regions. Data relating to Democratic Republic of Congo indicate, over time, a persistent and significant presence of the species in the eastern part of the country and, in any case, a diffusion in the remaining part of the country that the maps, in each period, probably underestimate. In fact, several authors over the course of time have insisted that the species (especially the spp. *flava* and *thunbergi*) is common and widespread in all environmentally suitable areas (Chapin, 1953; Pedersen, 2009). In the remaining countries of Middle Africa, despite limited data availability for the period 1945-1980, there seems to be a good presence of the species everywhere, with points of particular concentration in some environments suitable for night roosts (for example around Lake Chad, to other lake basins and also in the rice fields of Southern Chad). Also in this part of the continent, the western yellow wagtail is present in mountain areas, in fact in Cameroon it is common on Mount Oku (Northwest Province) between 2,200 and 2,800 m a.s.l. (Fotso, 2001), and on Mount Cameroon (Southwest Province) at about 1,400 m a.s.l. (Grimes, 1971).

In the area immediately south of the Sahara, the western yellow wagtail is currently widely distributed and quite common with points of considerable concentration especially in Nigeria, Mali, and Senegal, even in mountain areas (e.g. Mambilla Plateau at 1,500-2,000 m a.s.l.; Hall, 1976; 1977). This situation confirms both what emerges from the maps of the less recent periods and what has been highlighted in the past by numerous studies. In particular, the importance was emphasized, both for *Motacilla flava* and other paleartic species, of humid environments constituting the Nile System between the White and Blue

Niles from Khartoum south to Malakal and Roseires, respectively (Hogg *et al.*, 1984), the Lake Chad basin (Salvan, 1967; 1969a; 1969b; 1969c), the inundation zone of the Upper Niger (Curry & Sayer, 1979), and the Senegal River basin (Morel, 1973). The importance of these wetlands has recently been reaffirmed by several authors, who have estimated the presence of about 1,000,000 western yellow wagtails in winter in the inundation zone of the Upper Niger and around 500,000 others in the surrounding green areas (Zwarts *et al*., 2012), around 320,000 individuals in the 700 km^2 of rice fields in Mali (Zwarts *et al*., 2012), around 500,000 specimens in the Senegal delta (Zwarts *et al*., 2012), and around 268,000 individuals in the 1,120 km2 rice fields in Senegambia, Guinea-Bissau, and Guinea (Bos *et al*., 2006). The highest densities were found in rice fields and wetlands with less than 80 cm of water. In general, dry areas have lower densities unless animals are present: in this case the density can be up to five times higher than identical habitats without livestock (Zwarts *et al*., 2012).

In relation to Northern Africa, in Egypt, due to the substantial sedentary nature of the *pygmaea* subspecies, the regular presence of the species along the River Nile and in the area of its Delta (globaly the most extensive oasis on Earth!) is confirmed throughout the investigation period. In Lybia, Tunisia, and Algeria, the situation is uncertain until at least 1945, followed by sporadic reports in the period 1946-1980 and therefore an apparent increase in presences, especially in Tunisia. However, this trend must be considered cautiously given the probable increase in observers and the resulting greater availability of data. Similar attention must be paid to the situation in Morocco, where, however, the progressive increase in winter presences, both in terms of locations frequented by the species and in the number of birds present, as well as the presence of new subspecies never before reported in winter, indicates an actual change taking place. Numerically, the presences are more consistent along the Atlantic coast, but the species has also occupied internal areas with suitable environments. The limited availability of suitable environments seems to be the limiting factor for the wintering of the western yellow wagtail along the Mediterranean coast (Franchimount, *pers. com.*).

African climatic conditions

In consideration of the vastness of Africa, it is difficult to identify specific factors that correlate the distribution over time of the western yellow wagtail in wintering areas with environmental/climatic conditions and, above all, with the changes that have occurred. However, it is worthwhile to describe in general terms the climatic changes that have occurred during the study period, summarizing what is reported in the detailed studies by Nicholson (1994; 1998a; 1998b; 1999; 2001) on the subject. Particular emphasis is placed on precipitation trends as it has proved to be the factor of greatest impact on the environment (Chipanshia*et al*., 1999; Betser, 2005).

With the exception of South Africa and the Mediterranean area, currently most of the African continent has a tropical climate with rains that vary quantitatively along a pronounced gradient: from 1 mm/year in some areas of the Sahara to 5,000 mm/year in equatorial areas. Temperatures are normally high with modest variations in average values throughout the year (south of the Sahara remains between 6 and 10 °C), but day-night temperature variations are greater (as much as 10-15 °C, even more in the deserts).

After a period of strong and anomalous aridity during the 1820s and 1830s, in the mid-19th century, most of the African lakes recovered and by the end of the 19th century, most achieved very high stands, often exceeding any levels reached during the next century. From 1895 to the first decade of the 20th century, a new strong decline occurred in rainfall in the global tropics with arid conditions similar to those of the previous century, although less accentuated in equatorial Eastern Africa and in the temperate extremes of the north and south coasts of Africa. Good conditions returned during the 1920s and 1930s in Western Africa, but dry conditions persisted in Southern Africa. In the 1940s, there was again widespread drought, particularly in Western Africa. More extreme fluctuations occurred in the latter half of the 20th century. In the 1950s, rainfall and river flow increased markedly in the semi-arid regions of Northern and Southern Africa. In the early 1960s, rainfall increased dramatically throughout most of the equatorial region determining a significant increase in the level of Rift Valley lakes. In the late 1960s, a dry phase began that lasted for almost 30 years, followed by a period characterized by greater rainfall. Even with the fluctuations mentioned above, at the continental level the near surface temperatures increased by about 0.5 °C or more during the last 50-100 years with minimum temperatures warming more rapidly than maximum temperatures (Stern *et al*., 2011; Funk *et al*., 2012; Nicholson *et al*., 2013; Niang *et al*., 2014).

In recent times, with regard to the species, the greatest impact occurred during the last phase of widespread aridity in the 1970s as a result of obvious desertification phenomena that affected both wintering areas and territories crossed during migrations. In particular, the area in which the negative effect on the western yellow wagtail was most evident is that of the Sahel. This region lying between 12°N and 20°N longitude, covering the semi-arid and arid climate zones south of the Sahara (Trémolières, 2010). The Sahel region represents a transition zone between the Saharan desert and tropical Africa; it covers all or parts of 12 countries from the Atlantic Ocean to the Red Sea: Senegal, Gambia, Mauritania, Mali, Burkina Faso, Niger, Nigeria, Chad, Sudan, Ethiopia, Eritrea, and Djibouti (Trémolières, 2010). The dominant feature of the climate of this region is the West African Monsoon (WAM) system, which is a recurrent low latitude large-scale circulation pattern arising from the meridional boundary layer gradient of dry and moist static energy between the warm sub-Saharan continent and the tropical Atlantic Ocean; the WAM system develops from April to October bringing the Inter-Tropical Convergence Zone (ITCZ) and associated rainfall maxima to their northernmost location in August (Buontempo, 2010). Then there is a long drought period from November to March. Rainfall decreases towards the north, and the Sahel turns into the Sahara Desert. Over the last half century, a large proportion of the Sahel has became a barren land resulting in the deterioration of the soil and water resources.

Between 1950 and 1965 there washigher rainfall, followed by dryer conditions culminating in 1984, the driest year in the last 70 years (Biasutti *et al.*, 2008; Greene *et al.*, 2009). The effects of the severe water crisis that occurred in the Sahel can be easily understood by looking at Fig. 2 showing the dramatic decrease in Lake Chad's surface area over the last 54 years. The water level is largely controlled by the inflow from rivers, notably the River Chari from the south and, seasonally, the River Komodugu-Yobe from the northwest. Until 1973, the lake, although reduced in size, was still a single body of water, but by 1976 it had clearly separated into two areas: the northern basin and the southern basin, divided by a shallow sill called the Great Barrier. Throughout the 1970s, water disappeared from the northern basin. By the 1980s, the lake area reached a low of just 300 km^2 (down from 22,000 km^2) (Hansen, 2017).

Since 1985, an increase in rainfall has been observed in the Sahel, which until now has been barely sufficient to compensate for the massive water withdrawal from Lake Chad for irrigation. However, precipitation has caused the northward movement of the 300 mm isohyet, with an average progression of 9.4 km/year (300 mm of annual rainfall is approximately what is needed for rainfed dryland agriculture) (Betser, 2005). Fig. 3 clearly shows the shift from south to north of the 300 mm isohyet in the period 1984-1994 (Betser, 2005). This allowed the vegetation to progressively recolonize northward at approximately 4.3 km/year in the period 1982-2004 (Betser, 2005). From 1984 to 2017, we can therefore estimate that the desert is set back to the north, on average, by about 140 km.

Impact of the African climate change on the wester yellow wagtail

The western yellow wagtails face crossing the Sahara on a broad front (Cramp, 1988) and with an uninterrupted flight of 60-70 hours (Wood, 1982); it is therefore a very critical moment, especially in spring, for several factors:

- Individuals who winter in the Sahel must endure a long drought period (October to April) during which the arthropod biomass decreases proportionally with the decline of soil moisture (Gillon & Gillon, 1974; Wood, 1976; 1978). The greatest scarcity of food is therefore precisely concurrent with the start of pre-breeding migration. Wood (1976; 1992) found that during the last pre-migratory phase, the western yellow wagtails dedicate as much as 75% of the day time to feeding.
- During wintering in Nigeria, the weight of the birds is about 16-17 g and increases up to about 25 g in the imminence of the departure both for the accumulation of fats and for the hypertrophy of the pectoral muscles (Wood, 1982). When the western yellow wagtails arrive in Tripolitania, their weight is reduced to about 16 g with a loss of about 1 g every 200 km and therefore with a loss of about 0.6-1.0% of body weight for each hour of flight at the speed of 30-50 km/h (Fry *et al.*, 1972). By comparison, on the European continent the average daily trips are 74 km with a documented maximum value of 189 km traveled in 6 hours, using up 0.7 g of fat (Lundwall & Persson, 2006).
- By applying the formula of Pennycuick (1975), it is estimated that the maximum distance that the western yellow wagtail can cover with an uninterrupted flight is 2,040 km.

