

## THE GEOGRAPHICAL ANALYSIS OF THE RECOVERIES OF THE GREAT CORMORANTS *PHALACROCORAX CARBO* RINGED IN ESTONIAN DURING 1989-2010

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**Abstract.** This research is based on recoveries of the Great Cormorants during 1989–2010. Data was obtained from the Ringing Centre database of the Environmental Board in Matsalu. The analysis of water bodies included separate evaluation of recoveries from the Baltic Sea, the Mediterranean Sea, the Adriatic Sea, rivers, lakes and fishponds.

### Introduction

The primary data on the Great Cormorants breeding in Estonia were published at the end of the 18th and in the beginning of the 19th century (Lilleleht 2008). In the 19th century this species had become extinct in many European countries due to persecution. An intensive protection activity in the beginning of the 1980es led to a rapid population increase and the distribution range of this species was expanding. Since then, the population trend has been increasing throughout Europe.

Great Cormorants are migratory birds who breed in colonies and whose wintering areas are located across Europe. In many European countries studies on the breeding colonies of the Great Cormorant have been carried out, breeding pairs have been counted and breeding success has been analyzed (Eschbaum 2008; Ojaste 2010; Rattiste 2010). In several European countries also recoveries have been analyzed and papers on wintering grounds have been published. Yet there exists no thorough analyses on the recoveries of the cormorants breeding in Estonia.

Important factors for the cormorants are food availability and weather conditions, both, along the migration route and in wintering grounds. Food availability is a major factor affecting the survival rate, body condition, age during the first breeding attempt and offspring

production of the adults but also of the first calendar year nestlings. Thus information concerning wintering grounds may be important in terms of assessing future population condition of the cormorants, considering that the non-breeding wintering season substantially affects the subsequent breeding season.

The aim of the current study was to map the recoveries of the Great Cormorants ringed in Estonia in order to obtain a closer overview of the behaviour and the wintering areas of this species, but as well to better understand the effect of wintering areas on population status.

### **Material and methods**

Recoveries of the Great Cormorants ringed in Estonia were obtained from the Ringing Centre database of the Environmental Board in Matsalu. First bird fitted with a numbered ring in Estonia was in 1986. At the time rings of aluminium or steel were used. First colour-rings were applied in 2007 and were green. Since 2009, in addition to rings of aluminium or steel, also blue colour-rings have been used. During 1986 to 2010 a total of 15 470 cormorant nestlings have been ringed in Estonia. First recoveries of the cormorants ringed in Estonia were reported in 1989 which is why data of recoveries made during 1989 to 2010 has been used in the current paper. The available ringing database holds detailed information on the recoveries (recovery date, age of the bird, etc.) yet it will not be fully covered in the current paper.

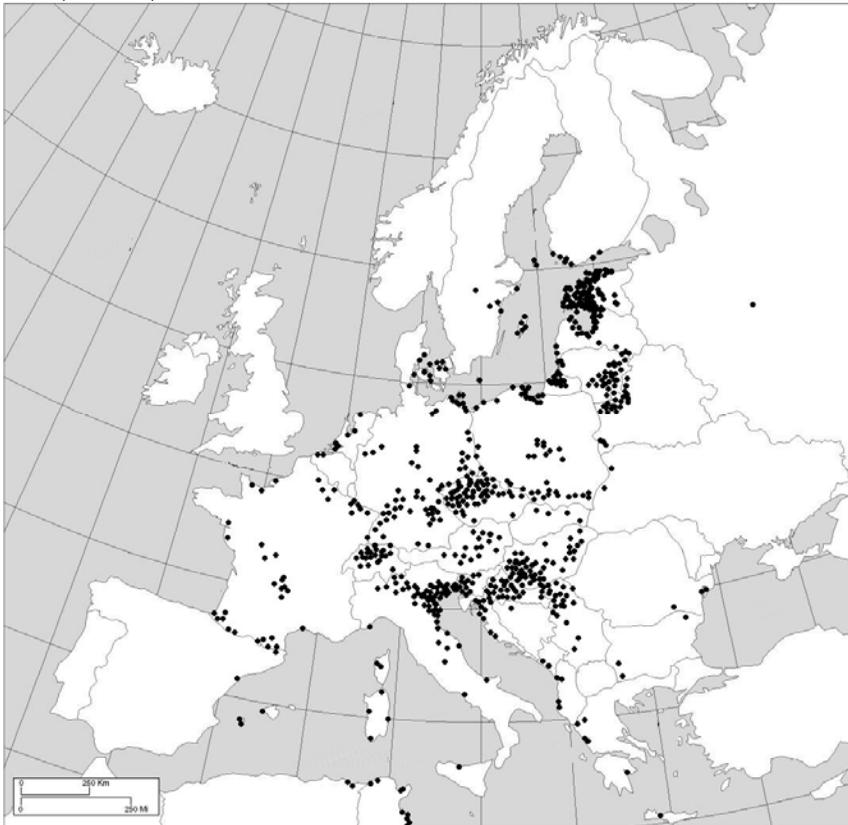
Coordinates of the recoveries were marked on Google Earth map. Particular attention was paid to the precise location of the recoveries - either near water bodies or in mainland. The number of the Great Cormorants in the immediate vicinity of large bays, rivers, lakes and fishponds was registered and also the areas with the highest number of recoveries were pointed out.

