Great Cormorant *Phalacrocorax carbo* in Europe. Population Development 1970 - 2009

How many Cormorants in Europe ?

- **Breeding Pairs**
  (countries + Europe, based on a synopsis of published data)
- **Total Population**
  (estimate based on a simplified age-cohort model)

A Documentation of EAA - European Anglers Alliance
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Foreword

Data on Cormorant Breeding Population exist for most countries in Europe. However, there is no actual publication which provides a satisfactory overview.

Publications from BirdLife (for 1998 -2002) and Wetlands International (for 2006) provide important overall figures. But the Wetlands International leaflet only published highly aggregated figures, not the counting results per country. And neither of the two enables an insight into population trends - which is indispensible for any rational discussion on cormorants.

This EAA-documentation provides a comprehensive data-set with the number of Cormorant Breeding Pairs, covering the period from 1970 to 2006/2009.

It is a compilation from a multitude of ornithological publications***, with 'cautious' interpolations where published data are lacking. Actually, the main outcome is just two tables with numbers of breeding pairs per year per country. However, it enables to draw a clear picture of the development of cormorant breeding population, both country by country and for Europe as a whole.

Based on these data on breeding population we have also tried an estimate of the **Total Cormorant Population** (including juveniles / non-breeders).

The documentation focuses on quantitative information, on numbers and diagrams, without interpretation or too much verbal comments. However, more differentiated explanations can be provided on request. Analysis, in general, is restricted to "Core Europe", which means all countries except Russia, Belarus, Ukraine and Moldava (where data are fragmentary). But at the end we also tried to make a tentative estimate also for this region.

This documentation will be updated whenever relevant new information is available. So please mind the version number / publication date. The latest issue always can be found on EAA-website *www.**eaa-europe**.org* .

Part A: Overall Figures & Trends

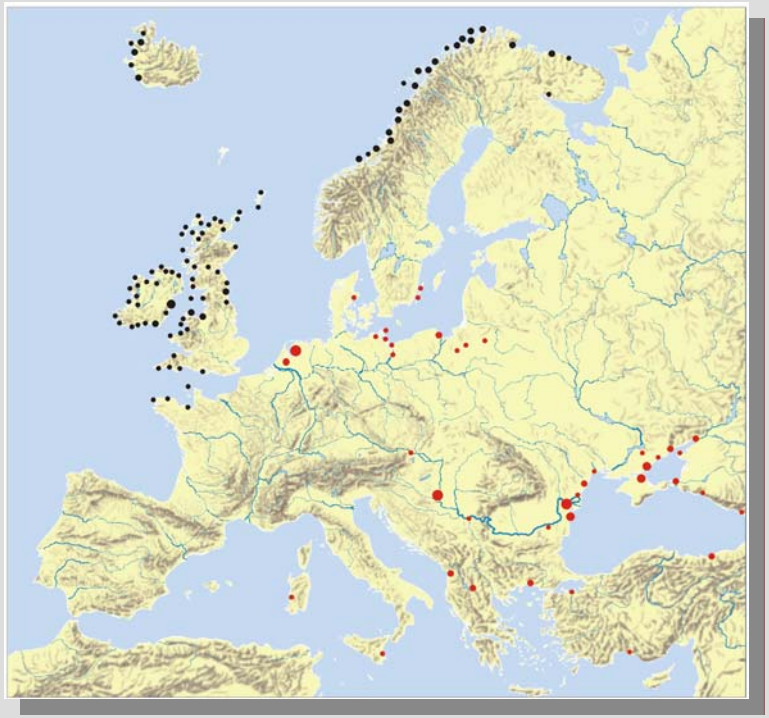
This first section contains "Overview Charts" with more general, aggregated information

More specific charts, especially development country by country, see following sections.

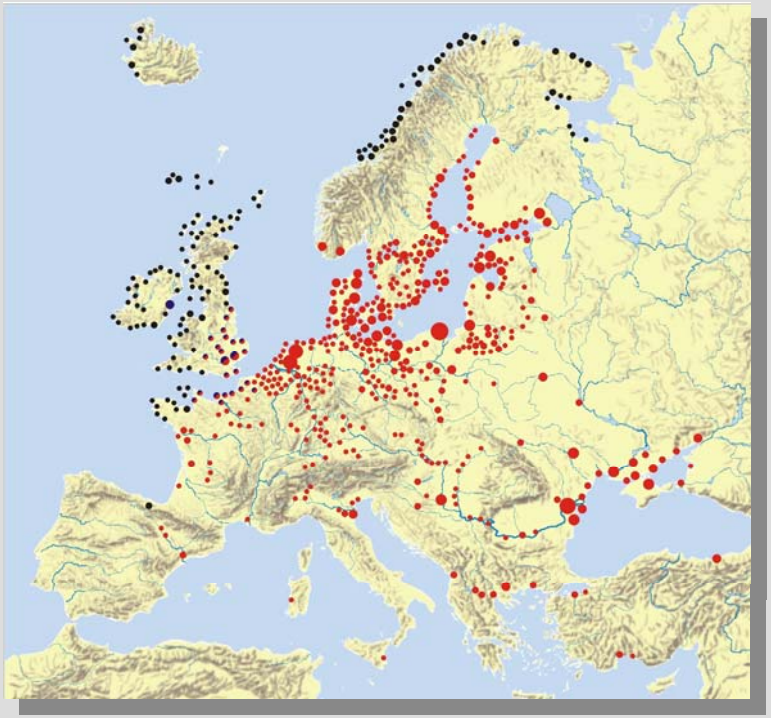
Part A: Regional Distribution of Breeding Colonies

Maps are based on a multitude of sources - see list in appendix

1965/70



2007/08



- **Ph. carbo *carbo* ⇨ virtually same regional range** (*except one small colony in Spain*)
- **Ph. carbo *sinensis* ⇨ massive expansion**

A2: Subspecies and Sub-Populations

Geographical Scope: Core Europe (excluding Ukraine, Russia*, Belarus and Moldova)

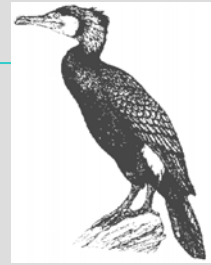
- Carbo-subspecies (often called "atlantic race") lives mainly along the coastal areas of western Europe (*Portugal up to now has no breeding colonies, and Spain only one, but are traditional wintering countries*).

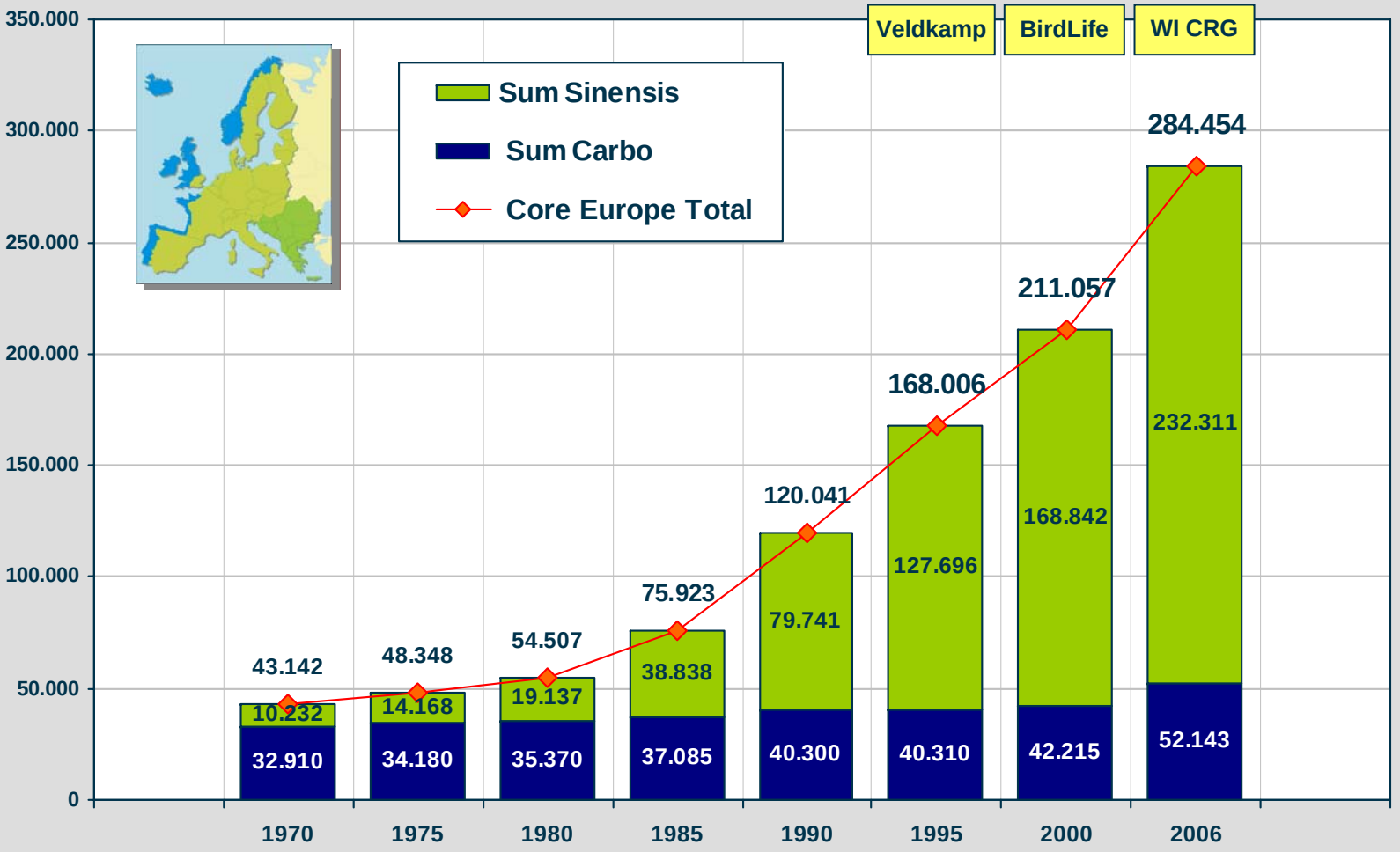
- Within the Sinensis-cormorant one can distinguish two separate sub-populations
  - Sinensis East: centered around Black Sea and Danube delta, extending upstream along the Danube
  - Sinensis West: historically centered in NL, DK, Sweden and Baltic coast of Germany and Poland, then expanding throughout western and central Europe
- Historically, the subspecies and sub-populations were sharply separated. Presently, due to the spectacular expansion of the cormorant population, it has become more difficult to draw a clear border. However, despite possible overlaps the following analysis still maintains this distinction

*) The european part of Russia holds a large number of breeding cormorants (BirdLife Fact Sheet reports 35 - 60.000 pairs in the period 1990-2000). A considerable part is also relevant for the EU, e.g. the colonies in Kaliningrad and near the Finnish border. But information on regional numbers is vague.

