

## **The Osprey in the Western Palearctic: Breeding Population Size and Trends in the Early 21st Century**

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# THE OSPREY IN THE WESTERN PALEARCTIC: BREEDING POPULATION SIZE AND TRENDS IN THE EARLY 21<sup>ST</sup> CENTURY

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**ABSTRACT.**—The number of Osprey (*Pandion haliaetus*) nesting pairs in Europe, northern Africa, and the Middle East has reached between 9500 and 11 500 in the early 21<sup>st</sup> century. Compared to numbers from the 1980s (ca. 5500 pairs), the population has almost doubled. The increase is most obvious in countries like Germany and the United Kingdom. The largest and most important European populations in Sweden, Finland, and Russia seem to be stable. In contrast, Portugal, mainland Spain, and Turkey lost their last breeding pairs in the 1980s and 1990s. Negative trends are also reported from Poland due to persecution and from southeastern Europe and northern Africa, where only very few pairs remain. Reintroductions in England, Spain, and Italy have resulted in a few new breeding pairs in recent years.

**KEY WORDS:** *Ospreys; Pandion haliaetus; Europe, populations; trends; Western Palearctic.*

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## PANDION HALIAETUS EN EL OESTE PALEÁRTICO: TAMAÑO DE LA POBLACIÓN REPRODUCTIVA Y TENDENCIAS A COMIENZOS DEL SIGLO XXI

**RESUMEN.**—El número de parejas nidificantes de *Pandion haliaetus* registradas en Europa, el norte de África y Oriente Medio ha alcanzado entre 9500 y 11 500 a comienzos del siglo XXI. Comparado con los números de la década de 1980 (ca. 5500 pares), la población casi se ha duplicado. El incremento es más obvio en países como Alemania y el Reino Unido. Las poblaciones europeas más grandes e importantes en Suecia, Finlandia y Rusia parecen ser estables. En contraste, Portugal, España continental y Turquía perdieron sus últimas parejas reproductivas en las décadas de 1980 y 1990. También fueron reportadas tendencias negativas en Polonia debido a la persecución y en el sudeste europeo y norte de África, donde sólo quedan pocas parejas. Las reintroducciones en Inglaterra, España e Italia han resultado en unas cuantas parejas reproductivas nuevas en años recientes.

[Traducción del equipo editorial]

As a raptor with an almost worldwide distribution, the Osprey (*Pandion haliaetus*) is an excellent sentinel species for habitat change (Saurola 1997, Bai et al. 2009), changes in fish communities (Fisher et al. 2001b, Baril et al. 2013) and for environmental contamination (Grove et al. 2009). For these and other reasons the Osprey has for decades been monitored in many countries, mainly in North America and in Europe (Poole 1989).

By the beginning of the 19<sup>th</sup> century, historic breeding populations of European Ospreys, especially in southern and western areas, were already greatly depleted by human persecution (Voous 1960, Dennis 2008). They were further reduced in numbers and range by even more intense human persecution in the 19<sup>th</sup> and early 20<sup>th</sup> century and by organochlorine pesticide poisoning in the 1950s and 1960s (e.g., Ahlgren and Eriksson 1984, Schmidt 1995, Weber et al. 2003, Saurola 2006). This was certainly also the case in most of the eastern countries of the region, as, for example, reported from Estonia by Lohmus (2001). Destruction of

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breeding habitat and disturbance by tourism played another role in the decline of some populations in later years (Saurola 1997). From the early 1970s, the species recovered through conservation measures, the ban on the use of DDT, and new regulations to stop hunting in several European countries (Saurola 1985, 1994). A significant increase in some populations followed in the late 1980s and more so in the 1990s and 2000s. However, many of these populations, for example, in the British Isles, Germany, France, and Spain, have not yet reached their former breeding numbers or range, and some countries, such as Switzerland (Krummenacher et al. 2009) and Portugal (Palma 2001), have not yet been recolonized. In the Mediterranean Sea, some of the small and scattered remaining island and coastal populations are still threatened by local extirpation (Thibault et al. 2001, Triay 2002, Triay and Siverio 2008, Monti et al. 2013). In this report, we present updated information on the breeding numbers of Ospreys to reflect recent population changes and new census work on Ospreys in many European countries, and to review the total numbers as a tool for ongoing and future monitoring schemes as well as conservation measures.

#### METHODS

We assembled the data presented here through literature research as well as personal and written inquiries to the coordinators of national breeding bird surveys or to species experts. We based this compilation on earlier reviews by Saurola (1997), Schmidt (1998), Mebs and Schmidt (2006), and Dennis (2008). Sources of data are marked “pers. comm.” when they were obtained through inquiries to experts who do not necessarily publish annual reports. We collected data of total numbers of nesting Ospreys and their trends for each nation within the Western Palearctic (Snow and Perrins 1998). In some cases, more detailed population parameters were available and are also presented here. The main period considered is 2000–2013, but we also report data from earlier years if no recent information could be found. For countries not mentioned in our review, we did not receive any data on breeding Ospreys, either because these countries are situated out of the current breeding range or because we did not know any experts in that region.