### **Results**

The Ringing Centre database included a total of 769 recoveries of the Great Cormorants (Fig. 1). Recoveries have been made almost all across Europe, including 32 European countries (Fig. 1, Table 1). The

majority of the recoveries were made in the Baltic Sea region and in Central Europe. Also, most of the recoveries were predominantly reported from the south-western direction.

The three largest waterbodies yielding the largest number of recoveries were the Baltic Sea, the Mediterranean Sea and the Adriatic Sea. Recoveries made at these three waterbodies were analysed in detail: bays, islands, straits, lagoons, channels or in any other coastal area (Table 2).



**Figure 1.** Recoveries of the Great Cormorants ringed in Estonia during 1989–2010.

*Figure 1. Eestis 1989–2010 rõngastatud kormoranide taasleidud.*

A high number of recoveries reported in the Central European region originate from mountain range. A relatively low number of cormorants have been recovered in north-western France and Spain. Several recoveries in the Ringing Centre database share the same geographical coordinates on the map. Such areas, which produce a high number of recoveries, are usually located near fish farms and lakes in Central Europe. So far the furthest recoveries of the Great Cormorants have been made in Tunisia, Algeria and Crete. One recovery was in the Eastern European region, in Russia, near Moscow, in a village called Lotošino, at River Lob, where a cormorant was reported dead in August 2007.

A total of 72 recoveries were reported at rivers, whereby 32 at the Danube and the Sava River area (22 and 10, respectively). The reason lies in the fact that these rivers flow through several countries - the Danube passes through

A remarkable observation was made among recoveries reported near rivers - namely, one cormorant was

Austria, Bulgaria, Romania, Serbia and Hungary, and the Sava River through Croatia, Serbia and Slovenia.

**Table 1.** Recoveries of cormorants ringed in Estonia 1989–2010 reported in different countries.

*Table 1. Eestis 1989–2010 rõngastatud kormoranide taastleitud erinevates riikides.*

<b>Riik / Country</b>	<b>Taastleide/Recoveries</b>
Albaania / <i>Albania</i>	4
Alžeeria / <i>Algeria</i>	2
Austria / <i>Austria</i>	16
Belgia / <i>Belgium</i>	2
Bosnia & Hercegovina	1
Bulgaaria / <i>Bulgaria</i>	3
Eesti / <i>Estonia</i>	196
Hispaania / <i>Spain</i>	5
Holland / <i>Netherlands</i>	6
Horvaatia / <i>Croatia</i>	31
Itaalia / <i>Italy</i>	69
Kreeka / <i>Greece</i>	6
Leedu / <i>Lithuania</i>	28
Läti / <i>Latvia</i>	19
Montenegro	2
Poola / <i>Poland</i>	46
Prantsusmaa /	38
Rootsi / <i>Sweden</i>	10
Rumeenia / <i>Romania</i>	3
Saksamaa / <i>Germany</i>	57
Serbia / <i>Serbia</i>	21
Slovakkia / <i>Slovakia</i>	4
Sloveenia / <i>Slovenia</i>	12
Soome / <i>Finland</i>	9
Šveits / <i>Switzerland</i>	22
Taani / <i>Denmark</i>	13
Tšehhi / <i>Czech</i>	57
Tuneesia / <i>Tunisia</i>	9
Ukraina / <i>Ukraine</i>	2
Ungari / <i>Hungary</i>	49
Valgevene / <i>Belarus</i>	21
Venemaa / <i>Russia</i>	6
<b>Kokku / Total</b>	<b>769</b>

sighted five times in two consecutive years at the River Nervia in Italy (twice in December 2005, once in January and twice in March 2006).

Recoveries were also reported near lakes. The lakes with three or more recoveries are as follows: Jeziorsko (4) and Goczalkowicki (3) in Poland; Hermanice (4), Ponedraž (9) and Nova Ves (8) in Czech; Oberkirch (10) in Switzerland.