As mentioned above, it is clear that the positioning of the border between Sahara and Sahel has a direct impact

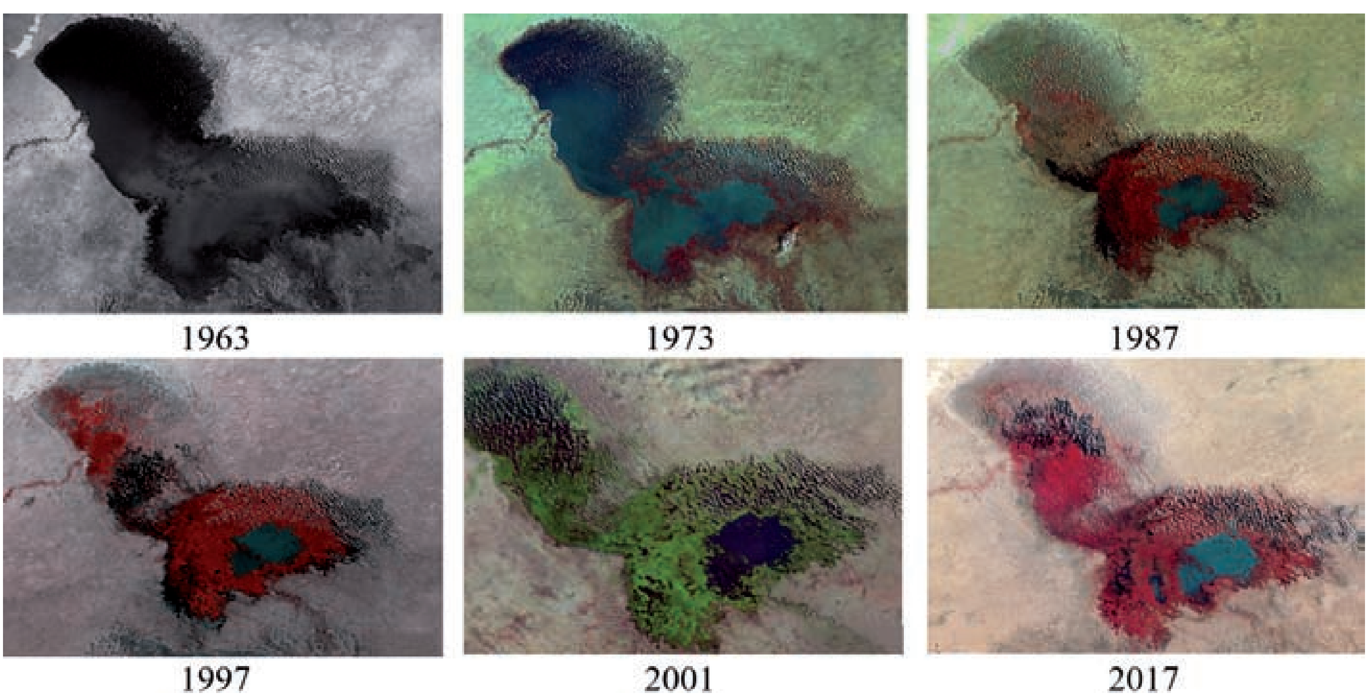


Fig. 2 - Surface evolution of Lake Chad. / Evoluzione della superficie del lago Ciad (Source / Fonte: NASA/Goddard Space Flight Center Scientific. Visualization Studio).

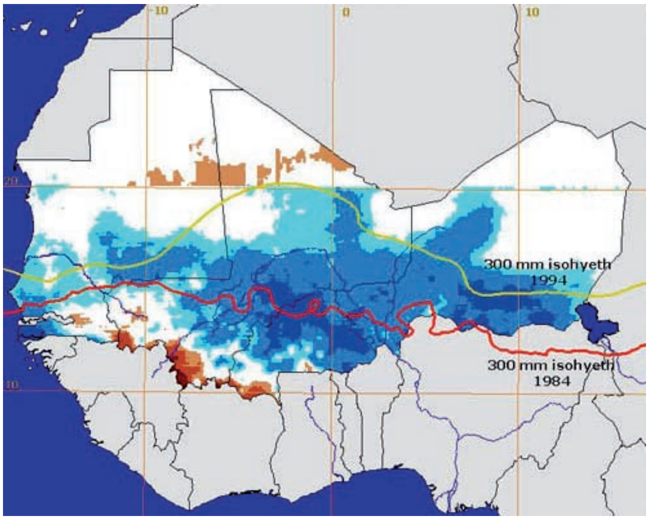


Fig. 3 - Rainfall trend 1982-2004, and the positions of the 300 mm isohyet in 1984 (red line) and 1994 (yellow line). / Tendenza delle piogge nel periodo 1982-2004 e posizioni delle isohyet dei 300 mm nel 1984 (linea rossa) e 1994 (linea gialla). (Source / Fonte: United Nations, 2008).

on the western yellow wagtail (as well as for other Palaearctic migrators) since the expansion of the desert during the dry phases requires the birds to spend more effort overflying and bring them to the limit of their physical capabilities with consequent increases in mortality (Hagemeijer & Blair, 1997; Zwarts *et al*., 2012). This factor, certainly significant during the 1980s, could have contributed, together with factors peculiar to the reproductive areas (Wilson & Vickery, 2005; BirdLife International, 2017), to the decline of the species observed in Europe. The strong competition for the trophic resources found in the Sahel due to the progressive drying up of the soil from October to April could perhaps explain the presence in central Nigeria, both in Vom (Wood, 1976; 1979) and in Jos (Bell, 2006), of males (occasionally also females) of western yellow wagtails that for the entire wintering period defend small individual feeding territories (0.1 ha). It is an unexpected behavior for a species that in the non-reproductive period lives without apparent difficulty in groups formed by hundreds or thousands of individuals which, in fact, could be induced by the scarcity of food resources. In confirmation of this, Wood (1979) found that, in the period of reduced availability of arthropods, a significant part of non-territorial individuals moved further south in search of areas with better food availability, while territorial individuals could avoid further migratory movements. The only other cases of territorial western yellow wagtails are known in Gabon and Democratic Republic of Congo, but in this case, the defense is practiced by small groups (3-6 birds) and not by individuals (Brosset & Erard, 1986; Keith *et al*., 1992). With regard to future developments in the Sahel and Sahara area, recent studies suggest that rainfall could increase by 40 to 300% over the current century, owing to a northward expansion of the West African Monsoon domain (Schewe & Levermann, 2017); if this happens, the Sahara will cease to be the main critical point during migration for the Palearctic birds. The effects of the increase in precipitation are already seen in Nigeria where the cultivated areas are expanding, even during the dry season, due to the use of irrigation techniques. With increasing frequency, the western yellow wagtails tend to move right into irrigated areas abandoning pastures with animals, their elective environment in previous decades (Bell, 2006).

Other areas frequented by the western yellow wagtail sensitive to climate change are those with savanna vegetation (Midgley & Thuiller, 2011). During the last decades, the encroachment of woody plants has already affected savannas due to the increase in the concentration of CO_2 (Ward, 2005; Buitenwerf *et al*., 2012); this trend is expected to accentuate over the course of the century in Central, Eastern, and Southern Africa (Wigley *et al*., 2009; 2010; Buitenwerf *et al*., 2012; Higgins & Scheiter, 2012; Mitchard & Flintrop, 2013; Ziervogel *et al*., 2014) thus reducing the areas that can be used for grazing by herbivores to which *Motacilla flava* is expected to obtain a trophic advantage with foreseeable impacts on the wintering areas of the latter.

Since it is expected that temperatures in Africa can rise faster than the global average increases during the 21st century (Christensen *et al*., 2007; James & Washington, 2013), in consideration of what has already been observed in Europe during the breeding season (Ferlini, 2015; 2016), it is possible that the western yellow wagtail will also use mountain grasslands at higher altitudes than the current limit (about 3,000 m a.s.l.) in the future.

Change in wintering range of *Motacilla flava* in Europe (Plate 1)

With regard to Europe, the expansion of the western yellow wagtail wintering range in the continent has been particularly evident. In fact, if presences until 1975 were sporadic and attributed to individuals unable to face or continue the migration, the species then began to appear in southwestern countries (Spain, Portugal, and Italy) in limited numbers in the 1980s and then with increasing regularity and abundance beginning in the 1990s. In this geographical area, specially in Spain, presences were limited only to climatically favorable zones that maintain a sufficient availability of invertebrates in winter (Tellería, 1988; Pérez-Tris & Asensio, 1997). From the 21st century, the presences were then extended to the islands of the Southeastern Mediterranean Sea (Malta, Crete, Cyprus) and, perhaps less predictable considering the different climatic conditions, to Western Europe (France, Switzerland, Austria, Germany, United Kingdom) and Scandinavia.

European winter climatic conditions

Considering the different environmental characteristics of the European countries where the western yellow wagtails were observed in December and January, it can be considered that the only abiotic factor that may have affected their presence is the climatic one. In Europe in winter, the temperature distribution clearly reflects the increase in thermal continentality along an east-west gradient: the process is driven by the exchange of air masses

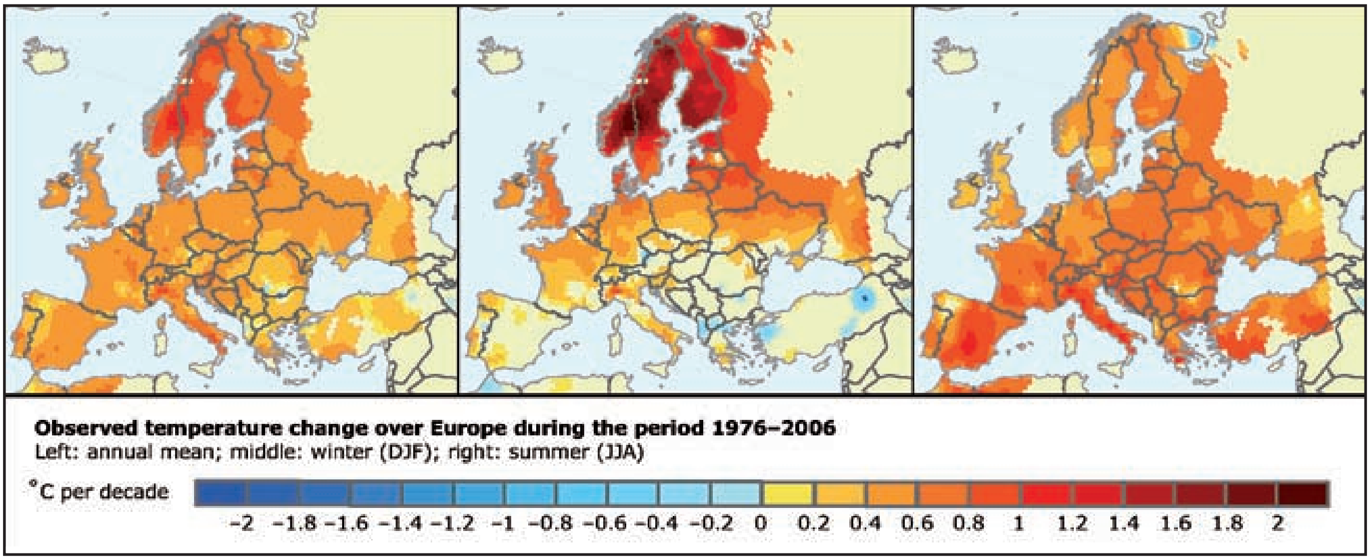


Fig. 4 - Observed temperature change over Europe during the period 1976-2006 (left: annual mean; middle: winter (DJF); right: summer (JJF). / Variazione della temperatura osservata in Europa durante il periodo 1976-2006 (sinistra: media annuale; centro: inverno (DJF); destra: estate (JJF). (Source / Fonte: EEA, 2009).

triggered by the westerly Gulf Stream and the high- and low-pressure areas which form below it (Westermann, 2010). After periodic fluctuations in the temperatures observed at continental level during the 19th and 20th centuries, from the 1980s a generalized increase was observed (especially in Scandinavia in winter) (Fig. 4).