The methods used to calculate the figures for total numbers of what is presented as “nesting pairs” or “breeding pairs” varied among countries. However, in most countries or study areas, where

precise counts and observations in the field are made, the same categories are used to report production parameters following Postupalsky (1977): “*occupied territory*” includes all territories with a single bird or pair regularly present, regardless of whether eggs were laid; “*active nest*” includes all nests where eggs were laid; “*successful nest*” includes all nests that fledged one or more young. In several countries, a high proportion of nests or even every known nest, was visited annually at least once per breeding season, e.g., in the British Isles, Finland, France, Germany, and Spain. In some countries, a known proportion of Ospreys were identified year after year by their individually coded colored rings. At these sites, second and third visits to most nests were often undertaken during the season to count or ring the young in the nest. Most of this work was done from the ground by volunteer nest caretakers, tree climbers, and ringers, in some countries coordinated by ringing centers, state officials, or scientists. In Germany, for example, all occupied nests on power line pylons were counted from helicopters early in the breeding season. This was done by power companies, who reported their results to volunteer nest wardens. In countries with very large Osprey populations, i.e., Russia and Sweden, annual counts were only made in a few study areas and total numbers were estimated. In some countries, nationwide counts were made only every ten or more years.

Several countries in eastern and southeastern Europe, in northern Africa, and the Middle East have big gaps in their Osprey data due to a lack of staff and funding. As a consequence, the accuracy of numbers as well as of trends varies greatly between countries. In some countries, trends are based on precise annual counts, whereas in others, rough estimates are compared over longer time intervals. Other parameters of population biology, such as reproductive rates, are not calculated using a standardized methodology in all countries, which makes comparisons difficult.

#### RESULTS

We estimated the current breeding population of Ospreys in the Western Palearctic at 9500–11500 pairs (Table 1), by summarizing census data from the 1980s, 1990s, and the early years of the 21<sup>st</sup> century. Nations are grouped hereafter in subregions, not strictly following geographic or faunistic definitions.

**British Isles.** In Scotland, the number of breeding Ospreys has grown almost exponentially from just

Table 1. Numbers of Osprey *Pandion h. haliaetus* pairs in the Western Palearctic (Europe, North Africa and parts of the Middle East) and their population trends: + increasing; – decreasing; ± stable; (+, –, ±) local trends; ? trend unknown. Nations with known breeding populations listed in alphabetical order. For Russia, only the European part is considered.

| NATION             | NO. OF PAIRS      | YEARS            | TREND | REFERENCE                                     |
|--------------------|-------------------|------------------|-------|---|
| Algeria            | 9–15              | 1989–1993        | ±     | Isenmann and Moali 2000                       |
| Armenia            | 1–4               | 1999–2002        | –     | BirdLife International 2004                   |
| Azerbaijan         | 0–5               | 1996–2000        | ±     | BirdLife International 2004                   |
| Belarus            | 150–180           | 1998–2002        | ±     | Dombrovski and Ivanovski 2005                 |
| Bulgaria           | 3–6               | 2007             | –     | Iankov 2007                                   |
| Cape Verde Islands | 72–81             | 2001             | –     | Palma et al. 2004                             |
| Denmark            | 3                 | 2012             | ±     | J. Tofft pers. comm., Bomholt and Novrup 2004 |
| Egypt              | 150–180           | 1984–1989        | –     | Fisher et al. 2001a                           |
| Estonia            | 50–60             | 2006             | +     | Männik 2006                                   |
| Finland            | ca. 1300          | 2010             | ±     | Saurola 2011                                  |
| France             |                   |                  |       |   |
| Continental France | 38                | 2011             | +     | G. Tardivo and R. Wahl pers. comm.            |
| Corsica            | 38                | 2011             | +     | J.-M. Dominici pers. comm.                    |
| Germany            | 550               | 2007–2009        | +     | Schmidt 2010                                  |
| Italy              | 1                 | 2011             | +     | A. Sforzi pers. comm.                         |
| Latvia             | 180–200           | 2007–2009        | +     | A. Kalvāns pers. comm.                        |
| Lithuania          | 20–30             | 1998–2008        | ±     | B. Sablevicius pers. comm.                    |
| Moldova            | 0–2               | 1990–2000        | ?     | BirdLife International 2004                   |
| Morocco            | 22                | 2013             | ± (–) | I. Cherkaoui pers. comm.                      |
| Norway             | 500               | 2012             | +     | T. Nygård pers. comm.                         |
| Poland             | 24–29             | 2009             | –     | Neubauer 2011                                 |
| Portugal           | 1                 | 2001             | –     | L. Palma pers. comm.                          |
| Russia             | 2000–4000         | 2004             | ± (–) | Mischenko 2004                                |
| Spain:             |                   |                  |       |   |
| Andalusia          | 13                | 2013             | +     | E. Casado pers. comm.                         |
| Balearic Islands   | 20                | 2013             | +     | R. Triay pers. comm.                          |
| Canary Islands     | 7                 | 2013             | –     | D. Trujillo and M. Siverio pers. comm.        |
| Chafarinas Islands | 1                 | 2008             | ±     | Triay and Siverio 2008                        |
| Sweden             | 4100              | 2010             | ±     | Ottosson et al. 2012                          |
| Turkey             | 0                 | 2009             | –     | M. Kasperek pers. comm.                       |
| Ukraine            | 1–2               | 2013             | –     | V. Grishchenko pers. comm.                    |
| U.K.               |                   |                  |       |   |
| Scotland           | min. 230          | 2010             | +     | R. Dennis pers. comm.                         |
| England            | 7                 | 2012             | +     | T. Mackrill pers. comm.                       |
| Wales              | 3                 | 2012             | +     | T. Mackrill pers. comm.                       |
| <b>Total:</b>      | <b>9494–11628</b> | <b>1984–2013</b> |       |   |