B1: Development of Breeding Population on European Scale

Geographical scope: "Core Europe" = all countries except Russia, Belarus, Ukraine & Moldova***





***) Remark concerning "East-eastern Europe": The vast area of european Russia, Belarus, Moldova and Ukraine also holds a large number of cormorants: For the period 1990 - 2000 BirdLife reported a total of up to 138.000 pairs, since then a further increase is reported, in Ukraine alone number of pairs increased from 65.000 to over 100.000 in 2007/08. However, historical data for this area are much less reliable - so this area will be dealt with separately.

B1a.Tables Breeding Pairs (1)

published data
interpolated

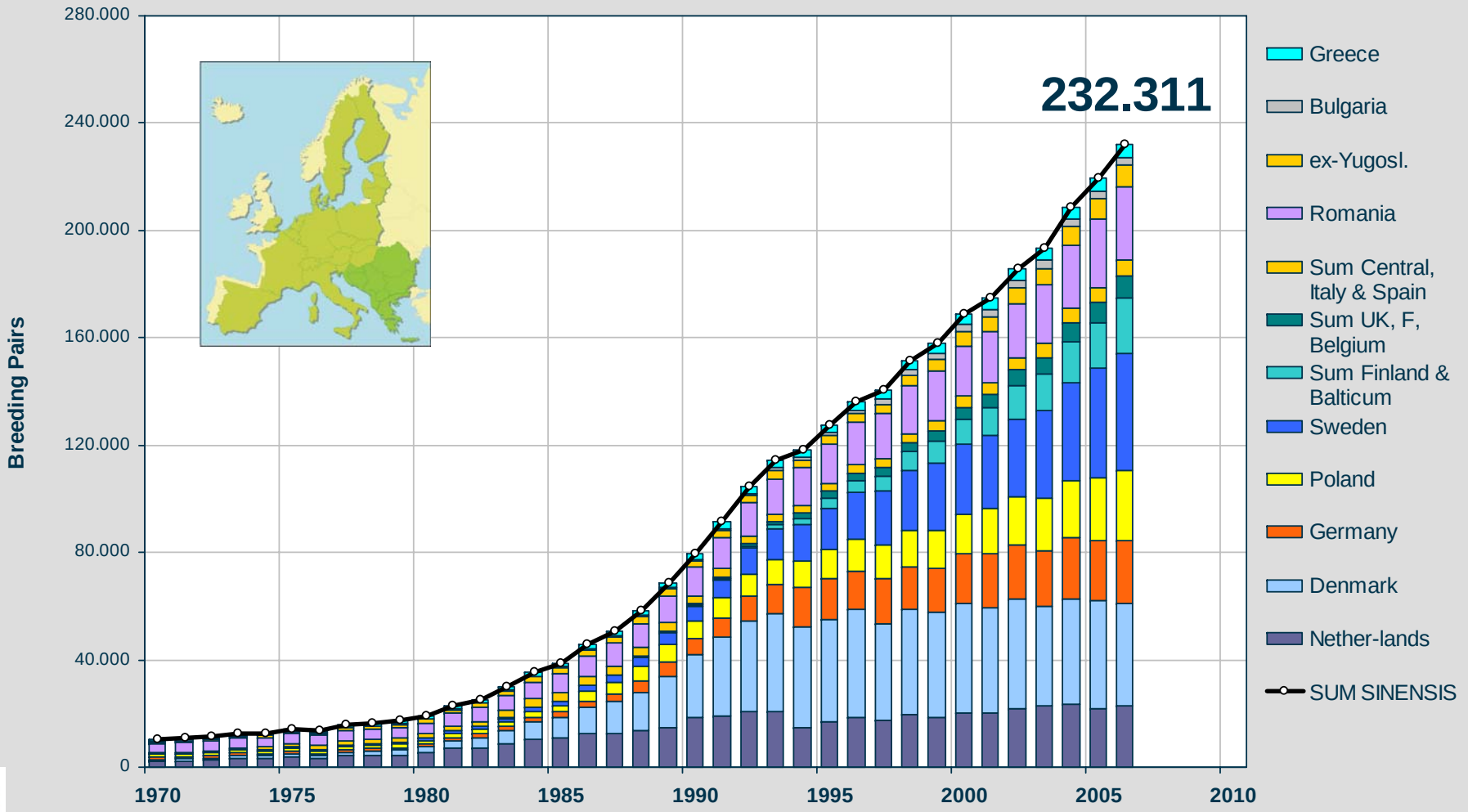
Year	Iceland & Faroes*	Norway	UK carbo	Ireland	France (coastal)	Spain carbo	SUM CARBO	Nether-lands	Denmark	Germany	Poland	Sweden	Estonia	Finland	Lithuania	Latvia
1970	3.210	20.000	6.400	2.100	1.200	–	**32.910**	2.060	600	1.000	1.000	295	–	–	–	–
1971	3.510	20.500	6.450	2.200	1.100	–	**33.760**	2.200	902	950	1.000	320	–	–	–	–
1972	3.210	20.000	6.350	2.370	1.050	–	**32.980**	2.550	950	1.000	1.000	350	–	–	–	–
1973	3.410	19.500	6.400	2.530	1.100	–	**32.940**	3.300	980	1.050	1.100	390	–	–	–	–
1974	3.210	19.500	6.500	2.700	1.280	–	**33.190**	3.090	1.020	1.000	1.150	430	–	–	–	–
1975	3.510	20.000	6.550	2.870	1.250	–	**34.180**	3.950	1.090	1.000	1.160	475	–	–	–	–
1976	3.210	20.500	6.650	3.060	1.300	–	**34.720**	3.070	1.160	920	1.100	520	–	–	–	–
1977	3.310	21.000	6.750	3.270	1.380	–	**35.710**	4.400	1.250	950	1.200	575	–	–	–	–
1978	3.710	21.000	6.800	3.480	1.350	–	**36.340**	4.470	1.375	970	1.300	630	–	–	–	–
1979	3.210	20.500	6.950	3.710	1.400	–	**35.770**	4.590	1.697	980	1.330	700	–	–	–	–
1980	3.010	20.000	7.000	3.960	1.400	–	**35.370**	5.494	2.037	979	1.390	767	–	–	–	–
1981	2.810	19.500	6.991	4.220	1.450	–	**34.971**	7.028	2.791	1.245	1.470	940	–	–	–	–
1982	2.810	20.000	7.010	4.500	1.440	–	**35.760**	7.226	3.713	1.476	1.500	1.090	0	–	–	–
1983	2.910	20.500	7.010	4.650	1.460	–	**36.530**	8.497	4.944	1.632	1.894	1.281	1	–	–	–
1984	2.610	21.000	7.020	4.800	1.500	–	**36.930**	10.505	6.272	1.925	2.261	1.355	5	–	0	–
1985	2.610	21.000	7.000	4.955	1.520	–	**37.085**	10.752	7.585	2.289	2.057	1.830	9	–	1	–
1986	2.710	22.000	7.005	4.955	1.550	–	**38.220**	12.621	9.503	2.655	3.716	1.861	21	–	10	–
1987	2.910	23.000	6.980	4.717	1.580	–	**39.187**	12.291	12.188	2.886	4.423	2.472	22	–	25	–
1988	2.810	24.000	7.060	4.717	1.600	–	**40.187**	13.642	14.116	4.615	5.130	3.450	36	–	45	0
1989	3.010	24.200	7.100	5.000	1.630	–	**40.940**	14.936	18.901	5.559	6.100	4.800	76	–	55	16
1990	2.810	23.500	7.100	5.200	1.690	–	**40.300**	18.528	23.557	5.750	6.600	5.500	139	–	100	25
1991	2.560	23.800	7.200	5.350	1.720	–	**40.630**	19.232	29.141	7.430	7.300	6.600	262	–	170	34
1992	2.610	24.000	7.440	5.500	1.800	–	**41.350**	20.894	33.560	9.428	8.200	9.400	484	–	300	60
1993	2.710	23.800	7.624	5.250	1.750	–	**41.134**	20.535	36.396	11.270	9.150	11.500	940	–	450	150
1994	2.810	24.000	7.600	5.000	1.750	–	**41.160**	14.700	37.600	14.510	10.100	13.600	1.425	–	700	160
1995	2.210	24.000	7.500	4.700	1.900	–	**40.310**	16.800	38.300	15.043	11.000	15.400	2.380	0	1.000	205
1996	2.410	24.200	7.500	4.900	1.900	–	**40.910**	18.500	40.200	14.260	11.850	17.500	2.368	10	2.000	250
1997	2.860	24.350	7.440	5.000	1.909	–	**41.559**	17.400	36.200	16.440	12.740	20.000	3.227	24	2.200	310
1998	2.760	24.650	7.438	4.800	1.911	0	**41.559**	19.800	39.000	15.920	13.500	22.400	3.898	50	2.500	370
1999	3.010	24.800	7.320	4.550	1.913	2	**41.595**	18.400	39.100	16.800	14.100	25.000	4.901	161	2.500	430
2000	3.260	25.150	7.100	4.550	1.750	5	**41.815**	19.950	41.000	18.400	15.000	26.000	5.836	336	2.700	500
2001	3.210	25.000	7.080	5.000	1.900	10	**42.200**	20.400	39.100	20.252	16.600	27.200	6.330	699	3.000	560
2002	3.160	26.535	7.180	5.200	2.000	15	**44.090**	22.050	40.800	20.031	18.000	29.000	8.094	1.390	3.130	620
2003	3.260	28.240	7.200	5.300	2.122	20	**46.142**	22.700	37.100	20.858	19.700	32.500	8.401	1.626	3.250	680
2004	3.210	30.150	7.170	5.350	2.000	25	**47.905**	23.325	39.200	23.059	21.400	36.500	9.529	2.910	3.360	740
2005	3.160	32.100	7.400	5.450	2.000	30	**50.140**	22.050	39.800	22.758	23.400	40.500	9.969	4.621	3.650	810
2006	3.310	34.147	7.200	5.500	1.956	30	**52.143**	23.139	37.900	23.505	25.830	43.700	11.695	5.770	3.630	870
2007	3.210								35.100	23.080		43.400	12.513	8.895	3.300	940
2008	3.210								33.500	24.760		42.800	13.356	12.626	4.300	1.000
2009										23.100		42.000	13.569	16.000	4.100	
2010														14.390		