The decadal average temperature over land area for 2002-2011 was 1.3 °C above the 1850-1899 average (Kovats *et al.*, 2014) and became 1.5 °C above the pre-industrial level for the decade 2006-2015 (the warmest decade on record) (EEA, 2017). Since 1950, annual precipitation has increased in Northern Europe (up to +70 mm per decade) and decreased in parts of Southern Europe (Kovats *et al.*, 2014). The beginning of the rise in the average temperature in Europe coincided temporally with the beginning of wintering by *Motacilla flava* in the south of the continent, and the expansion of their presence towards the north could be correlated with the equivalent increase in temperatures. In particular, it can be noted that in Western Europe the wintering range of the western yellow wagtail is included in the area characterized by positive January isotherms, and the limit, with a good approximation, is constituted by a 0 °C January isotherm that runs along a line from Western Scandinavia through Hamburg to the French Limestone Alps (Fig. 5) (Westermann, 2010).

Oversummering range of *Motacilla flava* in sub-Saharan Africa (Plate 2)

In the past, some authors have reported the occasional presence of western yellow wagtails during the austral winter (June, July, August) in the Democratic Republic of Congo (Schouteden, 1963; Herroelen, 2006), in Transvaal (Tarboton *et al*., 1987; Keith *et al*., 1992), and in Namibia (Koen, 1988). In Zambia, a specimen on 5th July 1908 was observed at Lake Bangweulu (Neave, 1910). In Uganda, a specimen was captured on 2nd June 1916 on Mount Elgon (Trombone, 2013). In South Africa, there are historical data with a specimen attributed to the ssp. *thunbergi* captured on 17th August 1880 in the Cape Province (Telenius & Ekström, 2017) and a *M. f. lutea* was collected in Warmbath (the current Bela-Bela) (Limpopo Province) on 5th July 1916 (Museums Victoria, 2016). In Namibia until 1988, at least seven reports were known (Koen, 1988). In the Democratic Republic of Congo, a young individual from that year was observed in Aru (Oriental Province) on 12th August 1952 (Schouteden, 1963; Herroelen, 2006).

The oversummering by Palearctic birds in Africa during the boreal summer (rather than migrating north) is common in immature individuals of most species of non-passerines (specially waders, terns, and raptors), but is very uncommon for passerines (e.g. northern wheatear

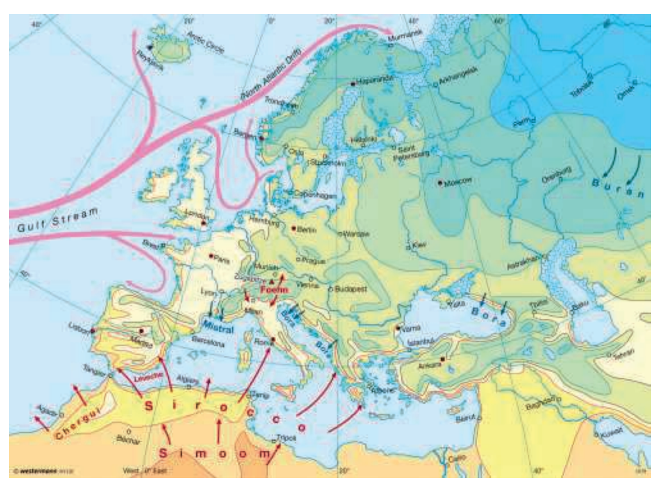


Fig. 5 - European January isotherms. / Isoterme di gennaio in Europa. (Source / Fonte: Westermann Schulbuch, 2010).

Plate 2 - Oversummering range of *Motacilla flava* in sub-Saharan Africa. / Areale estivo di *Motacilla flava* nell'Africa sub-sahariana.

Single ind.	2-10 ind.	11-100 ind.	101-1,000 ind.	1,001-10,000 ind.	Over 10,000 ind.

Oenanthe oenanthe, icterine warbler *Hippolais icterina,* garden warbler *Sylvia borin*) (Pearson & Britton, 1980; Lewis & Pomeroy, 1989; Newton, 2011; Oschadleus & Ranwashe, 2017), so it is interesting to consider the new data acquired after the publication of the book by Keith *et al*. (1992):

- In South Africa, between 1997 and 2016 there were at least 15 reports from June to August (Levatich & Padilla, 2016; Brooks, 2017a; 2017b; Observation.org, 2017). A recent observation (31^{st} July 2017) also concerns Swaziland (Observation.org, 2017). Five reports from South Africa refer to groups of western yellow wagtails: two specimens in July 1997 (Gauteng), seven in July 2001 (Mpumalanga), seven in July 2002 (Western Cape), as many as 28 individuals in July 2004 (Mpumalanga) and seven in July 2005 (Free State) (Levatich & Padilla, 2016; Brooks, 2017a; 2017b; Observation.org, 2017).
- In Namibia, there were at least four other observations between 2004 and 2010, including one involving two individuals present on 15^{th} August 2004 at the Daan Viljoen Game Reserve and one related to four specimens observed on 17^{th} July 2010 (probably attributable to *lutea*) (BirdForum, 2004; Levatich & Padilla, 2016; Observation.org, 2017).
- In Botswana, on 27^{th} July 2008 a specimen of the ssp. *lutea* was seen in the Okavango Delta (Observation. org, 2017).
- Between 1997 and 2014 in Tanzania, Rwanda, Mozambique, and Zimbabwe, there were sporadic

occurrences of individuals between July and August (Coetzer & Ranwashe, 2015; Levatich & Padilla, 2016; Observation.org, 2017).

- In Alphonse Atoll (Seychelles), one specimen was observed on 5th July 1995 (Levatich & Padilla, 2016).
- In Democratic Republic of Congo, one individual was reported on 1st August 1993 in South Kivu Province (Levatich & Padilla, 2016).
- In Kenya, between 1983 and 2017, there were at least 10 reports of isolated individuals with the exception of the observation of two specimens on 9th July 2003 near Lake Naivasha (Pearson, 1983; Backhurst, 1986; Levatich & Padilla, 2016; Naturgucker, 2016; Observation.org, 2017).
- In Uganda, from 1993 to 2017 there were at least 10 reports of which one related to five individuals, one to six individuals, and one to two individuals; all others concerned isolated specimens (Calabuig, 2013; Coetzer & Ranwashe, 2015; Tushabe, 2015; Levatich & Padilla, 2016).
- Regarding Cameroon, I found only the reference for a specimen on 11th August 2008 near the Mungoyeck village (near Maga) (Coetzer & Ranwashe, 2015).
- In Western Africa (Bénin, Ghana and Guinea Bissau), the reports are scarce (only four in 170 years) and all characterized by different levels of uncertainty.

The data suggest a possible intensification of the presence of *Motacilla flava* in sub-Saharan Africa between June and August, and starting from the 1990s (limited to the eastern part of the continent), the northward expansion of the geographic area was affected by the phenomenon. The reports are numerically significant, especially in Kenya and Uganda, where there are already consistent concentrations of western yellow wagtails during the boreal winter. Surprising, however, is to note the repeated presence of *Motacilla flav*a in South Africa during the austral winter, because the abundance in December-January in this area is much lower than those of the aforementioned equatorial countries. Even more surprising is the presence in South Africa of a group of as many as 28 individuals in July. This apparent accentuated presence in Eastern Africa suggested by the new data should probably be evaluated with caution and over time due the increased number of observers with a consequent increased probability of detection of the species. The absence of the species remains confirmed in the zone between the equatorial area and the southernmost latitudes of nesting (Banc d'Arguin in Mauritania to the west and the Aswan area in Egypt at east). With regard to the temperatures of the month of July, almost all of the observations are concentrated in areas included between the isotherms of 20 °C and 10 °C (Fig. 6). Finally, the presence of first yearyoung in the Democratic Republic of Congo on 12th August 1952 deserves a comment. Excluding an error of identification of the specimen, is it possible to imagine that a young individual may have already migrated from Europe or North Africa to the middle of Africa at the beginning of August when the first arrivals usually take place in the second half of September? This unusual presence could suggest a possible local nesting, of which, however, be uncertain.

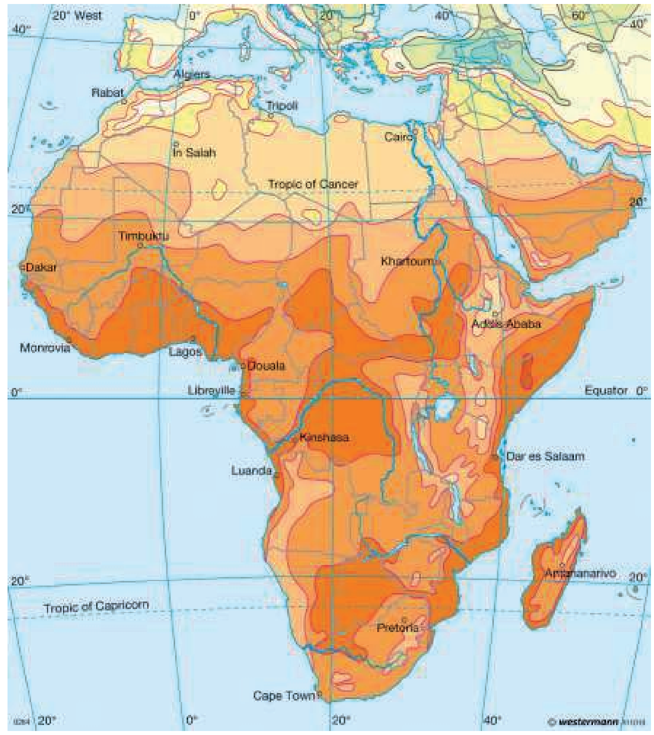


Fig. 6 - African July isotherms. / Isoterme africane di luglio. (Source / Fonte: Westermann Schulbuch, 2010).