one pair in the 1950s to at least 145 in 2000 (Dennis and McPhie 2003) and a minimum of 230 pairs in 2010. Protective measures such as nest-guarding in the early years and the construction of artificial nests were important factors influencing the growth of this population. The immigration of some breeding birds from Scandinavia is known from ring recoveries, but the majority of breeders were recruited from Scottish young. This, and much more concern-

ing the population biology, is well known through a long-term and intensive ringing program using individually coded colored rings on a high proportion of the population. Although reproduction was low in many years, and illegal egg-collecting in up to one third of the clutches in some years threatened the population, the range expanded southward to the English borders over the last 20 yr. Natural recolonization of England occurred in 1999, when a

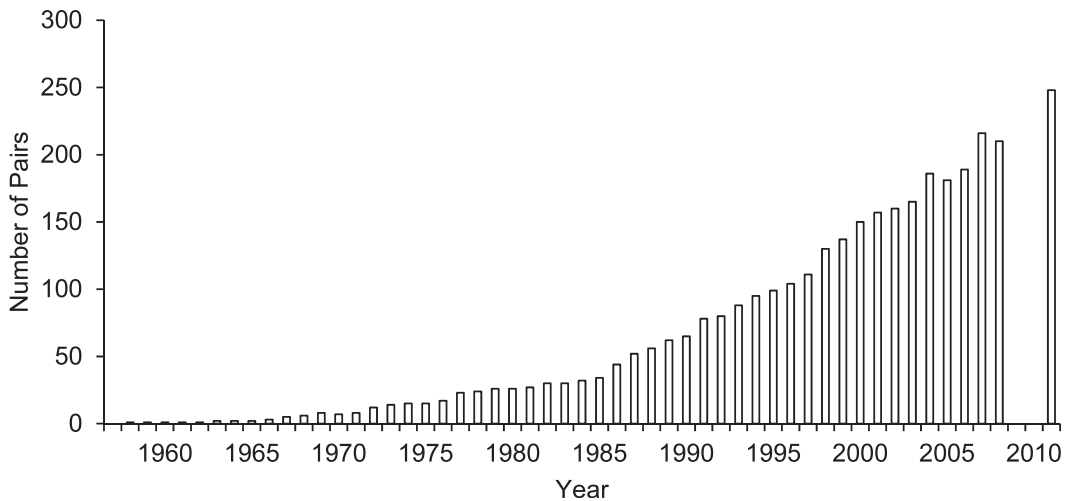


Figure 1. Numbers of Osprey nesting pairs in the U.K., 1954–2011. Data from 2009 and 2010 are missing, because of incomplete data collection.

pair bred in the Lake District. A reintroduction project started in 1996 at Rutland Water in central England, using nestlings from Scotland, resulted in successful breeding starting in 2001 (Mackrill et al. 2013). The breeding population in England had grown to at least seven pairs by 2012. In Wales, breeding was first recorded in 2004 and three breeding pairs were known in 2012 (T. Mackrill pers. comm.). Overall, the breeding population of Ospreys in the British Isles has reached almost 250 pairs (Fig. 1).

**Nordic Countries.** The very small number of breeding pairs in Denmark is noteworthy, because it seems that a country with such a big proportion of suitable habitat should have a much larger breeding population. However, only one pair was known for the period 1994–2003 (Bomholt and Novrup 2004). It had its nest on top of a Scots pine (*Pinus sylvestris*) in northern Jutland, with its location kept secret. Reproduction was poor: only seven young fledged altogether from 1994–2003. In 2011, three pairs were recorded (J. Tofft pers. comm.).