B1b. Tables Breeding Pairs (2)

published data
interpolated

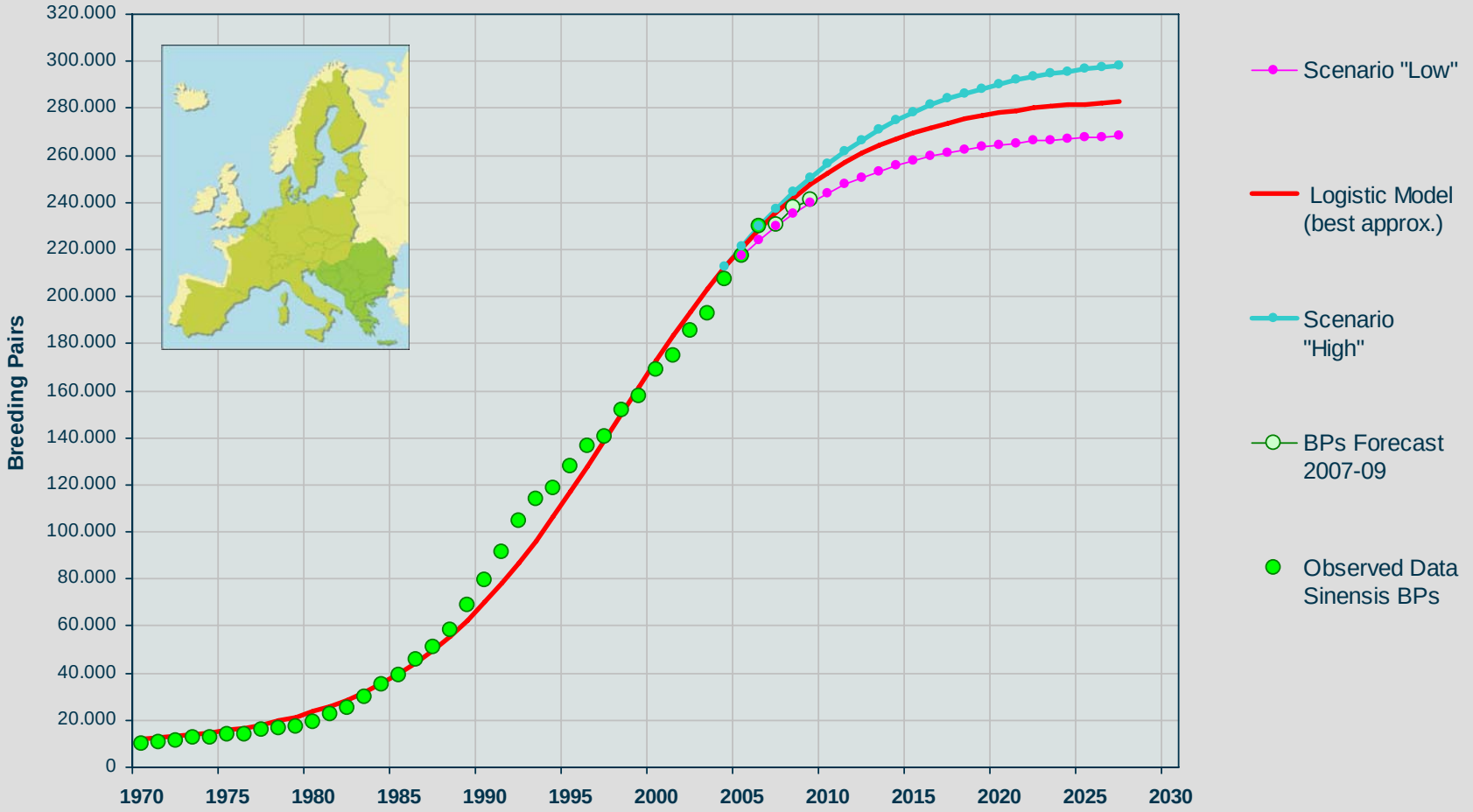
Year	UK sinensis	France (inland)	Belgium Vlanders	Belgium Wallonie	Hungary	Czech Rep.	Slovakia	Switzer-land	Austria	Italy	Spain sinensis	Romania	ex-Yugosl.	Bulgaria	Greece	SUM SINENSIS	CORMS TOTAL
1970	–	–	–	–	280	–	–	–	8	25	–	3.465	630	319	550	**10.232**	**43.142**
1971	–	–	–	–	289	–	–	–	7	20	–	3.530	631	321	560	**10.730**	**44.490**
1972	–	–	–	–	249	–	–	–	–	22	–	3.590	644	323	600	**11.278**	**44.258**
1973	–	–	–	–	350	–	–	–	–	15	–	3.660	661	326	645	**12.477**	**45.417**
1974	–	–	–	–	650	–	–	–	–	30	–	3.725	663	328	690	**12.776**	**45.966**
1975	–	–	–	–	900	–	–	–	–	33	–	3.790	700	330	740	**14.168**	**48.348**
1976	–	–	–	–	1.120	–	–	–	–	40	–	3.860	780	332	790	**13.692**	**48.412**
1977	–	–	–	–	1.240	–	–	–	–	52	–	3.930	874	334	850	**15.655**	**51.365**
1978	–	–	–	–	1.360	–	–	–	–	58	–	4.000	978	337	910	**16.388**	**52.728**
1979	–	–	–	–	1.500	–	–	–	–	63	–	4.075	1.083	339	980	**17.337**	**53.107**
1980	0	0	–	–	1.650	–	–	–	–	70	–	4.150	1.200	350	1.050	**19.137**	**54.507**
1981	9	8	–	–	1.760	–	–	–	–	70	–	4.605	1.376	366	1.130	**22.798**	**57.769**
1982	40	12	–	–	1.890	32	–	–	–	75	–	5.110	1.546	383	1.210	**25.303**	**61.063**
1983	90	20	–	–	2.500	52	–	–	–	100	–	5.670	1.734	401	1.300	**30.116**	**66.646**
1984	130	30	–	–	2.700	80	–	–	–	120	–	6.290	1.925	419	1.390	**35.407**	**72.337**
1985	160	36	–	–	3.000	120	–	–	–	130	–	6.980	1.960	439	1.490	**38.838**	**75.923**
1986	195	40	–	–	2.700	246		–	–	150	–	7.742	2.055	459	1.600	**45.574**	**83.794**
1987	220	45	–	–	2.550	453		–	–	175	–	8.590	2.182	480	1.715	**50.717**	**89.904**
1988	240	50	–	–	2.400	460	40	–	–	200	–	9.210	2.287	502	1.840	**58.263**	**98.450**
1989	280	120	–	–	2.350	613	0	–	–	215	–	9.875	2.396	526	1.970	**68.788**	**109.728**
1990	356	210	–	–	2.300	671	0	–	–	250	–	10.590	2.500	550	2.115	**78.753**	**120.041**
1991	400	350	0	0	2.150	670	30	–	–	280	0	11.350	2.596	1.000	2.270	**91.265**	**131.895**
1992	460	420	8	12	2.180	470	55	–	–	325	1	12.170	2.705	1.000	2.430	**104.562**	**145.912**
1993	526	600	17	34	2.050	380	100	–	–	370	0	13.050	2.806	1.200	2.610	**114.134**	**155.268**
1994	800	850	75	120	1.950	320	155	–	–	427	0	13.990	2.900	1.225	2.800	**118.407**	**159.567**
1995	1.113	1.180	118	154	1.800	265	195	–	–	493	0	15.000	3.000	1.250	3.000	**127.696**	**168.006**
1996	1.250	1.280	130	150	1.750	250	215	–	–	560	0	15.940	3.126	1.450	3.150	**136.189**	**177.099**
1997	1.410	1.425	321	199	1.900	245	230	–	–	630	0	16.940	3.515	1.700	3.300	**140.356**	**181.915**
1998	1.580	1.450	301	259	2.100	220	240	–	–	710	2	17.928	3.878	1.950	3.460	**151.588**	**193.147**
1999	1.780	1.474	444	306	2.350	205	250	–	–	795	8	18.461	4.550	2.200	3.630	**157.845**	**199.570**
2000	2.000	1.600	650	350	2.650	190	255	0	0	880	20	18.825	5.100	2.600	4.000	**168.842**	**211.057**
2001	2.020	1.800	680	370	2.900	200	265	2	5	950	30	19.137	5.500	2.700	4.195	**174.895**	**217.585**
2002	2.040	2.250	850	380	3.000	215	280	7	30	1.030	35	20.000	5.950	2.800	4.300	**185.591**	**218.641**
2003	2.060	2.807	916	390	3.300	230	275	23	65	1.120	40	21.464	6.450	2.800	4.500	**193.255**	**228.469**
2004	2.080	3.200	1.034	416	3.500	250	285	53	89	1.200	46	22.216	6.900	2.800	4.700	**208.792**	**245.408**
2005	2.130	3.700	1.119	400	3.550	265	290	117	115	1.350	53	23.749	7.400	2.800	5.040	**219.636**	**258.625**
2006	2.200	4.094	1.175	422	3.600	285	305	214	160	1.500	60	26.437	7.800	2.800	5.220	**232.311**	**284.454**
2007	2.250	4.300	1.220	480	3.850	300	300	350	180					2.800	5.400		
2008	2.300	4.400	1.335	452		336		440	230					2.800	5.600		
2009								547									
2010																	