Wintering range of *Motacilla flava flavissima* (Fig. 7, Plate 3)

The data relating to the subspecies in the second half of the 19th century show a distribution quite similar to the corrent one, with more authors attesting with certainty the wintering of yellow-headed wagtail in Nigeria (in the Nasarawa State) and in the northern highlands (Hartert, 1886; Shelley, 1900). In the following period (1901-1945), an evident confusion between *flavissima* and *lutea* was generated among the ornithologists. In fact, while the presence in Western Africa was confirmed, there were many reports of individuals attributed to *flavissima* also in Eastern Africa (Kenya, Uganda, Democratic Republic of Congo). The debate about the presence of the subspecies *flavissima* in Eastern and Southern Africa lasted until the 1970s. Authors such as van Someren (1931), Grant & Mackworth-Praed (1942), Benson (1946), Wallace (1955), Mackworth-Praed & Grant (1957), Archer & Godman (1961), and Fintha (1988) considered the migration of the British race to the eastern parts of Africa, from Somalia to Southern Rhodesia possible. That these apparent *flavissima* are derived from the small yellow-headed population breeding in Western Europe has been considered highly unlikely by Smith (1950), Williamson (1955), Moreau (1961; 1972), Dowsett (1965), Pearson (1972), Britton (1980), Ash & Miskell (1983), Clarke (1985), and Carswell (1986). A significant contribution towards defining the real situation was the study conducted by Pearson & Backhurst (1973). These researchers, through the ringing and recapture of individuals of yellow-headed wagtail near Nairobi (Kenya), found that:

Plate 3 - Wintering range of / Areale di svernamento di *Motacilla flava flavissima.*

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

Fig. 7 - *Motacilla flava flavissima*, 22nd January 2017, Sakamono Lagoon, Greater Accra Region, Ghana. / *Motacilla flava flavissima*, 22 gennaio 2017, Laguna di Sakamono, Regione della Grande Accra, Ghana. (Photo / Foto: Klaus Malling Olsen).

«… among the yellow-headed birds the majority in March and April were 'typical lutea', but half the adults and over 90% of the first-year birds trapped in winter before prenuptial moult were 'flavissima-like' (green or brownish forehead uniform with the crown and ear coverts, and yellow confined to the throat and supercilium).».

The same authors also recalled that:

«… five Yellow Wagtails from Kariobangi or nearby had been recovered in the Palaearctic, one (a female) on spring passage in Qatar, and four (three females and a yellow-headed male) in Russia between 51" and 59" N and 45" and 81" E».

From 1960 to 1981, 49,681 western yellow wagtails were ringed in Eastern Africa; 26 individuals ringed in Kenya were caught again in the Union of Soviet Socialist Republics, Saudi Arabia, Iran, Qatar, and Tanzania (Backhurst, 1981; 1988). The western yellow wagtails in Kenya that were attributed to the ssp. *flavissima* for a long time were in reality both adults and, mainly, first-year birds of the ssp. *lutea*, as confirmed by the catches in places located northeast of the ringing area in Africa. This is also probably true for the *flavissima* observed by Curry-Lindahl (1965) in the Congo for which, in fact, there was no consistency between migration times and the development of the gonads. Also, the reports of *flavissima* in Somalia are due to *lutea* (Ash & Miskell, 1983). Since the Second World War, the subspecies is relatively common in some suitable environments of Western Africa, going east to Southwestern Nigeria. The subspecies from the reproductive area reaches Africa converging towards the western half of the Iberian Peninsula to finally cross the Strait of Gibraltar (Pérez-Tris & Asensio, 1997; de Juana & Garcia, 2015). During post-breeding migration, some specimens were also observed in Southern Germany (e.g. a specimen on 30 August 2015 in Heidelberg-Grenzhof in Baden-Württemberg) (Avifaunistische Kommission Baden-Württemberg, 2016), in Switzerland (4-5 reports from 1992 to 2014) (Marques & Thoma, 2015), and Italy (a dozen reports, all along the peninsula, distributed between the first ten days of August and mid-October). This leads to the hypothesis, in the absence of objective evidence consisting of ringed individuals, of the existence of a small migratory flow that, after crossing the Italian peninsula, reaches Africa crossing the central Mediterranean. If so, where are these individuals wintering? The analysis of the data of specimens ringed in Nigeria and captured elsewhere, as well as those of individuals ringed in Europe and taken back to Nigeria, have highlighted the existence of a clear migratory route that, starting from Scandinavia, crosses Central and Eastern Europe, Italy, Malta, Tunisia, Libya, Niger, and Chad to reach Nigeria (Sharland, 1964; 1965; 1966; 1967a; 1967b; 1968; 1969; 1972a; 1972b; 1974; 1975; 1978; 1979; 1985; 1996; Wood, 1975). This justifies the wintering in this country of the subspecies *thunbergi*, *flava*, *feldegg,* and *cinereocapilla*. The individuals of ssp. *flavissima* observed in transit in Italy could belong to the part of the most eastern population nesting along the North Sea coast (from Belgium to Norway). These could migrate together with the other subspecies listed above and this would justify the observations of the western yellow wagtail with a yellow head occasionally present at Lake Chad (Fry *et al*., 1972) and Nguru (Nigerian Sahel) (Bell, 2006). In the past, it has been hypothesized that the specimens observed at Nguru could belong to Central European breeding populations (Bell, 2006), while according to Wood (1975), three specimens observed at Lake Chad could more probably be attributed to *lutea*. In my opinion, the *flavissima* hypothesis should be considered, especially for the data concerning pre-reproductive migration: the subspecies, in fact, was observed in Tunisia (five individuals on 18th March 2014 in the Korba lagoon, Nabuel Governatorate) (Smith, 2014), in Linosa (an individual on 27th April 1967) (Moltoni, 1970), along the Italian peninsula, Sardinia, and Corsica (Moltoni, 1971; Brichetti & Fracasso, 2007), and was more accentuated with respect to post-breeding migration, from mid-March to mid-May, peaking in the last two decades of April. The timing of transit in Italy is very similar to that observed in Switzerland where, however, the subspecies is reported more frequently (81-82 observations on a total of 84-85 individuals until 31st December 2015) (Martinez & Maumary, 2016). These individuals could be those potentially wintering in Nigeria to which other specimens could be added coming from the nearest areas where the presence of the subspecies is documented (Burkina Faso, Togo, Bénin), because during the pre-breeding migration, the species in Western Africa tends to follow a more easterly route than in autumn (Cramp, 1988; Wernham *et al*., 2002; Gargallo *et al*., 2011). However, there is still doubt about attributing the correct subspecies for the western yellow wagtail with the yellow heads observed in Cameroon, Gabon, and Congo. In this area, the reports during the period 1901-1945 were numerically limited, but widespread, and in time they became increasingly scarce. On the basis of the foregoing considerations, it could be noted that Cameroon, Gabon, and Congo are on the same migratory route which, descending from Scandinavia, crosses Italy, the central Mediterranean, and then reaches Nigeria, and therefore it is possible to assume these presences can be attributed to the subspecies *flavissima*. Another factor, concomitant and compatible with the previous one which could lead to the same conclusion, is what was observed by Gatter (1987) about Palaearctic bird migration in Western Africa according to which:

«... from November until at least January, another south-east movement occurs, which is induced (food shortage, aridity) and supported (tail winds) by the north-east trade wind or harmattan. Part of the population continues migration to the equatorial region and probably even further south.».

The greater frequency of reports in Cameroon were recorded in the years 1932-1964. Probably this coincided with the peak reached by the population of *flavissima* during the reproductive phase in Europe: at least since 1923, the subspecies began to nest in Netherlands; in the 1930s and 1940s, the subspecies colonized the north of Germany, the Helgoland Islands and the Frisian Islands, then reached the south of Norway in 1947 (Bernis, 1970). The progressive decrease in the number of observations could be related to the numerical decline of the subspecies in the reproductive area (-43% in United Kingdom from 1995 to 2013; Hayhow *et al*., 2014), including the part of the population that reproduces on the coasts of North Sea (e.g. in the Netherlands nesting pairs have decreased from 150-200 in 1975 and 200-350 in 1980s to an estimated 40-80 in 1998-2000 and 25-40 in 2008-2011; SOVON, 2002; 2017).

The presence of individuals with a yellow head more to the east, in the Central African Republic, remains still undefined. Here the *flavissima*/*lutea* subspecies was reported at the beginning of the 20th century in the Kémo Prefecture (Oustalet, 1904-1905) and was frequently found in the 1980-82 period in the Bamingui-Bangoran National Park (Green, 1984). Considering that this Park is far from the area of normal presence of the ssp. *lutea*, that the period of observations coincide with the maximum abundance of *flavissima* along the coast of the North Sea, and that the basin of the River Chari and rice cultivations in the plain between the Rivers Logone and Chari can constitute a good ecological corridor connecting Lake Chad to the Park, I favor the hypothesis that the individuals observed by Green (1984) were attributed to *flavissima*. Obviously, these are purely speculative considerations that I hope can be better defined or corrected through the acquisition of data supported by scientifically acceptable evidence in the future.

Morocco was indicated as a wintering area for the subspecies by Alström *et al*. (2003), but I have found only one specific data, so I hypothesize that the abundance of the subspecies is rather limited. The Iberian Peninsula remains the main route for pre-breeding migration, however, the spring flow occurs on a larger front; in fact, ringed individuals were captured both in the western and in the eastern part of the Peninsula (Cramp, 1988; Pérez-Tris & Asensio, 1997; Tellería *et al*., 1999; Wood, 2002; de Juana & Garcia, 2015). The individuals of the ssp. *flavissima* that migrate north along the Mediterranean coast of Spain are probably those observed migrating in France, in Camargue, and along the Rhône Valley from the first ten days of April to the first ten days of May (Hafner *et al*., 1980; Réserve Nationale de Camargue, 1987; Boutin & Cherain, 1989; Kayser *et al*., 2008; Tissier, 2015) and that, in part, could reach Switzerland following the path of the river. This could explain the number of observations made in Switzerland that are much higher than expected if these were only due to the small flow that goes back north following the route of the central Mediterranean and passing through Italy. Exceptionally the subspecies winters in Spain and United Kingdom.

Wintering range of *Motacilla flava flava* (Plate 4)

The distribution of the subspecies *flava* in Africa coincides with a good approximation of the species as a whole; in fact, it is widely distributed in the continent and is the most abundant subspecies almost everywhere. Since the 1970s, the subspecies has been observed in Egypt, with a tendency to increase the number of wintering individuals (over 1,000 near Luxor in December 2012) and its range is expanding north along the River Nile (also present in its delta in December 1999) (Grieve, 2000; Prescott, 2012). The subspecies has also been reported in the last decades in Cyprus, Greece, Italy, and Spain, but it is probable that individuals observed in Central Europe are also attributable to the ssp. *flava*, as is the case of the specimen observed in late November in Netherlands.