Because of the wealth of freshwater lakes and coastal waters, as well as suitable nesting habitat, Scandinavia and Finland are today's strongholds of the Osprey in Europe. In Norway, the population size was thought to be stable over several years and estimated at 150–200 pairs in 2000 (Steen and Hansen 2001, Bakken et al. 2003), but had increased to 500 pairs by 2012 (T. Nygård pers. comm.).

Sweden holds the largest breeding population in Europe, with almost 3600 pairs counted in 2001

(Ryttman 2004). The large size of the population makes it impossible to count the numbers every year and calculate trends. Repeated counts in six areas in southern and central Sweden between 1971 and 1998 revealed only a slight increase in numbers during that period (Odsjö and Sondell 2001). Today the population is estimated at 4100 pairs and seems to be generally stable (Ottosson et al. 2012), with a slight but significant increase in Scania, the southernmost part of the country (R. Strandberg pers. comm.).

Finland holds the best monitored large breeding population of Ospreys in Europe with about 1300 pairs (Saurola 2011). Numbers grew during the period 1982–1994, with an annual increase of 3%, and the population was stable through most of the first decade of this century. However, the population has slightly increased again over the past 3 yr (Saurola 2008, Fig. 2). In many regions of Fennoscandia, Ospreys are dependent on artificial nesting platforms (as in most other parts of Europe) because old and suitable nesting trees are rare in the landscape due to intensive forestry. During the 2000s, almost half (47–49%) of the Finnish Ospreys bred on artificial nests constructed by volunteers; in some local areas, the Ospreys nested only on platforms (Saurola 2006, 2011).

**Baltic States and Central Europe.** Within this region we found diverging trends. In Estonia, most of the 50–60 pairs breed in the eastern half of the country, where fish densities are highest (Löhms 2001). The population is slowly increasing and

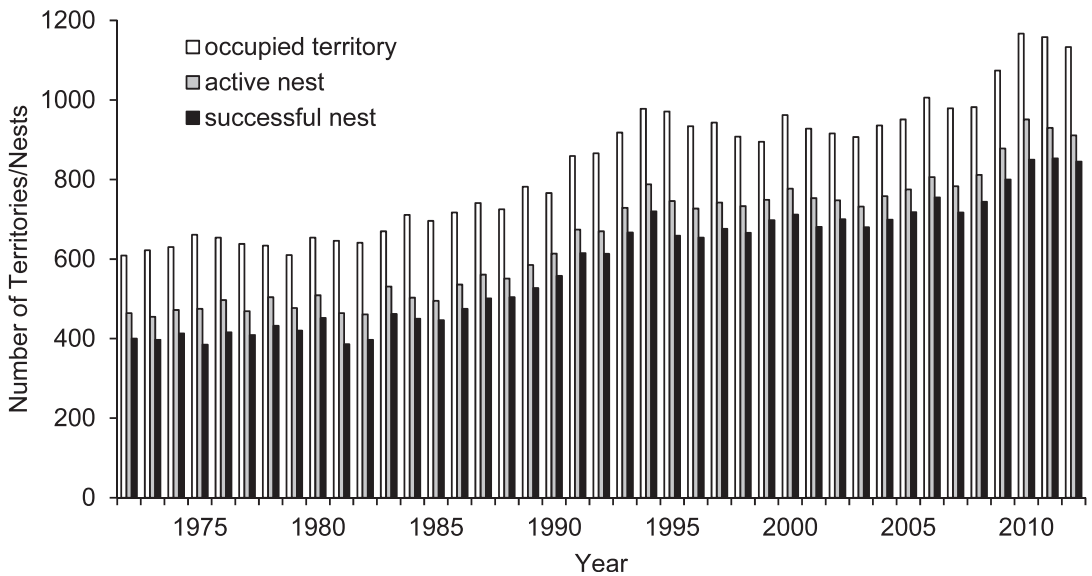


Figure 2. Numbers of Osprey nesting pairs in Finland 1972–2010. *Occupied territory* includes all territories with a single bird or pair regularly present, regardless of whether eggs were laid; *active nest* includes all nests where eggs were laid; *successful nest* includes all those that fledged at least one young, or contained at least one young of nearly fledging age.

recolonizing the central inland and western coastal areas (Männik 2006). However, the population is still far below the estimated historical number of about 1000 pairs in Estonia (Lõhmus 2001). In Latvia, the second atlas of breeding bird distribution for the early years of the 21<sup>st</sup> century is in preparation. It will show an increasing Osprey population in that country, reaching an almost evenly distributed 200 pairs in 2007–2009 (A. Kalvāns pers. comm.). In Lithuania, no studies are currently underway on Ospreys, but the population of about 20–30 pairs, found mainly in the east of the country in a census in the 1980s and '90s, seems to be stable (Sablevicius 2001, B. Sablevicius pers. comm.).