B4-1. Overview Sinensis Total: Breeding Pairs 1970-2006



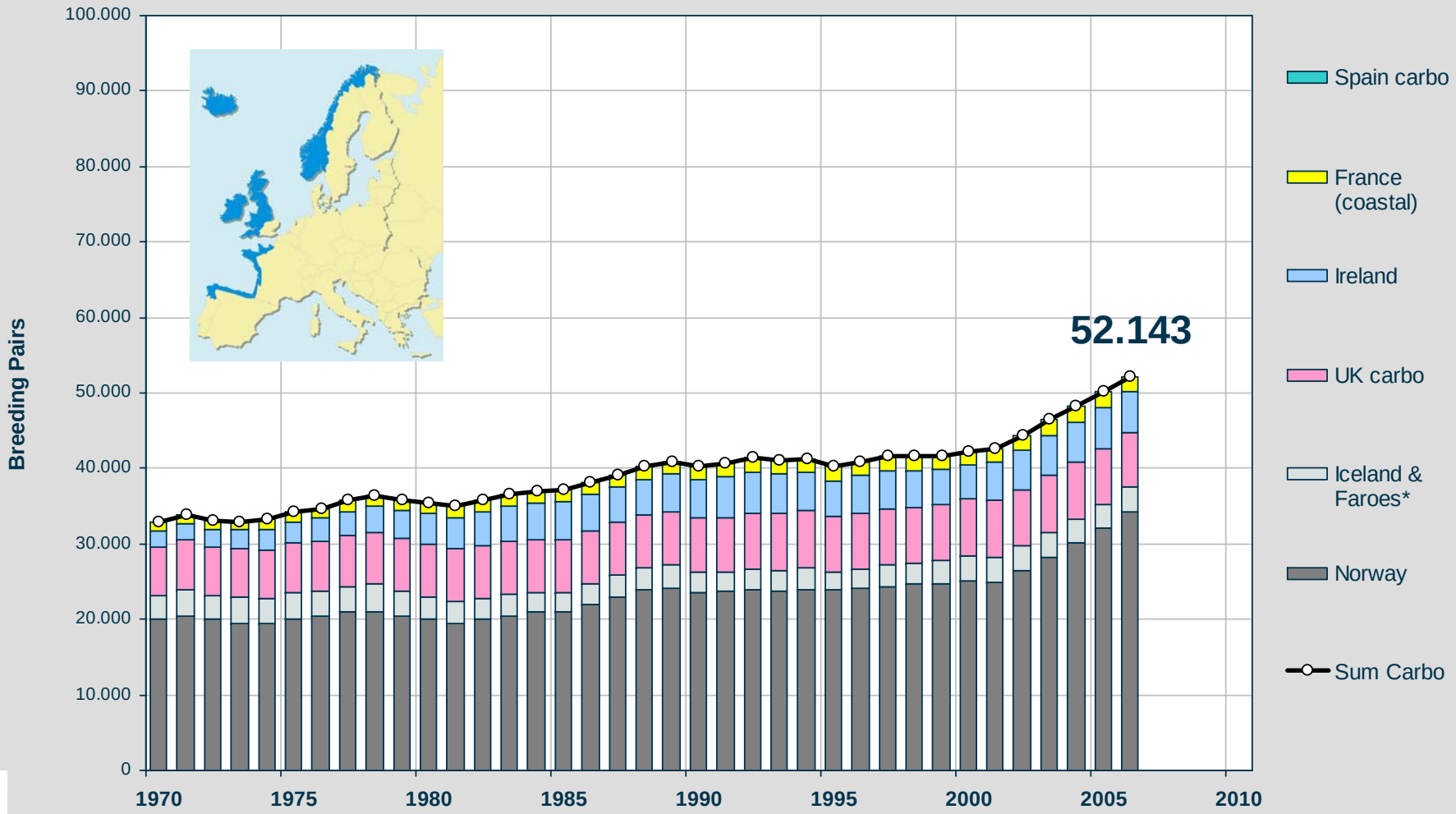
B5-2. Logistic Model Breeding Population Sinensis: Scenarios high - low

Basis: Sinensis Total (West + East) in Core Europe Assumption: No serious population management measures



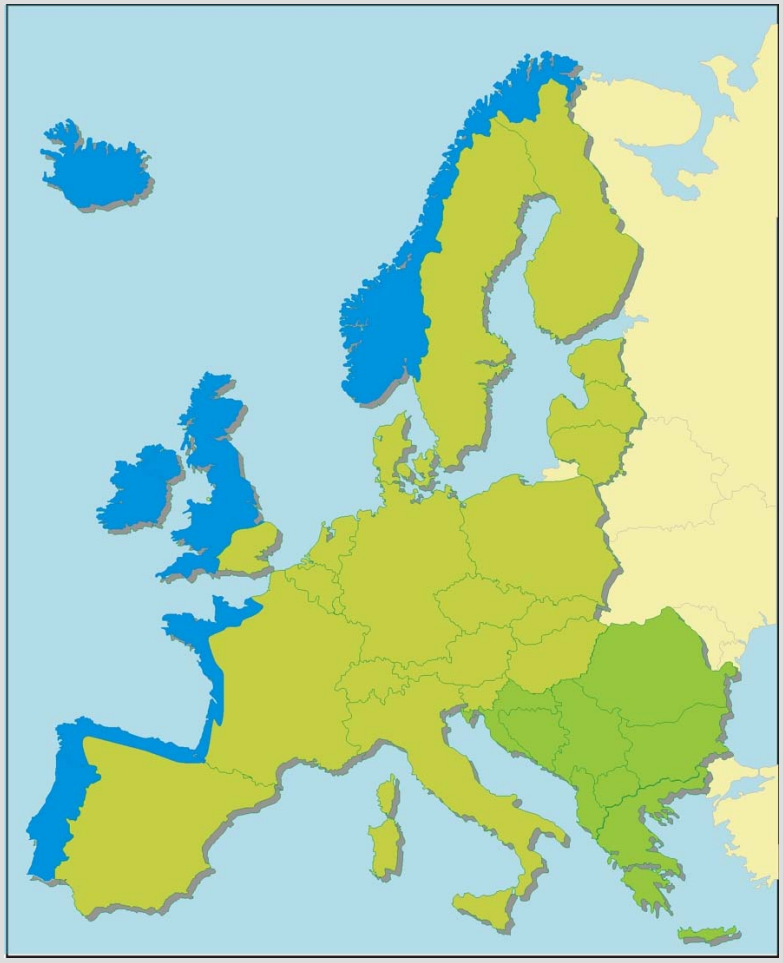
Logistic Function ⇨⇨ BP in year t = a + (b-a)/(1+Exp(-(t-c)/d))
"Best Approximation" with a=9.210, b=285.000, c=28,7, d=6,1

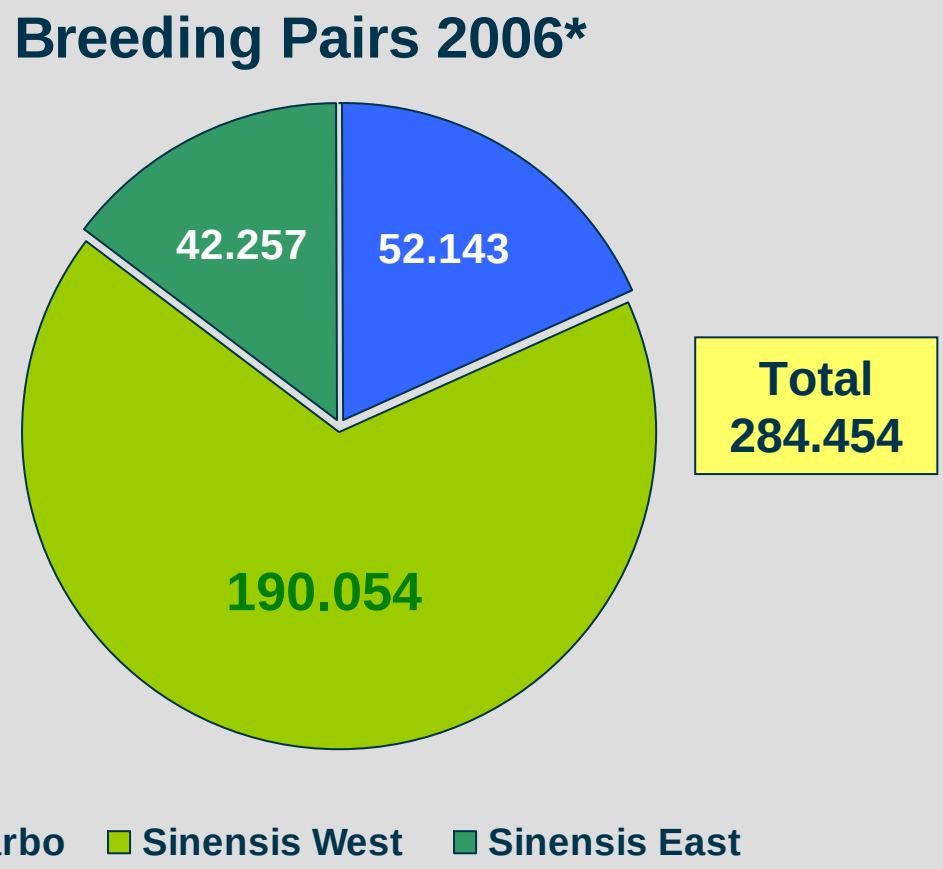
B6-1. Breeding Pairs 1970-2006 - Carbo Total