Wintering range of *Motacilla flava thunbergi* (Fig. 8, Plate 5)

The 19th century data for this subspecies were very scarce and, curiously, related to extreme points of the wintering range of the species in that period: in Egypt, South Africa, and Namibia. Overall, the distributions during the 20th and the beginning of the 21st century confirm a prevalent presence in sub-Saharan Africa with the exception of the western part of Middle Africa. Local concentrations are found in Western Africa (between Ghana and Nigeria), Ethiopia, and Uganda. The presence of the subspecies (with a possible numerical increase in the last decades) is confirmed in Egypt (in the Luxor area). The distribution along the coast of Western Africa seems to have had a significant evolution, in fact Shelley (1900), referring to the situation at the end of the 19th century, pointed out that no data were known concerning the subspecies, and until the 1980s, there were only sporadic reports in Sierra Leone (Bannerman, 1936) and Liberia (Torben, 1950). This is a rather strange situation, because although very limited, the transit of the subspecies during migrations in Spain and Morocco was already recorded in the first half of the 20th century (Hartert, 1928; Bernis, 1954) and confirmed in the 1960s in Spain, Morocco, and Senegal (Bernis, 1970). Subsequently, a growing presence was noted in the countries bordering the Gulf of Guinea, and along with the extension of the wintering range along the west coast in Gambia, Senegal, and with isolated individuals, also Morocco. The winter presences along the West African coast are probably favored by the migratory flow of the subspecies along the Scandinavian-Iberian route, which manifests itself through a regular transit along the Iberian Peninsula: 3% of the over 76,000 western yellow wagtails ringed in Spain from 1973 to 2009 are *thunbergi*; the pre-

Plate 4 - Wintering range of / Areale di svernamento di *Motacilla flava flava.*

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

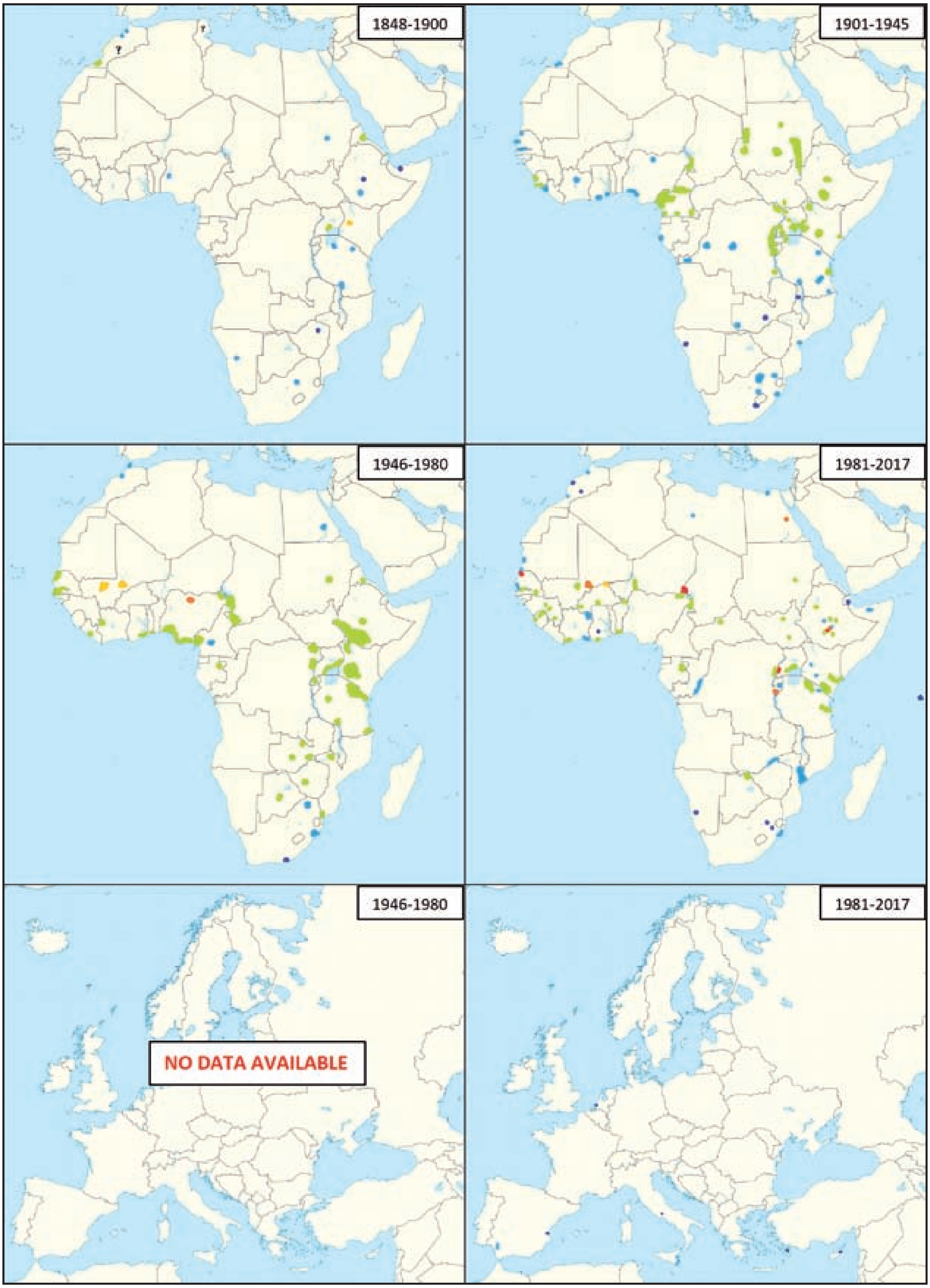


Plate 5 - Wintering range of / Areale di svernamento di *Motacilla flava thunbergi*.

Single ind.	2-10 ind.	11-100 ind.	101-1,000 ind.	1,001-10,000 ind.	Over 10,000 ind.

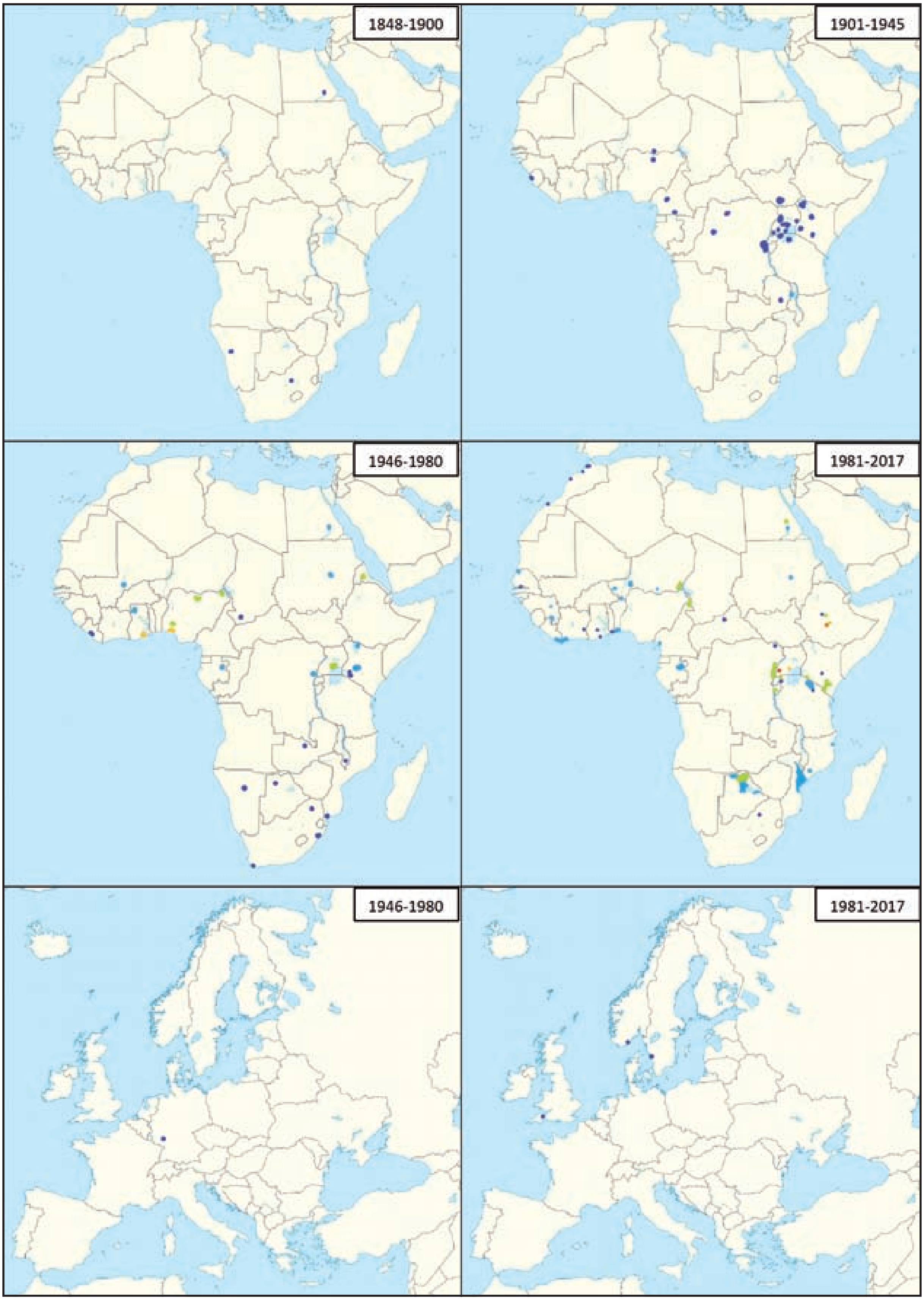


Fig. 8 - *Motacilla flava thunbergi*, February 2012, Cotonou harbour, Bénin. / *Motacilla flava thunbergi*, febbraio 2012, porto di Cotonou, Bénin. (Photo / Foto: Bruno Portier).

Fig. 9 - *Motacilla flava iberiae*, March 2017, Mansour Reservoir, Morocco. / *Motacilla flava iberiae*, marzo 2017, invaso di Mansour, Marocco. (Photo / Foto: Tony Davison, www.tonydavisonphotography.com).

sence is more abundant on the western half of the Iberian Peninsula and Balearics (at Ebro delta 14% of the western yellow wagtails ringed in the autumns of 1992-1995 are *thunbergi*) (Finlayson, 1992; Pérez-Tris & Asensio, 1997; Aymí, 1999; de Juana & Garcia, 2015). By analogy with what has been observed for *cinereocapilla* and *feldegg* (Ferlini, 2015; 2016), the increase in the presence in Western Africa could be a consequence of a western expansion of the breeding range of *thunbergi*, which should be further investigated. In Europe, reports in winter of isolated specimens have only occurred since 2006 in England, Sweden, and Norway.

Wintering range of *Motacilla flava iberiae* (Fig. 9, Plate 6)

Over the entire period covered by the study, the subspecies has been regularly present in Morocco. In this country, the apparent increase in both the number of reported individuals and the number of localities where the subspecies is present probably should be attributed to the increase of ornithologists who have frequented the area. The subspecies goes south to Southern Mali and Ivory Coast. In consideration of the most recent data and of the studies conducted by Wood (1975), it can be assumed that the individuals observed in Nigeria in the 1960s identified as *iberiae*, were specimens of the subspecies *cinereocapilla*. The actual wintering range in Western Africa appears to be significantly less extensive than previously indicated (Keith *et al*., 1992; Alström *et al*., 2003). In the 21st century, the wintering of the subspecies *iberiae* has also been ascertained in Spain.

Wintering range of *Motacilla flava cinereocapilla* (Plate 7)

The winter range of *cinereocapilla* has been very controversial over time as can be guessed from the unlikely situation described by Chapin (1953) relating to the period 1910-1946:

«Winters quarters are apparently from the upper Niger east to Lado, Entebbe on the north shore of lake Victoria, and Abyssinia. There is no actual record from Congo, but an occasional winter wanderer may be espected in the Upper Uele or near Lake Albert.».