In contrast, the situation in Poland is not positive, mainly due to persecution (Mizera 2009). In 2007, only 37 occupied territories (with 22 nesting pairs) were found, a dramatic decline from the almost 75 pairs estimated in the early 2000s (Tomialojc and Stawarczyk 2003, Sikora et al. 2007).

In neighboring Germany, the population has more than tripled over the last 20 yr and had reached at least 550 nesting pairs by 2009 (Schmidt 2010, Fig. 3). A summary of the latest available results from the federal states in 2007–2009 showed that, of these, 90% were breeding pairs that produced almost 950 young per year. Along with this growth in total numbers, there was also a slight in-

crease in reproductive rates (Bai et al. 2009). In the largest German population, in the federal state (land) of Brandenburg, with 314 territorial pairs in 2008 (on average 1.06 pairs/100 km<sup>2</sup>, 286 breeding pairs, 241 successful pairs, 548 known young), the number of young per successful pair was 2.27 and the number of young per pair with eggs was 1.96 (Ryslavý 2011). The growth in numbers also resulted in a range expansion starting in the early 1990s, which led to the recolonization of northwestern Germany (Lower Saxony) and southern Germany (northeastern Bavaria, Müller et al. 2008). In 2012, there were six breeding pairs in Bavaria with a total of 14 young (D. Schmidt-Rothmund unpubl. data). This population increase was facilitated in all federal states by the building of artificial nest platforms on electricity pylons and in trees. In addition, more than 10 000 nestling Ospreys have been ringed with individually coded colored rings in Germany since 1995 (Schmidt 2009, Bai and Schmidt 2011). Data on reproduction obtained when nestlings were ringed and several hundred resightings of ringed adult birds, with many of them followed over consecutive years, are in a database managed by the Hiddensee Bird Ringing Center. Analysis of this database will give a detailed insight into most parameters of the population dynamics of Ospreys in central Europe.

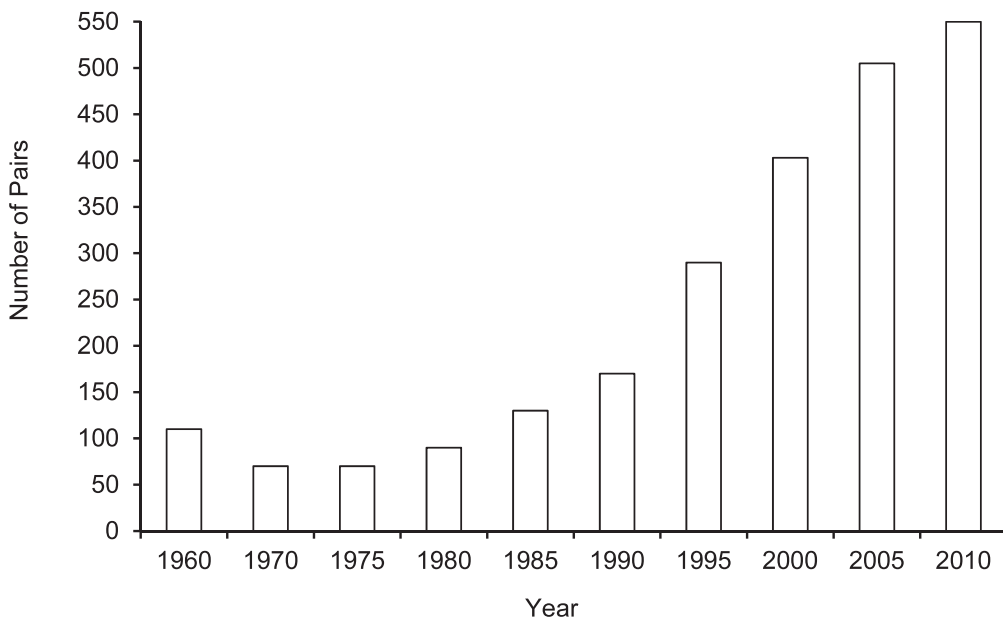


Figure 3. Numbers of Osprey nesting pairs in Germany 1960–2010. Data from 1960 to 1985 are reconstructed estimates from literature analyses (data for 1965 not available); data from 1990 and later are based on annual counts.