B7-2. Breeding Pairs: Carbo vs Sinensis West vs Sinensis East - Status 2006

Basis: Core Europe - excluding Russia, Belarus, Ukraine & Moldova





*) Totals according Wetlands International CRG, pan-European Breeding Population Census 2006

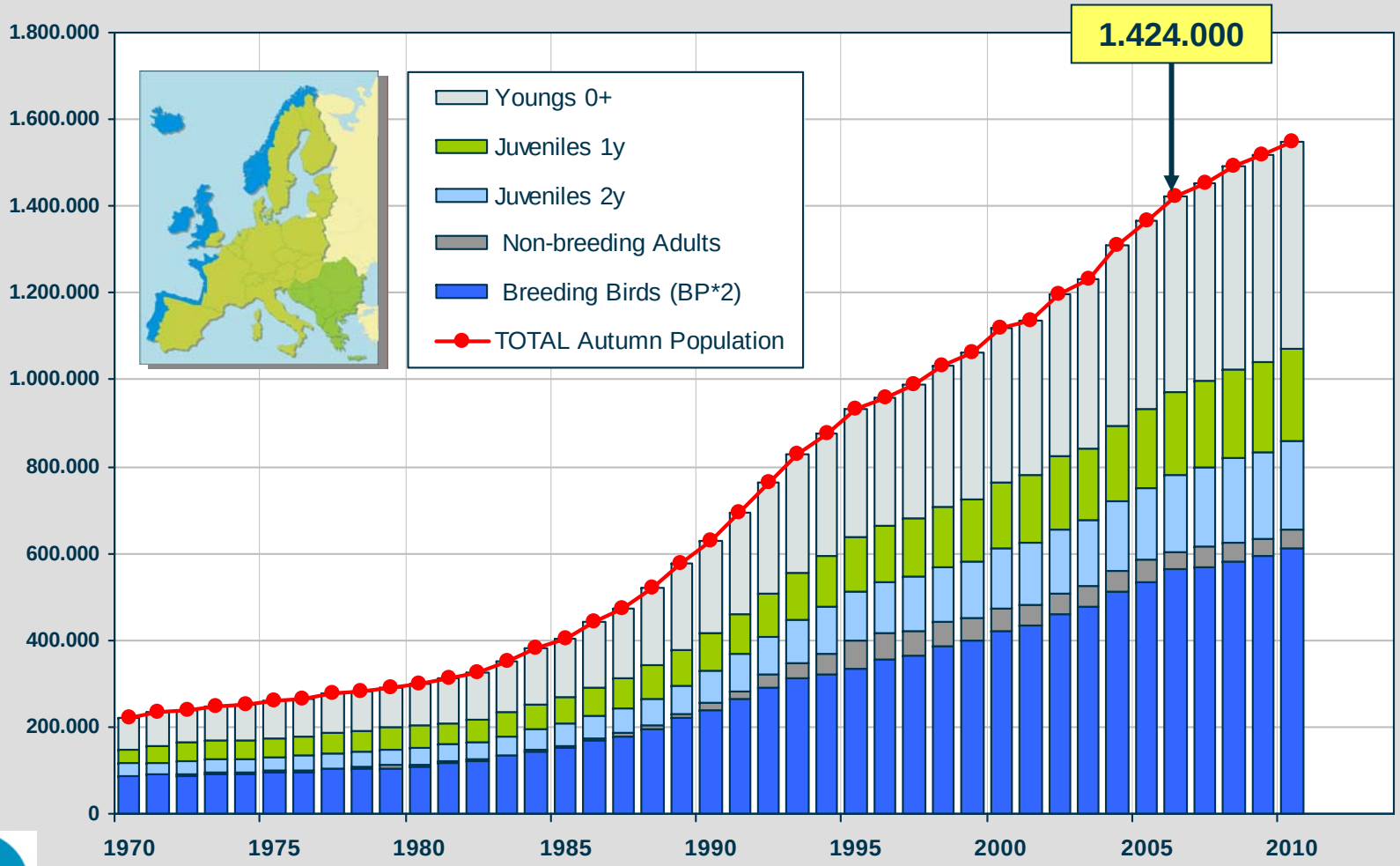
Part C: Estimate of Total Cormorant Population

Methodological Remarks

- Cormorants start breeding with 3 - 5 years, so breeding pairs represent only a part the total population
- A direct count of the non-breeding birds is not feasible. However, if the development of Breeding Pairs is known (% of increase/decrease) then the size of the non-breeding population can be estimated by using observed mortality- and fertility rates.
  - in case of stable number of breeding pairs the number of first-time breeders must be equal the mortality of last year's breeders
  - and in case of an increasing breeding population the number of first time breeders must be adequately more (*to balance the mortality of adult birds + to make up for the increase*)
- Consequently, the percentage of non-breeding juveniles will be relatively higher when the population grows and relatively lower in case of stable or shrinking populations.
- The following estimates are based on a calculation model with the following simplified assumptions:
  - cormorants start breeding with 3 years, almost all (> 95%) adults do effectively breed
  - constant mortality rates: 1st winter 40%, 2nd and 3rd winter 30%, after 3rd year 20%.
  - average fertility may vary in a range between 1,5 - 1,9 fledged youngs per nest
- With this parameter values the model delivered a good fit with the development of breeding pairs
- Under these assumptions the total population (carbo + sinensis) per summer 2006 was estimated at ca. 1.425.000 cormorants in core Europe, a tentative forecast for summer 2010 would be ca. 1.550.000.
- However, it must be reminded that number of non-breeders and consequently the total population could be significantly higher if there is a higher percentage of adult non-breeders.

C3. Development Cormorants (Carbo + Sinensis) in Core Europe

Total Cormorant Population - Estimate F. Kohl (ÖKF/EAA)*



*) Estimates based on following simplified assumptions: Cormorants start breeding with 3 years, average fertility and mortality rates as suggested by Wetlands International CRG (mortality 40% in first winter, 30% from first to second, 30% from second to third year).

Part E: Total Cormorant Population incl. East-East Europe 2006

Basis: Whole Europe - including Russia, Belarus, Ukraine & Moldova

- Adding the east-eastern numbers to the population and applying a medium expansion factor from Breeding Pairs to total population the following estimates are possible.

Cormorant Population Europe 2006	Breeding Pairs	Expansion Factor	Individuals (Summer)
Sum Core Europe	**284.454**	5,0	**1.424.000**
Sinensis East-East	**165.000**	5,2	**858.000**
Sum Cormorants Total Europe	**449.454**		**2.282.000**

- **Looking at whole European continent, in 2006 there were about 450.000 breeding pairs of the Great Cormorant. The total population (breeders + non-breeders) per summer 2006 amounted to about 2,2 - 2,3 million individual birds.**

Parts B - Part E: Specific Charts / Aspects

Part B: Breeding Population

- B1: Development of Breeding Population on European Scale
- B3: Development of Breeding Population - Individual Countries
  - *Sinensis DK, NL, D, PL and Sweden*
  - *Sinensis in Finland & Balticum*
  - *Sinensis West in UK, France and Belgium*
  - *Sinensis Central Europe (Hungary, Austria, CZ, Slovakia, Switzerland)*
  - *Sinensis in Italy and Spain*
  - *Sinensis East (Romania, ex-Yug, Bulgaria, Greece)*
- B4. Overview Sinensis: Breeding Pairs 1970-2006
- B5. Sinensis Breeding Population: Logistic Growth Model
- B6. Development of Carbo carbo ("atlantic race")
- B7: Breeding Population Trends : Carbo + Sinensis East + Sinensis West

Part C: Estimate of Total Cormorant Population

Part D: Cormorants in Russia, Belarus, Ukraine & Moldova

Part E: Total Cormorant Population incl. East-East Europe 2006

Appendix I: Sources for Maps of Cormorant Colonies Europe
Appendix II: Sources for Breeding Population / Breeding Pairs

Part B: Breeding Population

Background and Objectives

Data on Cormorant Breeding Population exist for most countries in Europe. However, there is no actual publication which provides a satisfactory overview. Over the last decade, only few publications have attempted to give figures for Europe as a whole.

- Development until 1995: Veldkamp (1996) "A first step towards a European management plan"*** contains a comprehensive compilation of numbers and trends for all european breeding countries, authoritative but naturally not up-to-date..
- Status per 1998-2002: BirdLife Cormorant Fact Sheet (published 2004)*** shows a table with breeding population for all European countries. However, there are no figures for previous years.
- Status per 2006: Leaflet by Wetlands International CRG (published 2008)*** provides the overall results of the pan-european Breeding Pair Census 2006. It is very informative regarding regional distribution of the cormorants However, only highly aggregated figures for three European regions, not for the individual countries. And there is no reference to previous data.

The two publications from BirdLife and Wetlands International undoubtedly provide important and authoritative figures. But they don't enable an insight into population trends - which is indispensible for any rational discussion on cormorants.