The critical element in this case was the possible confusion with the subspecies *pygmaea* and *thunbergi*. The reports that have occurred over time with reference to the eastern part of Africa (from Sudan to Malawi) are in fact attributable to the latter subspecies (Pearson, 1972; Carswell, 1986). Even the recent single report concerning the Aswan Governatorate (Egypt) could be the result of confusion with *pygmaea*. Compared to what is indicated by the most up-to-date reference texts (Morocco, from Mali to Nigeria, east to Lake Chad) (Keith *et al*., 1992; Alström *et al*., 2003; Borrow & Demey, 2008), it seems that the subspecies has expanded and is also well established in Senegal and Gambia, an area for which sporadic reports existed at the end of the 19th century (Shelley, 1900) and in the first decades of the 20th century (Bannerman, 1936). Louette & Prévost (1987) have expressed doubts about the presence of *cinereocapilla* in Cameroon, however I believe that the observations are plausible given the certain and abundant presence at Lake Chad and the reports of the subspecies in more southern areas than to the latter during the migratory period. Completely new compared to the past is the winter presence of the subspecies in Europe: certainly in Italy, probably in Spain, and exceptionally in Germany (possible confusion with *thunbergi*?).

Plate 6 - Wintering range of / Areale di svernamento di *Motacilla flava iberiae.*

Single ind.	2-10 ind.	11-100 ind.	101-1,000 ind.	1,001-10,000 ind.	Over 10,000 ind.

Plate 7 - Wintering range of / Areale di svernamento di *Motacilla flava cinereocapilla.*

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

Wintering range of *Motacilla flava pygmaea* (Fig. 10, Plate 8)

During the entire study period, the subspecies had a concentrated presence along the River Nile (from Lake Nasser to the river delta) and some Egyptian wetlands (e.g. in the Wadi el Natrun Valley and Lake Qarun). The subspecies is substantially sedentary, even if it makes movements within the area previously outlined. The observations of individuals outside of Egypt are quite exceptional: a specimen was reported in Sudan in 1908 (Goodman & Atta, 1987) and some individuals were in Israel (4 reports until 2011) (Porter & Aspinall, 2010; IRDC, 2015).

Fig. 10 - *Motacilla flava pygmaea*, 14th January 2012, eastern bank of the river Nile near Cairo, Egypt. / *Motacilla flava pygmaea*, 14 gennaio 2012, riva orientale del fiume Nilo vicino a Il Cairo, Egitto. (Photo / Foto: Rachid H., CC BY-NC 2.0, https://www.flickr.com/photos/rachidh/6840295687/in/photostream/, "Egyptian Yellow Wagtail - *Motacilla flava* - Bergeronnette printanière - on the eastern bank of the river Nile near Cairo").

Wintering range of *Motacilla flava feldegg* (Fig. 11, Plate 9)

Until 1945, the subspecies was predominantly concentrated in the eastern part of Africa between Sudan and Kenya; further south, the presence was scarce or accidental. In South Africa, there was only one presence during the 19th century (Ayres, 1871; Sharpe, 1871), and there were no others until the 1960s (Clancey, 1966; Winterbottom, 1968). In the second half of the twentieth century, the situation described above for Eastern Africa was confirmed, but starting from the 1960s, the subspecies was also frequent in Southern Chad (Hopson, 1965), common along the shores of Lake Chad (Dowsett, 1969), abundant in the area of Kano (Nigeria) (Ebbutt *et al*., 1964; Fry, 1965a; 1965b; Sharland, 1964; 1965; 1966; 1967a; 1968; Moreau, 1972), and present in the eastern part of the Nigerian Atlantic coast (Wells & Walsh, 1969). In the following decade, sporadic reports were also reported in Mali (Delta and Plateau Dogon) (Lamarche, 1981). In the period 1981-2017, the distribution was confirmed mainly in the central-eastern part of Africa, but there was also an expansion towards the west for the subspecies in the sub-Saharan belt up to a few specimens in Sierra Leone, Gambia, and Mauritania (Ward & Ward, 2004; Observation.org, 2017). The wintering of some individuals in Western Africa from the late 1980s has established a new migratory route that brings the subspecies to the reproductive quarters of central Europe through Spain and Southern France (Ferlini, 2016). Starting from the beginning of the 21st century, the expansion of the wintering area towards the north appears to be completely new, with regular presences in Egypt along the River Nile. In Europe, the only winter reports were recorded in Italy, and until now, limited to Sicily. The occasional presence of individuals is confirmed also in the south up to South Africa. Over time, the authors agreed that *feldegg* is more often associated with water than the other subspecies (Chapin, 1953; Britton, 1980; Carswell, 1986; Nikolaus, 1989).

Fig. 11 - *Motacilla flava feldegg* (first winter), 19th December 2012, Lake Ziway, Ethiopia. / *Motacilla flava feldegg* (primo inverno), 19 dicembre 2012, lago Zuai, Etiopia. (Photo / Foto: Thomas Varto Nielsen).

Wintering range of *Motacilla flava beema* (Fig. 12, Plate 10)

For the *beema* subspecies I did not find any data concerning the 19th century. Until 1980, reports were scarce, mainly concerning isolated individuals, concentrated in the equatorial area of Eastern Africa (Kenya, Uganda, Burundi, Democratic Republic of Congo), with sporadic presences in Zambia. Also in the period 1981-2017, this distribution was confirmed with accidental presenses in South Africa, as well as the novelty constituted by reporting important concentrations in Ethiopia (this data deserves further confirmation). The distribution in Eastern Africa, as for the other eastern subspecies (*lutea* and *leucocephala*), is certainly motivated by the use of the well-known Great Rift Valley Migration Flyway which stretches over 7,000 km from the Taurus Mountains in Turkey to the Zambezi River in Mozambique (Leshem *et al*., 2006).

Plate 8 - Wintering range of / Areale di svernamento di *Motacilla flava pygmaea.*

Single ind.	2-10 ind.	11-100 ind.	101-1,000 ind.	1,001-10,000 ind.	Over 10,000 ind.

Plate 9 - Wintering range of / Areale di svernamento di *Motacilla flava feldegg*.

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

Plate 10 - Wintering range of / Areale di svernamento di *Motacilla flava beema.*

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

Fig. 12 - *Motacilla flava beema*, 11th March 2010, Strandfontein, Cape Town, South Africa. / *Motacilla flava beema*, 11 marzo 2010, Strandfontein, Città del Capo, Sud Africa. (Photo / Foto: Patrick Cardwell, www.avianleisure.com).

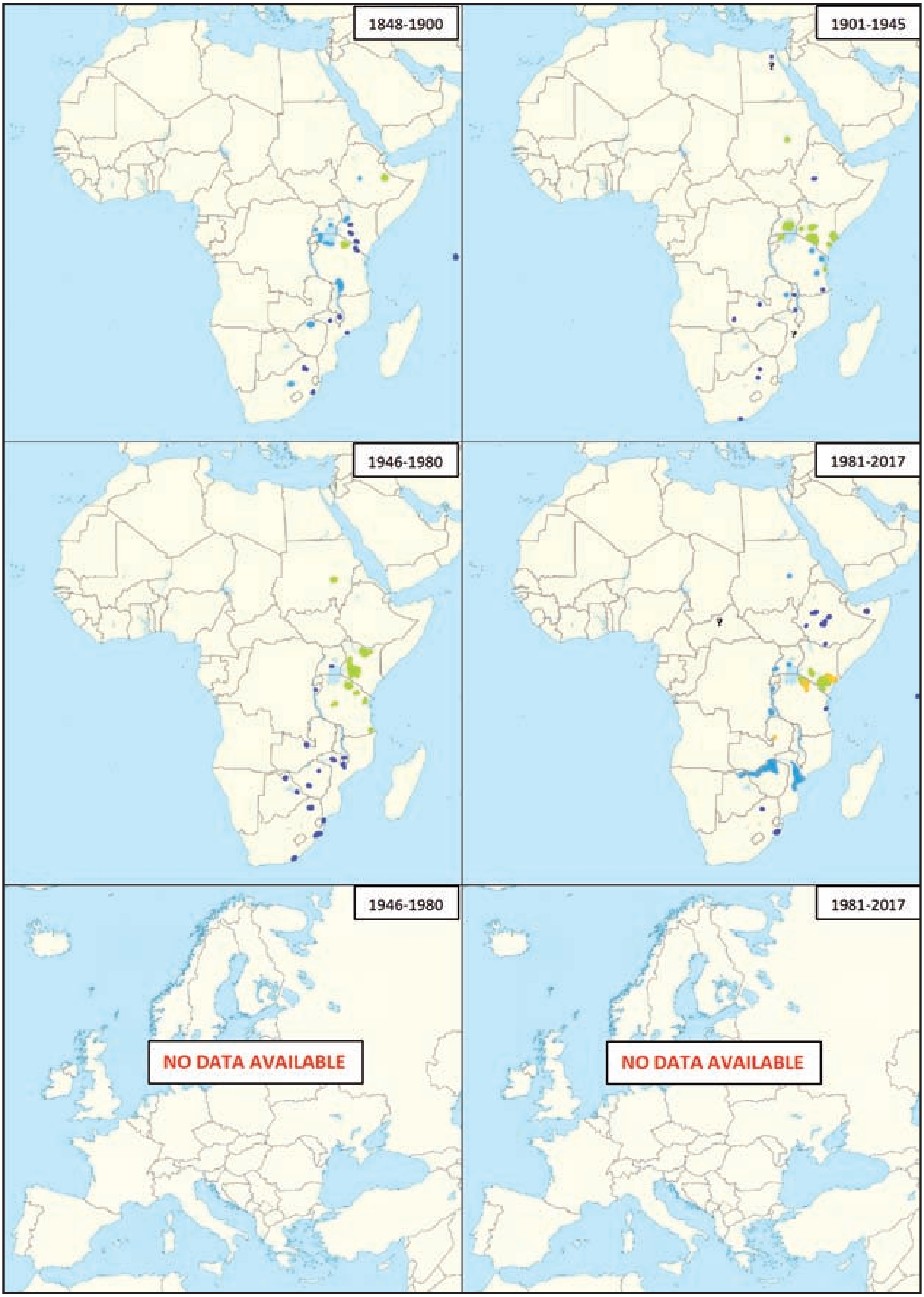
Fig. 13 - *Motacilla flava lutea*, 19th December 2012, Lake Ziway, Ethiopia. / *Motacilla flava lutea*, 19 dicembre 2012, lago Zuai, Etiopia. (Photo / Foto: Thomas Varto Nielsen).