**Table 2.** Detailed information on recoveries of the Great Cormorant in different regions.

*Tabel 2. Erinevate piirkondade detailsemad taaleidude andmed.*

<i>Läänemeri/Baltic Sea</i>	<i>Vahemeri/MediterraneanSea</i>	<i>Aadriameri/Adriatic Sea</i>
rannik/coast	7	rannik/coast 9
Gulf of Riga <sup>1</sup>	10	Gulf of Cagliari <sup>1</sup> 1
Kattegat Strait <sup>2</sup>	6	Gulf of Oristano <sup>1</sup> 1
The Great Belt	5	Gulf of Tunis <sup>1</sup> 1
Fehmarn Strait <sup>2</sup>	1	Gulf of Gabès <sup>1</sup> 1
Archipelago Sea	3	Comaccio Lagoon <sup>5</sup> 4
Curonian Lagoon <sup>1</sup>	15	Marano Lagoon <sup>5</sup> 4
Vistula Lagoon <sup>1</sup>	6	Corsica <sup>3</sup> 2
Puck Bay <sup>1</sup>	8	Gulf of Venice <sup>5</sup> 12
Gdańsk Bay <sup>1</sup>	2	Canale Nicessolo <sup>6</sup> 2
Pomeranian Bay <sup>1</sup>	8	Elba <sup>3</sup> 5
Bay of Greifswald <sup>1</sup>	5	Sardinia <sup>3</sup> 1
Bay of Kiel <sup>1</sup>	1	Sicily <sup>3</sup> 1
Bornholm <sup>3</sup>	1	Kerkennah Islands <sup>3</sup> 4
Gotland <sup>3</sup>	5	Djerba <sup>3</sup> 3
Åland archipelago <sup>4</sup>	3	Ibiza <sup>3</sup> 1
		Crete <sup>3</sup> 1

<sup>1</sup>laht-bay, <sup>2</sup>väin-strait, <sup>3</sup>saar-island, <sup>4</sup>saarestik-archipelago, <sup>5</sup>laguun-lagoon, <sup>6</sup>kanal-canal.

Fish farming is practiced all over Europe, but particularly extensively in a few countries. A total of 99 recoveries were reported at fish farming ponds. The ponds with the highest number of recoveries were Szeged (14), Biharugra (5) Leeds Vasaknos (4), Paupys (3) and Kietaviskes (3) in Hungary, Selets (13) in Belarus, Poljana (17) in Croatia, Velky Dvur (4) and Pohorelice (6) in Czech.

## Discussion

The waterbodies with the highest number of recoveries of the Great Cormorant were the Baltic Sea, the Mediterranean Sea, the Adriatic Sea, rivers, lakes, reservoirs and fish ponds. A large proportion of the recoveries in the Baltic Sea region were made on the coasts of the Gdańsk Bay and Courland Lagoon (Table 1). The Gdańsk Bay is a wintering area mainly for cormorants breeding in Poland (Gwiazda & Bzoma 2005). At this bay the number of wintering cormorants has been continuously rising, remaining below 100 in 1990 but exceeding 3000 after the year 2000 (Bzoma & Meissner 2005).

Studies carried out in other European countries show that breeding and wintering Great Cormorant colonies are mainly located at lagoons, large lakes and rivers, but also at fish ponds. Based on recoveries, a similar trend exists among the cormorants breeding in Estonia. Cormorant colonies gathering at waterbodies in which fish abound, indicates that food availability in the immediate surroundings of the colonies is of major importance during the wintering period.

Numerous cormorant recoveries in fish farms may be explained by the feeding habits of this species. The Biharugra fish ponds belong to the most valuable bird habitats in Hungary (WOW Demonstration Project 2011). This large system of fish ponds comprise low-lying flood-plain situated in the eastern part of the country and is managed for conservation. The fish ponds are surrounded by extensive saline grasslands and arable fields (WOW Demonstration Project 2011). The Hungarian fish farming company Rybnikarstvi Pohorelice operates on 138 fishponds comprising 1614 ha. The oldest fish pond was adapted in the 15th century (Rybnikarstvi Pohorelice a.s. 2011). Ponds are situated in 6 districts, most of them in the Břeclav and Znojmo regions. A large proportion of cormorant recoveries at fish ponds indicate that food availability close by the colonies is of major importance for this species (Ojaste 2010). Farmed fish are kept in concentrations never seen in the wild and open fish ponds with such food availability make suitable wintering sites for the cormorants.

All Great Cormorants in the Baltic Sea region are part of one major population. This means that cormorants hatched in Estonia or Sweden might breed in Poland or in Denmark. The number of cormorants annually migrating to Finland is estimated to over 50%. Thus in Finland more than 5 000 young cormorants start their breeding season every year. Twenty percent of the Great

Cormorant population of the Baltic Sea region is divided into three major colonies: 10 800 pairs in Odra lagoon, Germany; 11 500 pairs in Vistula lagoon, Poland and 11 300 pairs in Curonian Spit, Lithuania (Ojaste 2010). The author's point of view is that the population of the European Great Cormorants should be dealt with greater integrity (unpublished data). Cormorants have been recovered during the breeding season in June and July in Finland, Sweden, Poland, Germany, Hungary and Belarus but also in Tunisia, Italy and Spain, which may suggest that cormorants are breeding also in these Mediterranean countries. Therefore it would be reasonable to consider the cormorants breeding across Europe as one whole population.

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