***) Full citations see Appendix II, Sources for Breeding Population

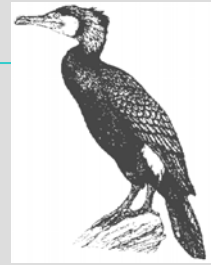
Part B: Breeding Population - Methodological remarks

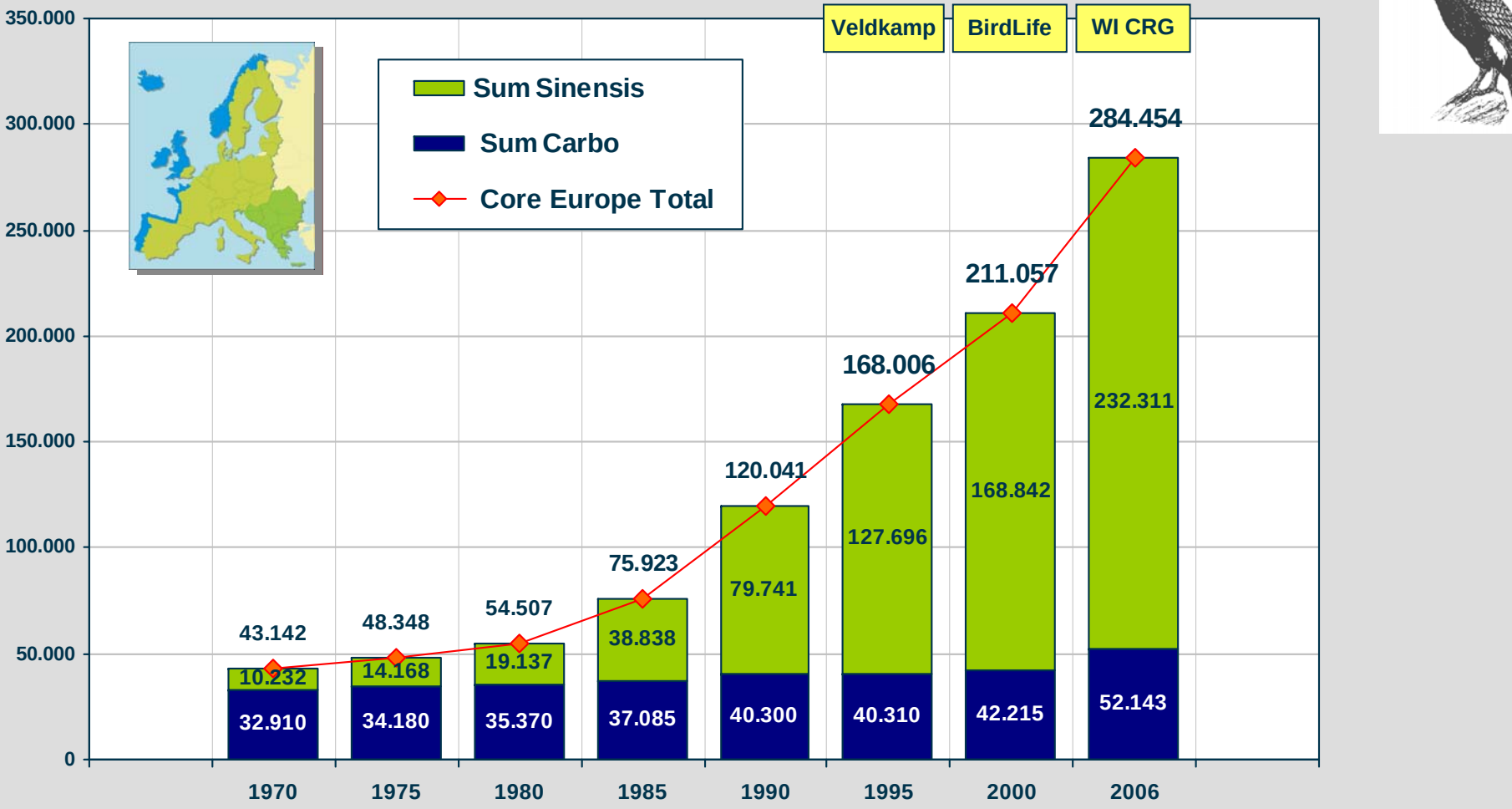
- Cormorants start breeding with 3 - 5 years, so breeding pairs represent only a part the total population - however, the trends are closely correlated. (*For size of total cormorant population see extra chapter*)
- As a rule, number of breeding pairs is assessed by physical counting in breeding colonies (number of AONs = Apparently Occupied Nests), and counting is done by ornithologists and/or experienced bird watchers. Counting methodology as prescribed by WI Cormorant Research Group for Census 2006 is excellent (⇨*though there's no guarantee of perfect implementation in all cases, results deserve high trust*)
- In general, the reliability of published counting data is good. However, counting errors can't be excluded - e. g. due to incomplete knowledge of colonies, time-shifted breeding, counting problems in badly accessible areas like Danube-Delta. As most possible counting errors would result in underreporting, published figures must be regarded as minima - but nevertheless can be regarded as "hard data".
- Data for the following charts were compiled from a broad spectrum of ornithological sources (*list of sources see appendix, details per case available from EAA*). Each figure was put into a databank, along with its source. If different BP-figures are given in different publications, those were taken which better fit the trend.
- In case of 'gaps' in a country the missing BP-numbers were estimated / extrapolated from the trend.
- The country-specific diagrams show "counted data" and "interpolated numbers" in different colours - this is a good indicator for the reliability of the data for each individual country.

- **Generally, data quality is exceptionally good in western and central Europe, while information is thinner for Balkan region (especially countries of ex-Yugoslavia and Romania).**

B1: Development of Breeding Population on European Scale

Geographical scope: "Core Europe" = all countries except Russia, Belarus, Ukraine & Moldova***





***) Remark concerning "East-eastern Europe": The vast area of european Russia, Belarus, Moldova and Ukraine also holds a large number of cormorants: For the period 1990 - 2000 BirdLife reported a total of up to 138.000 pairs, since then a further increase is reported, in Ukraine alone number of pairs increased from 65.000 to over 100.000 in 2007/08. However, historical data for this area are much less reliable - so this area will be dealt with separately.

Development Breeding Population on European Scale -Table

Numbers relate to "Core Europe" = all countries except Russia, Belarus, Ukraine & Moldova***

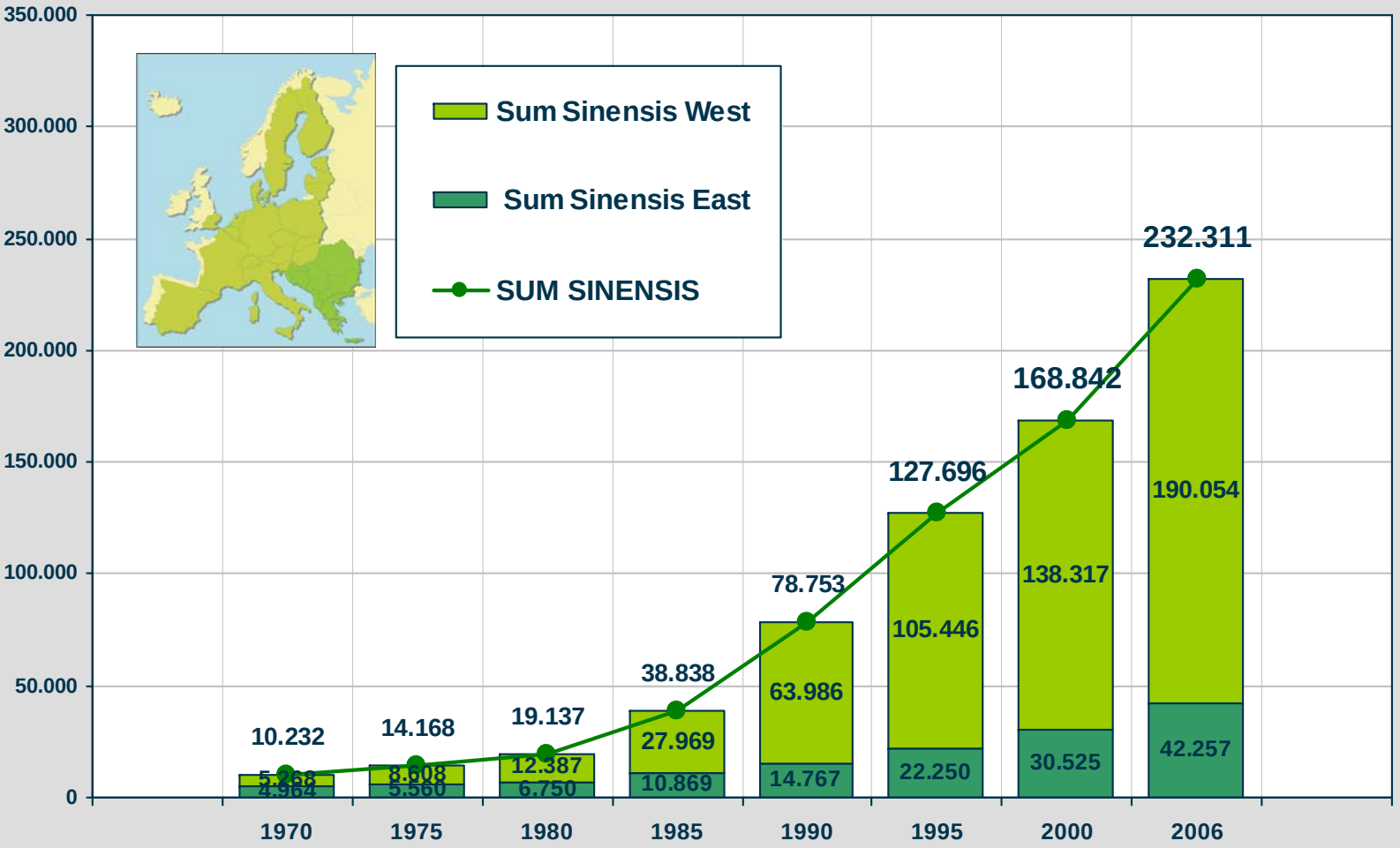
"Hard data" from authoritative ornithological sources: For 1970 -1995 there is information from Ardea (Special Cor-morant Issue 1995) and Veldkamp (1996). For 2000 data are from BirdLife's Cormorant Fact detailed Sheet (*see appendix II*). Numbers for 2006 are from the pan-European Census organised by Wetlands International Cormorant Research Group (in context of INTERCAFE)..