Wintering range of *Motacilla flava lutea* (Fig. 13, Plate 11)

The subspecies *lutea* remained permanently present in the eastern part of Africa throughout the period of study, reaching to the north the southern part of Sudan and to the south the Eastern Cape Province (South Africa). The greatest permanent abundance was recorded in Tanzania and Kenya. In this last country, ringing activity was particularly intense, thus allowing information on the origin of the wintering individuals to be obtained. On 23rd August 1969, an adult male was collected in Raveskii (Republic of Bashkortostan, Russia) after being ringed on 8th December 1968 in Kariobangi (Nairobi, Kenya); in July 1974, an adult male was captured in Novotulka (Saratov, Russia) after being ringed in the suburbs of Nairobi (Kenya) on 18th February 1969 at a distance of 5,884 km; another male ringed in Kariobangi (Nairobi, Kenya) on 10th October 1972 was captured in Ufa (Republic of Bashkortostan, Russia) on 24th June 1974 at a distance of 6,473 km; an individual in the second year was ringed at Nairobi (Kenya) on 2nd February 1975 and returned to Engels (Saratov, Russia) on 2nd May 1975 after traveling 5,931 km (Backhurst, 1970; 1977). The subspecies reaches the African wintering range (as well as those of the Arabian Peninsula) probably following the Volga Valley up to the Caspian Sea shores, then crossing the bottleneck constituted by the Caucasian area (Backhurst, 1974; 1977; Millen, 2017; Observation.org, 2017), after which the migratory flow widens as can be guessed from the reports, to the north, in Greece and in the Eastern Mediterranean islands (Kos, Crete and Cyprus) (Ferlini, 1994; Hellenic Rarities Committee, 2010; Porter & Aspinall, 2010; RAF Ornithological Society, 2016; Observation.org, 2017), and to the south, in Saudi Arabia and Oman (Salalah) (Observation.org, 2017). The post-reproductive migratory movements can begin as early as August, as can be deduced from the observation of three specimens (two adults and one young) present on 16th August 1993 in a fallow in Kamari on the island of Kos (Greece) (Ferlini, 1994). Also during the pre-breeding migration, the flow towards northeast is dispersed on a broad front that touches Greece (island of Lèsbos), Turkey (Gögsu Delta, Gaziantep), Israel (Eilat), Saudi Arabia (Dhahran, Taif), Kuwait, and Qatar, up to the south coast of the Caspian Sea in Iranian territory (Backhurst, 1974; Observation.org, 2017). In the ascent to the northeast to reach the breading range, the flow is again concentrated in the Caucasian area (Georgia, Armenia, Azerbaijan) (Observation.org, 2017). During the stay in Africa, *lutea* shows environmental preferences that vary radically from area to area; both in Sudan and in Congo it seems particularly linked, more than other subspecies, to wetlands and the banks of rivers (Macleay, 1960; Curry-Lindahl, 1965), while in Kenya, Tanzania, and Uganda it winters in drier areas (Wallace, 1955; Curry-Lindahl, 1965; Pearson, 1972; Britton, 1980; Carswell, 1986; Pearson & Turner, 1986).

Plate 11 - Wintering range of / Areale di svernamento di *Motacilla flava lutea.*

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.



Wintering range of *Motacilla flava leucocephala* (Fig. 14, Plate 12)

There are no data on this subspecies in the 19th century. Subsequently, the sporadic observations were concentrated in the equatorial area and, in particular, in Kenya (Nairobi County and Laikipia County), Uganda (Wakiso District), and Tanzania (Lake Manyara National Park). For Tanzania, Keith *et al*. (1992) also cited the locality of Arusha Chini (Moshi Rural District), but the date of the observation is not known. Further south, the subspecies was observed in 1947 in the Karonga District in Malawi and, on an unknown date, in Zambia (Kanyamwe in Feira) (Keith *et al*., 1992). The birds from Mongolia that reached Malawi or Zambia have traveled over 12,500 km. The identification of this subspecies outside the reproductive range requires a certain caution, since birds resembling *leucocephala* may be aberrant or very pale *beema*, but these usually conserve darkish looking lores (Wassink, 2015; 2016); they could even be anomalous individuals of the subspecies *flava* (Meinertzhagen, 1956), hybrids of *M. f. beema* with *M. f. leucocephala* (characteristic e.g. of Tuva Republic, Russia) (Redkin, 2011) or first generation hybrids of *M. f. flava* with *M. f. lutea* (Redkin, 2013). Since the subspecies breeds around the Great Lakes Basin of Western Mongolia (Bräunlich, 2002), the few individuals that reach the African continent must cross Central Asia and the Middle East; rare observations are made in Southern and Southeastern Kazakhstan (spring migration from 17th April to 19th May and autumn migration in September, but one was ringed at Lake Alakol on 8th July 1981) (Gavrilov & Gavrilov, 2005; Wassink & Oreel, 2008; Wassink, 2009), Azerbaijan (only one record on 12th April 2012) (Heiss & Eidam, 2015), Iran (South Khorasan and Parapamis in the past and one record in Golestan Province on 7th April 2017), Turkey (only one record on 25th April 2011), Israel, Kuwait, United Arab Emirates, and Oman (records on Spring 1991 and 2012) (Zarudny, 1911; Al-Sirhan, 2009; Porter & Aspinall, 2010; Kirwan *et al*., 2014; Blair *et al*., 2017; Eriksen & Porter, 2017; Iran Bird Records Committee, 2017). Bernis (1970) reported two subjects observed in Greece in May, but without other details. For this subspecies, I consider further studies necessary because I cannot exclude that many of the white-headed western yellow wagtails observed in Africa and along the migratory routes that connect it to Asia are not true *leucocephala*.

Fig. 14 - *Motacilla flava leucocephala*, 5th April 2015, Ngorongoro Crater Rim, Tanzania. / *Motacilla flava leucocephala*, 5 aprile 2015, cratere di Ngorongoro, Tanzania. (Photo / Foto: Per Holmen, www.holmen-birding-safari.com).

CONCLUSIONS

Evolution of wintering range of *Motacilla flava* in Africa and Europe

The data collected from 1848 to 2017 show that the wintering range of the western yellow wagtail *Motacilla flava* remained substantially stable in Africa, with a probable quantitative reduction in South Africa, perhaps linked to the overall decline of the species in the European breeding range. Since the mid-1980s, the wintering area of the species has significantly expanded to the north, occupying areas in Europe with average temperatures in January above 0 °C. The northward expansion of the area used for wintering by the western yellow wagtail is consistent with the similar trend shown by other trans-Saharan migrant species, especially non-passerines, which are increasingly present in winter north of the Sahara (Morganti & Pulido, 2012; Morganti *et al*., 2014). Taking into account the current climate changes with the increase in minimum winter temperatures in Europe (EEA, 2009), this choice is a competitive advantage, since it allows birds to reduce the distances traveled during migration and, consequently, to decrease the connected energy cost, as well as advancing physiological development in response to exposure to photoperiods from northern latitudes (Coppack & Both, 2002; Coppack & Pulido, 2004; Newton, 2008).

The current distribution of the species during the boreal winter can be summarized as follows: in Europe, it is scarce but regular in the southwestern countries (Spain, Portugal, and Italy) and present in a more occasional and limited way in Greece, the Southeastern Mediterranean islands (Malta, Crete, Cyprus), Western Europe (France, Switzerland, Austria, Germany, United Kingdom), and Scandinavia. In Northern Africa, it is common in Morocco and Egypt, and it is present in small numbers in Algeria, Tunisia, and Libya (although there may be an underestimation of the phenomenon due to the lesser presence of ornithologists). It overwinters locally in abundance from the Sahel up to the wetlands of Botswana; it is regular, but scarce, further south to Cape Town and even more occasional in Angola and Namibia. It is scarcely present in the Malagasy Region. It is absent or very localized in African climatic zones classified as “subtropical high-continental arid” (Lauer & Frankenberg, 1988) (Fig. 15).

Plate 12 - Wintering range of / Areale di svernamento di *Motacilla flava leucocephala*.

	Single ind.		2-10 ind.		11-100 ind.		101-1,000 ind.		1,001-10,000 ind.		Over 10,000 ind.

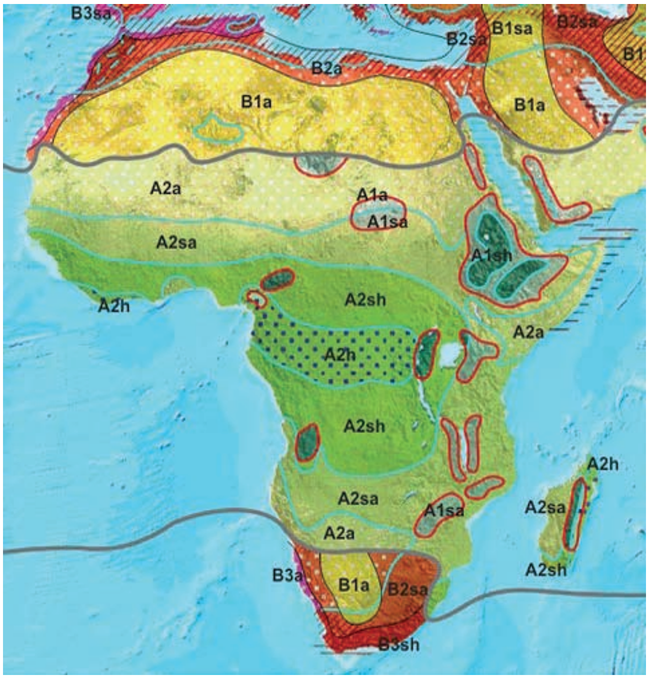


Fig. 15 - Classification of African climate zones based on natural vegetation Climate Zones. / Classificazione delle zone climatiche africane basate sulla vegetazione naturale. A) tropical / tropicale. B) subtropical / subtropicale. C) temperate (I = moderately warm, II = cold) / temperato (I = moderatamente caldo, II = freddo). D) polar regions. / regioni polari. Subclassification of the tropical climate zone. / Sottoclassificazione della zona climatica tropicale. 1) cold tropical / freddo tropicale; 2) warm tropical / caldo tropicale. Subclassification of other climate zones. / Sottoclassificazione di altre zone climatiche. 1) high-continental / fortemente continentale, 2) continental / continentale, 3)= maritime / marittimo. Water household. / Livello di umidità: a) arid (0-2 rainy months) / = arida (0-2 mesi piovosi); sa) semi-arid (3-5 rainy months) / semi-arida (3-5 mesi piovosi); sh) semi-humid (6-9 rainy months) / semi-umida (6-9 giorni piovosi); h) humid (10-12 rainy months) / umida (10-12 mesi piovosi). (Source / Fonte: Lauer & Frankenberg, 1988).

Analyzing the situation in Africa in terms of subspecies, the main changes for the wintering ranges, compared to what was known in the past, can be summarized as follows:

Increased presence of the subspecies *flava* in Egypt since the 1970s.

Less amplitude of the winter range of *iberiae*. In West Africa, the subspecies is confined between the Atlantic coast and the meridian 2°W instead of reaching the meridian 14°E, as previously indicated.

Expansion of *cinereocapilla* towards the west with significant numerical presences in Senegal and Gambia.