The probable breeding of Ospreys presented (presumably by mistake) in the European Breeding Bird Atlas (Hagemeijer and Blair 1997) and in Huntley et al. (2007) for the Czech Republic (11 grid-squares, each 50 km × 50 km) could not be confirmed (Cepák et al. 2008, Štastný et al. 2006). In 2008–2010, however, a few Ospreys were observed at nesting platforms on pylons and on a tree, mainly in May. The birds built nests and copulated, but no active nests were documented (K. Štastný pers. comm., Šimeček 2013). In Hungary, two unsuccessful nesting attempts were observed between 1990 and 2010, one in a tree in the *puszta* (steppe) in atypical habitat, and the other on an electric pylon close to fishponds (Kotymán et al. 2011).

In Austria and Switzerland, the Osprey was extirpated as a breeding species about 100 yr ago, but projects to help the birds return or to establish a new breeding population by hacking are in preparation (see Strahm and Landenbergue 2013 for Switzerland). In the Netherlands, a pair of non-breeding Ospreys built a nest in 2002 and illustrated the potential of this region for colonization. However, the birds did not return in the following years (Bijlsma and de Roder 2002).

**Eastern Europe.** In Belarus, the Osprey breeds mainly in the north, with up to five pairs/100 km<sup>2</sup>,

and the population seems stable at 150–180 pairs (Ivanovski 2000, Dombrowski and Ivanovski 2005). In Ukraine, only 1–2 pairs have been documented (V. Grishchenko pers. comm.). No recent and accurate estimate of the large Osprey population in the European part of Russia is available; population estimates vary from 2000 to 4000 pairs (Mischenko 2004).

**Southern and Southwestern Europe.** In southern and southwestern Europe, Ospreys are very rare or absent in several countries. Italy has had a single breeding pair since 2011, due to a translocation project with young from Corsica (A. Sforzi pers. comm.). In Portugal, the last pair with a clutch was seen in 1997 and the last nest occupied by a pair until 2001 and until 2003 by a single Osprey (Palma 2001, L. Palma pers. comm.). After almost three decades with no nesting Ospreys, continental Spain had two new breeding pairs in Andalusia in 2009 due to a reintroduction project (see below) and this new population increased to 13 pairs by 2013. In the Mediterranean, only a few other small and scattered populations remain in the western half on islands and along the coast of northern Africa. In Morocco, the last few pairs are threatened by dynamite and poison fishing (Monti et al. 2013). Corsica has 38 pairs (J.-M. Dominici pers. comm.)



and the Balearic Islands have 20 pairs (R. Triay pers. comm., Malmierca and Muntaner 2010). These two mainly cliff-nesting island populations are well monitored and protected, but still vulnerable (Thibault et al. 2001, Triay 2002, Martí and del Moral 2003, Triay and Siverio 2008). In the Atlantic Ocean two populations are present: ca. 80 pairs in the Cape Verde Islands (Palma et al. 2004) and seven pairs in the Canary Islands, where the numbers recently decreased (Siverio 2006, Triay and Siverio 2008, Rodríguez et al. 2013, D. Trujillo and M. Siverio pers. comm.).

After decades of absence as a breeding species in mainland France, a nesting pair established spontaneously near Orléans in the mid-1980s, and since then the population has increased to its present level of 38 pairs (G. Tardivo and R. Wahl pers. comm., cf. Thiollay and Bretagnolle 2004). The recovery in central France was undoubtedly helped by the construction of artificial nests in trees and nest-site protection. The ringing of nestlings and adult birds, along with the annual monitoring of individually color-ringed breeders, revealed a high proportion of recruitment from within the growing population and some long-distance immigration from eastern Germany (Schmidt and Wahl 2001, Wahl and Barbraud 2005, 2014). In addition, a single pair of Osprey bred successfully at an artificial nest in the northeast of France (Moselle) in 2009 (Hirtz 2008).

**Southeastern Europe.** In most of southeastern Europe (Slovenia, Bosnia, Slovakia, Serbia, Albania, Croatia, Kosovo and Montenegro, and Greece) the Osprey is either extirpated or no data are available. In Bulgaria, three to six pairs are estimated for the entire country, in the Trakia Plain and in eastern Bulgaria. Between 1990 and 2005, single pairs bred during some years or in certain periods only, but in general the population has decreased (Iankov 2007). The situation is probably similar in Moldova, where only two pairs were reported in the 1990s. The former breeding population of Turkey (ca. 10–20 pairs until the 1980s; Kasperek 1989) is probably extirpated. Observations of adult Ospreys during the breeding season were made in various places in 2009, but no nests were found (M. Kasperek pers. comm.).

**Northern Africa and the Middle East.** For most countries in northern Africa and in the Middle East, current data are difficult to obtain and trends cannot be estimated easily. Only one breeding pair was known in 2008 in the Chafarinas Islands, which lie off the north coast of Morocco, but which are Spanish territory (Triay and Siverio 2008). For Morocco,

ca. 20 pairs were reported for the early 2000s, mainly breeding along the Mediterranean coast (Thévenot et al. 2003), but this may be an overestimate (I. Cherkaoui pers. comm., N. Houssine pers. comm., Monti et al. 2013). The estimates for Algeria are 9–15 pairs, breeding mainly along the eastern rocky coasts (Isenmann and Moali 2000).