Breeding Pairs	1970	1975	1980	1985	1990	1995 Ardea	2000 BirdLife	2006 WI CRG	*Increase 2000-06*
carbo carbo	32.910	34.180	35.370	37.085	40.300	40.810	41.785	52.143	***+ 25%***
carbo sinensis	10.232	14.168	19.137	38.838	79.741	126.696	168.842	232.311	***+ 37%***
carbo + sin	**43.142**	**48.348**	**54.507**	**75.923**	**120.041**	**168.006**	**210.657**	**284.454**	***+ 35%***

- Long-term development: The "atlantic subspecies" Ph. carbo carbo showed only a relatively moderate increase, whereas the breeding population of the sinensis-race grew by a factor of 23 over the last 35 years.
- In the last period 2000 - 2006 there is a further increase of both subspecies:
  - plus 25% for Carbo
  - plus 37% for Sinensis
- For 2007-09 Information is incomplete, but there's still a clear upward trend. Signs of stagnation in "old" breeding countries are more than outweighed by steep increases in "new" breeding areas (esp. Balticum)

***) Remark concerning "East-eastern Europe": The vast area of european Russia, Belarus, Moldova and Ukraine also holds a large number of cormorants: For the period 1990 - 2000 BirdLife reported a total of up to 138.000 pairs, since then a further increase is reported, in Ukraine alone number of pairs increased from 65.000 to over 100.000 in 2007/08. However, historical data for this area are much less reliable - so this area will be dealt with separately.

B2: Breeding Population - Sinensis East + Sinensis West



B2a: Breeding Population Sinensis East vs Sinensis West - Table

Numbers relate to "Core Europe" = all countries except Russia, Belarus, Ukraine & Moldova***

Breeding Pairs	1970	1975	1980	1985	1990	1995 Veldkamp	2000 BirdLife	2006 (WI CRG)	*Increase 1970-2006*
sinensis west	5.268	8.608	12.387	27.969	63.986	105.446	138.317	190.054	***36 times***
sinensis east	4.964	5.560	6.750	10.869	15.755	22.250	30.525	42.257	***9 times***
Sum Sinensis	**10.232**	**14.168**	**19.137**	**38.838**	**79.741**	**127.696**	**168.842**	**232.311**	***23 times***

Sinensis West

Sinensis East

- Both sub-populations of the Sinensis cormorant grew steeply since 1970
- But expansion of the western sub-population was even extremely higher than in Eastern parts of Europe (Romania, countries of ex-Yugoslavia, Bulgaria and Greece)

***) Remark concerning "East-eastern Europe": The vast area of european Russia, Belarus, Moldova and Ukraine also holds a large number of cormorants: For the period 1990 - 2000 BirdLife reported a total of up to 138.000 pairs, since then a further increase is reported at least in Ukraine. So in 2006 there were probably about 160. - 170.000 pairs. However, historical data for this area are much less reliable - so this area will be dealt with separately.

B3: Development of Breeding Population - Individual Countries

Introductory remarks:

- The following charts show the development of Cormorant breeding population country by country
- The colour of the columns indicates for each year whether the BP-number is from a published source or whether it is an interpolation
  - **dark blue** ⇨ published / actually counted numbers
  - **light blue** ⇨ interpolation / trend estimate
- This enables an instant assessment of "data quality" in a certain country
  ⇨ if most columns are "dark blue" (= published / counted data), high reliability can be assumed
  As charts will show, in many countries cormorant breeding pairs are counted year by year
- Main objective of these charts is the visualization of quantitative trends - so diagrams mostly are without verbal commentary and without numbers except for selected years (*Tables with concrete numbers per year can be found in Part A. Overall Figures & Trends*)

B3-1. Development of Sinensis West in DK, NL, D, PL and Sweden

- Population growth of the Sinensis-Cormorant started in The Netherlands, followed by Denmark, which in 1989 overtook the NL as holding the highest numbers of cormorants.
- After a period of exponential growth in the 1980ies and early 1990ies the development in NL and DK started to stagnate.
- However, this was more than compensated by the development in neighbouring Germany, Poland and Sweden, where Cormorant breeding population showed enormous growth until the most recent years.
- **In 2006, these 5 countries held 67% of the total Sinensis-population in Core Europe** (= without Russia, Belarus, Ukraine & Moldova).

Remarkable: Quality of population data in this area is exceptionally good:
In NL, DK and Germany data are from systematic year-by-year countings, also in Sweden and Poland actual countings are done in quite regular intervals of 5 to 6 years.