Greater width of the wintering range of *flavissima* in Western Africa with possible presences also in Nigeria and Cameroon. The presence of a minority migratory route is hypothesized for the subspecies, which passes through the central Mediterranean more intensely in spring.

Increasing presences of *thunbergi* in the countries bordering the Gulf of Guinea that extended along the Atlantic coast in Gambia, Senegal, and with isolated individuals, Morocco.

West expansion of *feldegg* in the sub-Saharan belt and, from the beginning of the 21st century, in Egypt along the River Nile.

Apparent numerical increases of *beema* in Ethiopia.

Substantial stability of the wintering ranges of *pygmaea*, *lutea,* and *leucocephala*.

For what has been reported above regarding the Euro-African area, the wintering ranges of the subspecies can be updated as follows:

Motacilla flava flava – In Europe, it is scarce in southwestern countries (Spain, Italy, and Portugal) and present more occasionally and locally in Greece, Cyprus, and the islands of the Southeastern Mediterranean, as well as Western Europe. In North Africa, there is a good numerical presence in Egypt, with small groups in Morocco and a very limited presence in Algeria, Tunisia, and Libya. It overwinters locally in abundance from the Sahel up to the wetlands of Botswana; it is regular, but scarce further south to Cape Town and even more occasional in Angola and Namibia. It occurs sporadically in the Malagasy Region.

Motacilla flava iberiae – It is present in small numbers in Spain and is widespread in Morocco, abundant in Senegal, Gambia, and, locally, in Southern Mali. It is less frequent further south to Ivory Coast.

Motacilla flava cinereocapilla – It is locally common in Western Africa, from Senegal to Nigeria and to Cameroon; present, but not common, in Morocco. It is scarce in Italy, probably present in Spain and accidental wintering in Germany (?).

Motacilla flava flavissima – It is widespread and locally common in Western Africa from Southern Mauritania to Burkina Faso and then south to the Atlantic coast. It is very scarce or occasional in Cameroon, Nigeria, and Central African Republic. It is uncommon in Morocco, and occasionally winters in Spain and the United Kingdom.

Motacilla flava thunbergi – It is locally abundant in the Sahel, from Senegal to Eritrea, in the south to the wetlands of Botswana and is scarce in South Africa. It is absent or very scarce along the Atlantic coast from Gabon to Namibia. It is common in Egypt along the River Nile, and scarce but regular, in Morocco. It is occasionally present in central and Northern Europe.

Motacilla flava pygmaea – It is concentrated along the River Nile (from Lake Nasser to the river delta) and in some Egyptian wetlands (e.g. Wadi el Natrun Valley and Lake Qarun).

Motacilla flava feldegg – It is widespread and locally common or very abundant from Egypt to the south to Northern Tanzania. It is scarce further south until reaching South Africa. To the west, it is common from Chad to Niger and very scarce south of the Sahara in the remaining countries of Western Africa until reaching Gambia. It occurs sporadically in the Malagasy Region and occasionallyin Southern Italy.

Motacilla flava beema – It is localy common in Ethiopia and widespread in the equatorial area of Eastern Africa (Kenya, Uganda, Burundi, Democratic Republic of Congo) with sporadic presences in Zambia. It is rare further south to South Africa and sporadically occurs in the Malagasy Region.

Motacilla flava lutea – It is widespread in Eastern Africa from Southern Sudan to the Eastern Cape Province (South Africa), is common and locally abundant in Tanzania and Kenya, and sporadically occurs in the Malagasy Region.

Motacilla flava leucocephala – It is occasional in the equatorial area, particularly in Kenya, Uganda, and Tanzania; in the past it reached Sudan, Malawi, and Zambia, but there are no recent reports.

Conservation of the species in Africa and Europe

The analysis carried out to define the priority areas for conservation of Palearctic passerines within sub-Saharan Africa has identified four geographical areas: (1) a west African area centered on Southern Mali that includes Southern Mauritania, Senegambia, Guinea-Bissau, Guinea, Northwestern Ivory Coast, and Burkina Faso; (2) an East African area centered on Eritrea that includes large parts of central Sudan, Northern Ethiopia, Djibouti, and Northwestern Somalia; (3) an area encompassing Uganda, Southwestern Kenya, and Northeastern Tanzania; and (4) an area centered on Northern Zimbabwe that includes Southwestern Zambia and small parts of Malawi, Mozambique, Northern Botswana, and Northern South Africa (Walther *et al.*, 2010). As emerged from this study, it can be concluded that the priority areas defined as such are perfectly valid to protect also the western yellow wagtail specifically.

For the conservation of the species, the relationship between the western yellow wagtail and agriculture in Africa deserves attention. As already mentioned, the increased frequency of western yellow wagtails in cultivated areas, in particular those irrigated or flooded (rice paddies), is evident. This is a direct consequence of the increase in the presence in Africa of this environmental typology as a response to the growth of the population of the continent that drives the transformation of natural vegetation into farmland. Farming is the major source of food and income for poor rural households, whose numbers are growing despite urbanisation and overall economic growth (Bolwig *et al*., 2006). Farmland expansion and intensification are inevitably causing natural habitat degradation and act as a major acceleration in biodiversity loss (Sala *et al*., 2000; Bolwig *et al*., 2006). Between 1970 and 2000, sub-Saharan Africa's agriculturally used area increased by 4%, fertilizer consumption almost tripled, and pesticide imports increased more than fivefold to treat about 16.3% of the cultivated area (Wolanski, 2012; Sheahan & Barrett, 2017). In Africa, the predominant pesticide groups used are: insecticides (mainly organophosphates), fungicides, and herbicides. The total annual average amount of pesticides used per country is more important in North Africa and in the eastern flyway of African migratory birds from Egypt to South Africa via Kenya and Zimbabwe (Fig. 16) (Mullié & Diop, 2001). Agricultural households across sub-Saharan Africa apply pesticides, fungicides, and herbicides far more frequently than is commonly acknowledged (Sheahan & Barrett, 2014). Above all, this last aspect is worrying when considering the multiple effects that agrochemicals can have on birds: death, hormonal deregulations, breeding failures, deterioration of habitats due to herbicides or fertilizers, loss of food due to the impact of insecticides on invertebrates (Newton, 1998; Mitra *et al*., 2011). Of all those

Fig. 16 - Average use of pesticides per area of cropland (arable land and permanent crops) at national levels in a time series from 1990 to 2015. / Uso medio di pesticidi per superficie coltivata (seminativi e colture permanenti) a livello nazionale dal 1990 al 2015. (Source / Fonte: FAO, 2017).

used, the most lethal agrochemical for birds is Carbofuran (2,3-dihydro-2,2-dimethylbenzofuran-7-yl methylcarbamate, also known as Furadan or Curater, the most toxic of the carbamate pesticides and the most widely abused in Africa), since in its granular form, a single grain may kill a bird: birds often eat numerous grains of the pesticide, mistaking them for seeds or pebbles and then die shortly thereafter (Mineau, 2005; Harrison, 2006; Parsons *et al*., 2010). Carbofuran is strictly controlled in the United States, Canada, and the European Union, but is still used in the rice paddies of Africa as pest control against locusts and birds (Ruelle, 1983; Odino & Ogada, 2008; Parsons *et al*., 2010). As documented in Senegal, the western yellow wagtail is among the birds that die poisoned in the rice fields due to Carbofuran use (Mullié *et al*., 1991; Bogdanski *et al*., 2015).

In addition to being used to defend crops, Carbofuran is also intentionally used to kill wild animals for food and for traditional medicine (Ogada, 2014). Although, under national laws, it is illegal to hunt wildlife using poisons in 83% of African countries, it is a very widespread traditional practice. Recently, synthetic pesticides have replaced traditional plant- and animal-based poisons used to deliberately kill wildlife, and despite high levels of contamination, birds are coveted as bushmeat by consumers as a source of protein (Odino, 2011; Ogada, 2014). In the rice paddies in Western Kenya (Busia District), many species, both local and Palearctic migrants (e.g. Marsh sandpiper *Tringa stagnatilis*, common snipe *Gallinago gallinago*, black-tailed godwit *Limosa limosa*, ringed plover *Charadrius hiaticula*, wood sandpiper *Tringa glareola,* and western yellow wagtail), are caught by bait made up of termites laced with Carbofuran; in relation to the western yellow wagtail, it has been found that about 29% of the specimens present in the fields are killed by this hunting method (Odino, 2011). In 2010, every western yellow wagtail killed was sold for 5-10 Kenyan Shilling, equivalent to 0.04-0.08 Euro or 0.05-0.10 US Dollars (Odino, 2011). The western yellow wagtail is also an object of hunting as it is one of the 399 taxa (of which 107 Passeriformes) sold on skin-and-bone stalls as part of a general system of traditional African medicine (Williams *et al*., 2013; 2014). The fetish markets are particularly conspicuous in Ghana, Togo, Bénin, and Nigeria, and collectively they create a strong demand among the region's hunters and trappers (Cocker & Mikkola, 2001; Williams *et al.*, 2013). In Bénin, along with 7,039 other birds, eight specimens of western yellow wagtail were found on 20th January 2002 in the Dantokpa market in Cotonou (Littoral Department), the biggest fetish market in Bénin and West Africa (Adjakpa *et al.*, 2002). By analogy with the african pied wagtail *Motacilla aguimp* in Nigeria, it can be hypothesized that the power of giving security is attributed also to *Motacilla flava* (Nikolaus, 2001; 2011). In Central Africa, the wagtails are regarded as a good omens and messangers of peace (Daniels & Stevens, 1903).

It is evident that the agricultural expansion and intensification and the resulting increase in the application of agrochemicals in Africa constitute an effective danger for the conservation of the western yellow wagtail. To remedy this, I hope that the recommendations clearly expressed by Ogada (2014) for the African continent can be appropriately adopted: banning pesticides, improving pesticide regulations and controlling distribution, better enforcement, stiffer penalties for offenders, increasing international support and awareness, and developing regional pesticide centers.

If the quality of the agrochemicals used in the African wintering range of the western yellow wagtail is most worrying for this region, in Western Europe, the use of chemical products in agriculture during the breeding season can also be a serious danger considering the high quantity used per unit area (kg/ha) (Fig. 16) (Bright *et al*., 2008; Goulson, 2014; Hallmann *et al*., 2014; Eyhorn *et al*., 2015). For the conservation of *Motacilla flava* and the other farmland birds, it is therefore necessary that cultivation methods that involve a reduction in the use of agrochemical products and encourage a more respectful use of natural resources and biodiversity (e.g. crop rotation, bio-control and natural pesticides, Integrated Pest Management, agroecology, organic agricolture) are adopted in Europe.

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SUPPORTING INFORMATION / APPENDICE

Additional Supporting Information may be found online for this article.

S1 - Wintering range of western yellow wagtail *Motacilla flava* in Africa and Europe in a historical perspective: detailed results / Areale di svernamento della Cutrettola *Motacilla flava* in Africa ed Europa in una prospettiva storica: risultati di dettaglio.