No recent data are available for Egypt, but 150–180 pairs were estimated in the 1980s or early 1990s. For the mainland breeding population of Egypt and other countries of the Middle East, severe losses were expected (Fisher et al. 2001a), due to the development of the coastline for industrial use and tourism. The last review and census of the Osprey population in the Middle East from the mid-1990s resulted in an estimated minimum of 1400 pairs, with the majority (70%) breeding in the Red Sea area, mainly on islands along the Saudi Arabian coast (Fisher et al. 2001a), which is partly outside the boundaries of the Western Palearctic, as defined by Snow and Perrins (1998).

Very small numbers of breeding pairs are reported from Armenia (1–4 pairs in 1999–2002) and Azerbaijan (0–5 pairs in 1996–2000; BirdLife International 2004). Evidence for breeding on Cyprus (Meyburg and Meyburg 1987) could not be found (J.-C. Thibault pers. comm., Flint and Stewart 1983). There are no breeding Ospreys in Israel and no proof that they have ever bred there (O. Hatzofe pers. comm.). In 1967–81 there may have been ca. 45 pairs in the Sinai (Meyburg and Meyburg 1987), but these were part of the larger Egyptian population of Red Sea Ospreys.

For all other countries in the Middle East outside the Western Palearctic, see Fisher et al. (2001a). The only more recent census of Ospreys known from this region was in Abu Dhabi Emirate in 2007. It revealed a stable population of 61 nesting pairs, making it an important population in the Arabian region (Khan et al. 2008).

**Reintroductions.** The first European Osprey reintroduction project using hacking techniques was undertaken in the British Isles, where young from Scotland were released into central England at Rutland Water in 1996–2001 (Dennis and Dixon 2001). This translocation resulted in first breeding there in 2001 and in Wales in 2004 (Mackrill et al. 2013). In 2012, there were seven pairs in England and three pairs in Wales (T. Mackrill pers. comm.). A second European reintroduction project, releasing young Ospreys from Germany, Finland, and Scotland, in southern mainland Spain (Andalusia) from 2003



until 2012, resulted in the first spontaneous breeding attempt by a non-released pair in 2005. They failed to hatch eggs, so young were fostered from Germany into this nest, which proved to be successful (Muriel et al. 2006). By 2013, there were 13 nesting pairs in this region (E. Casado pers. comm.).

The third reintroduction project was started in Italy in 2006 using donor young from Corsica. The first pair from that effort bred successfully in spring 2011, producing two young (Sforzi et al. 2008, Dominici and Nadal 2009, A. Sforzi pers. comm.). Two more reintroduction projects were started recently, one in Portugal in 2011, with young translocated from Finland and Sweden (L. Palma pers. comm.), and the other one in the Basque country (northeastern Spain) in 2012, with young coming from Scotland (A. Galarza pers. comm.).

#### DISCUSSION

We found that the Osprey breeding population probably almost doubled in Europe and adjacent regions within the last 20 to 30 yr, compared to the estimate of 5175–5550 pairs in the 1980s in the review by Poole (1989). The growth of some populations is obvious, such as in Germany and in Scotland, where numbers have risen considerably in recent years. The recovery of the Osprey breeding population in Great Britain is an example of a very successful bird conservation effort (Dennis 2008).

In most countries, where precise data on the numbers of breeding pairs and on their reproduction are available, there is a positive trend. Generally, there is a high proportion of pairs breeding, and the numbers of young per breeding attempt, as well as per successful nest, are sufficient in most countries to maintain a stable population. Spitzer (1980) calculated that about 0.80 young per active nest was the breeding rate needed for a stable population. In France, for example, the growing population of Ospreys produced an average of  $1.89 \pm 1.09$  fledglings per nest per year (Wahl and Barbraud 2014), and the figures in several other European countries are similar. In some regions, where young are numerous and survival rates are high, recruits lead to growing and expanding populations and even to the recolonization of neighboring areas (Bai et al. 2009, Wahl and Barbraud 2014). Accordingly, the Osprey is placed in the 2009 IUCN Red List Category of Least Concern. In conclusion, the conservation measures for Ospreys in Europe have been generally successful. However, not all populations have increased. In Poland, for example, there is evidence

that heavy persecution at fishponds has adversely affected the numbers of breeding pairs (Mizera 2009). In the Mediterranean, despite the positive trends in Corsica and the Balearics, the fragmented and small population faces local extirpation, especially along the coast of northern Africa. A recently begun project will improve knowledge of numbers breeding in that region and help protect the remaining nesting sites (Monti 2012).

In some countries, mainly in the southeast of Europe, the level of knowledge about the population size is far from adequate. Another disadvantage regarding our estimates is that data from several nations differ in the way they were collected. Osprey populations such as those in the Balearic Islands, in Corsica, or in mainland France, are comparatively easy to assess, because numbers of pairs are small, and they are under expert, annual monitoring. On the other hand, the very large population figures for Sweden and Russia are based on extrapolations following surveys of limited areas, and major errors could therefore be entailed in the estimates. This is especially true for Russia, because huge areas there cannot be surveyed due to the lack of funding and staff. We are nonetheless confident that the evaluations of the general trends are correct.

A different approach to surveying breeding numbers and trends is conducted by the Monitoring of European Raptors and Owls (MEROS) program (Mammen and Stubbe 2009). Volunteers count the breeding populations of raptors and owls in hundreds of large study plots distributed over several European countries and trends are calculated using TRIM (Trends and Indices for Monitoring data). In Germany, for example, Osprey population status and changes are constantly monitored within this program. In 2004, there were 14 study plots in four different federal states including 191 pairs, with 158 of them being successful (82.7%). They produced 2.39 young per successful pair and 1.97 young per breeding pair (pair with eggs). Results from 1990 until 2004 also showed a clearly positive trend of  $+7.6\% \pm 1.6\%$  with  $P < 0.01$  and  $n = 1699$  breeding attempts (Mammen and Stubbe 2009). Data from the federal state (land) of Brandenburg, where all nests are monitored annually, are similar, with 2.27 young per successful pair (pair with large young) and 1.96 young per breeding pair, from a total of 314 pairs in 2008 (Ryslavý 2011).

To assess the conservation status of a migratory bird such as the Osprey, one must look not only at the conditions in the breeding range, but also at the

migration routes and the places where these birds live when it is winter at northern latitudes. Most of the European Ospreys spend our winter months in western Africa south of the Sahara, along rivers and lake shores of the Sahel and, most of all, in coastal habitats of the Atlantic, such as estuaries and mangroves (Saurola 1994, Zwartz et al. 2009, Bai and Schmidt 2011). In this region, many dams have been created over the past 50 yr, turning natural rivers and wetlands into reservoirs. At first glance, it would seem that these new and larger water bodies would be beneficial for Ospreys, but competition for fish with the local fishermen could pose a serious threat for the birds. The degree of persecution on the wintering grounds and on migration could also influence the rate of population growth in Europe.

Ospreys will likely return to breed in the Czech Republic and in Austria in the future, as well as in southwestern Germany, in Switzerland, and over the long term, all along most lakes and rivers north of the Alps. In Switzerland, a study to assess the potential for recolonization of this portion of the historical breeding range (Krummenacher et al. 2009) indicated that fish supply is adequate, but there is a lack of suitable nest sites. There is also room for expansion in northeastern France, to fill the gaps between the two breeding populations of central France and Germany. The same will probably be the case in Denmark, Ireland, and in the U.K., where England and Wales seem suitable for larger breeding populations. Another area of potential expansion is southern Europe, including Spain, Portugal, and Italy. Dennis (2008) has estimated the potential for an additional population increase of 5000 to 6000 pairs if the original breeding ranges in central, western, and southern Europe were fully recolonized (not including the eastern European countries). Because of the philopatric behavior of Ospreys, natural recolonization of all these regions will likely be slow unless aided by release of hacked young birds.

We do not agree with Huntley et al. (2007), who predicted that the breeding range of the Osprey will be shifted northward in the late 21<sup>st</sup> century, with the British Isles, central France, Germany, Poland, the Baltic States, and most of southern Sweden and southern Finland no longer suitable for breeding Ospreys. We see no reason a species with a pan-European breeding distribution, and some populations in Mediterranean and subtropical areas cannot also live under warmer conditions throughout Europe in the future. To address this issue, we must continue to monitor breeding populations. Moni-

toring is a crucial element of conservation and management in a rapidly changing world. Reliable information on the status of populations, their long-term trends (including numbers, productivity, survival, and dispersal), and their annual fluctuations is necessary to formulate sound management programs. The Finnish *Project Pandion* is an example of such a large-scale, statistically powerful monitoring program (Saurola 2008). Since the start of the project in 1971, nearly all known potential nest sites (e.g.,  $n = 2090$  in 2010; Saurola 2011) of the Osprey have been checked annually by qualified, volunteer Osprey ringers ( $n = 117$  in 2010). Furthermore, the results have been published every year (e.g., Saurola 2011), which is important both for conservation authorities and for volunteers to maintain motivation.

The future of the Osprey in Europe lies in our hands. To quote Roger Tory Peterson: "Of all the raptors, the Osprey is the one that can live most happily with modern man, if given a chance" (Poole 1989, p. xiii).

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