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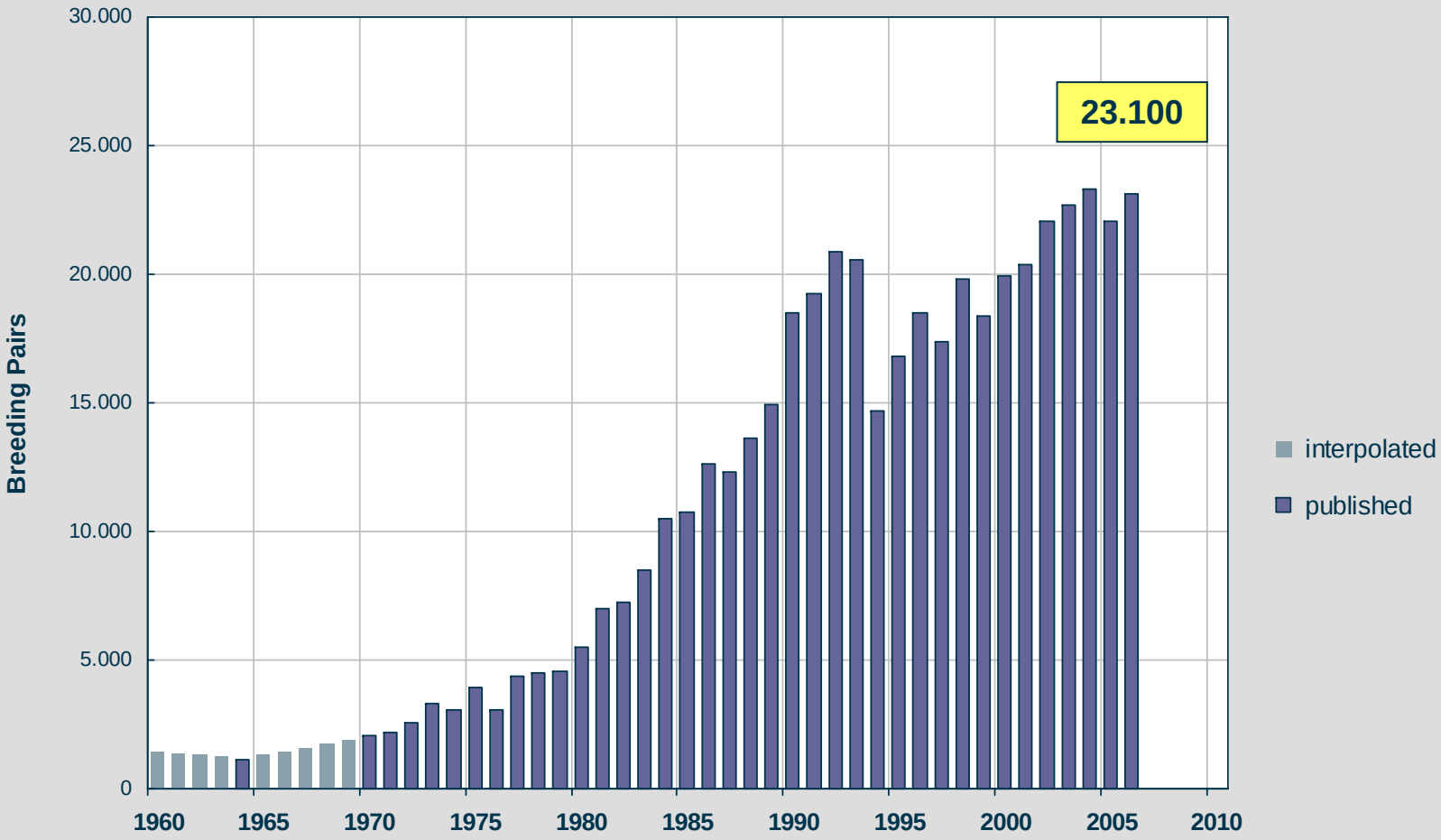
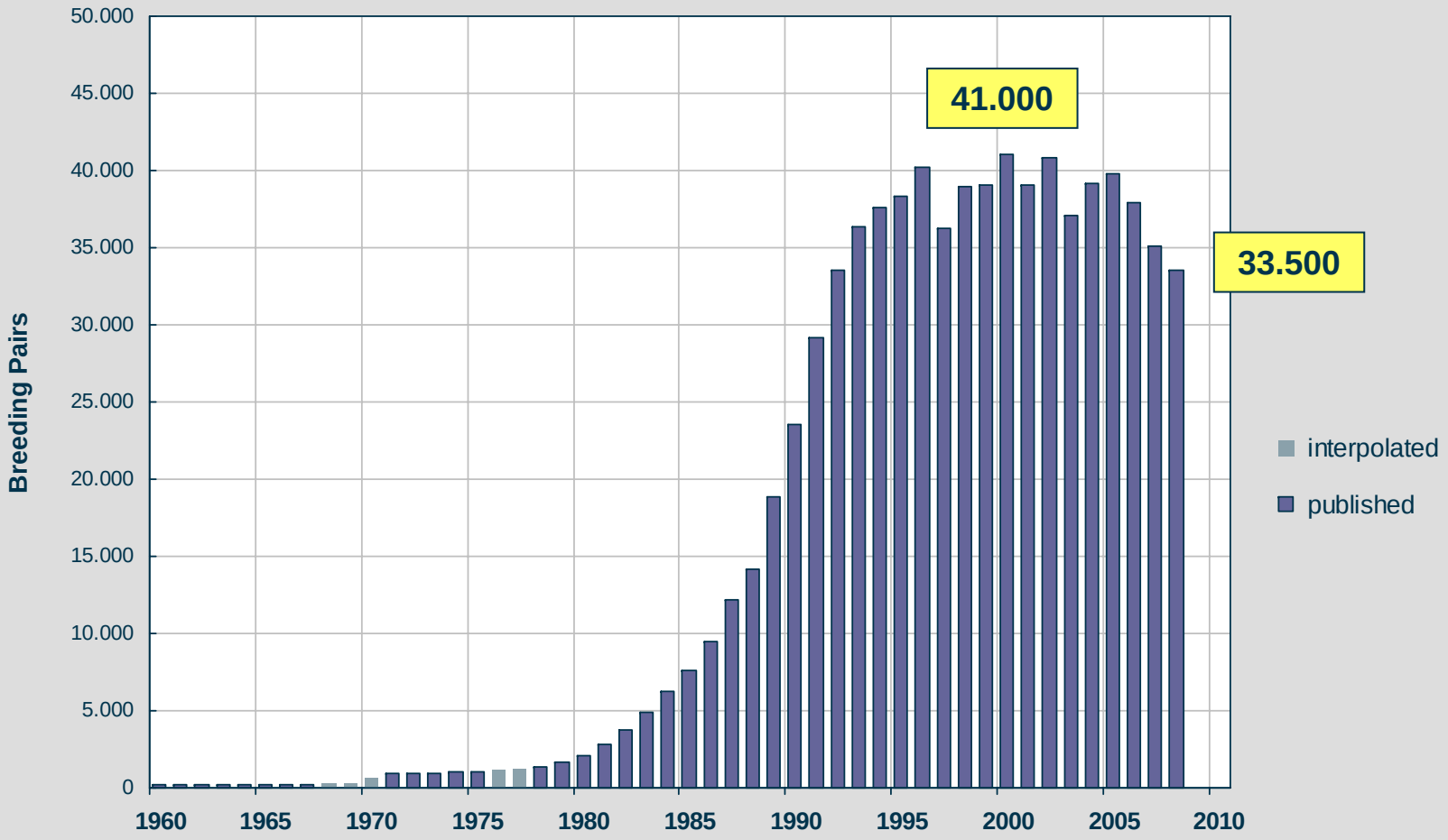
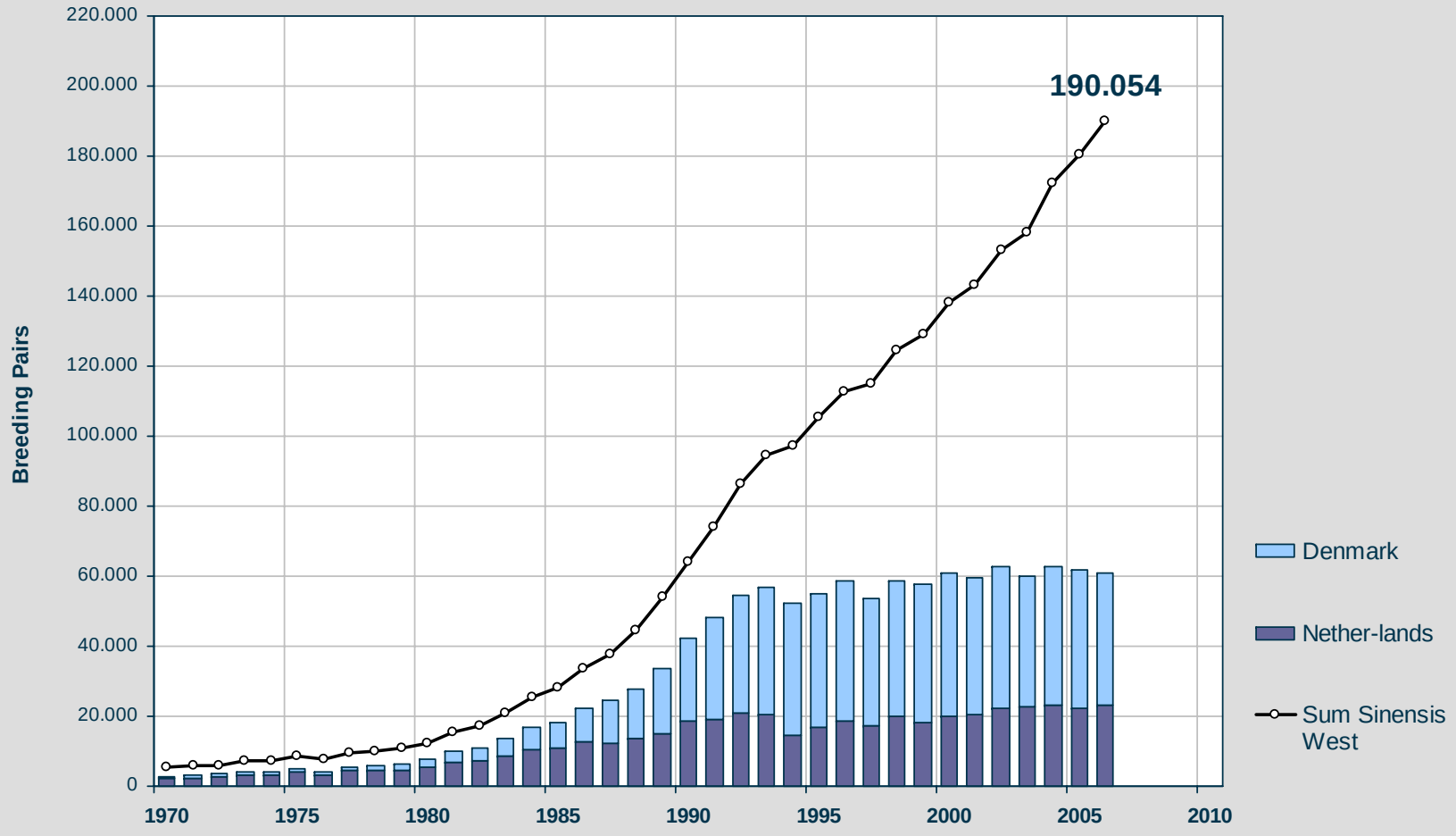
Cormorant Breeding Pairs - NETHERLANDS



Cormorant Breeding Pairs - DENMARK

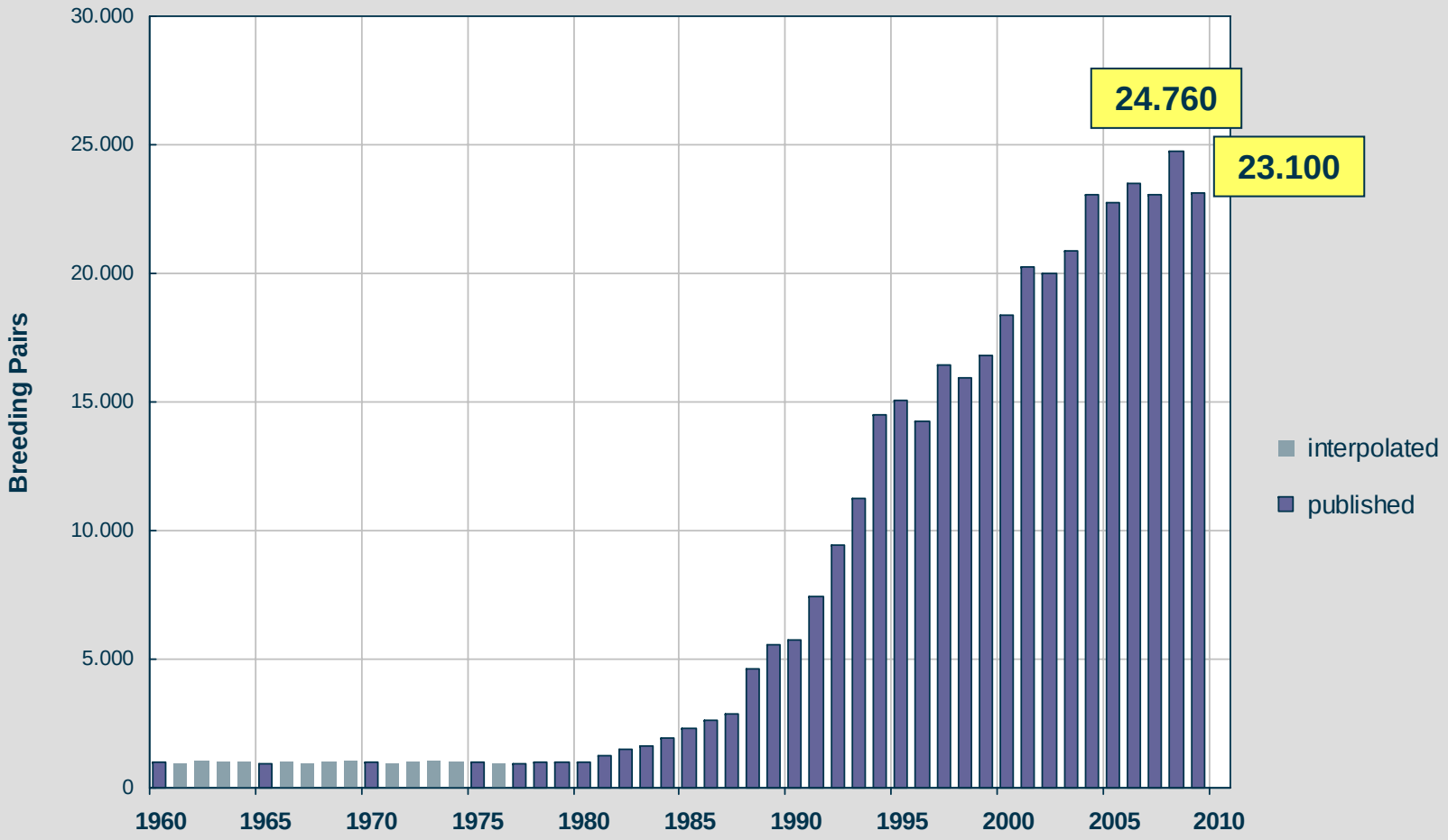


B3-1a. Sinensis West - Country Groups (1)

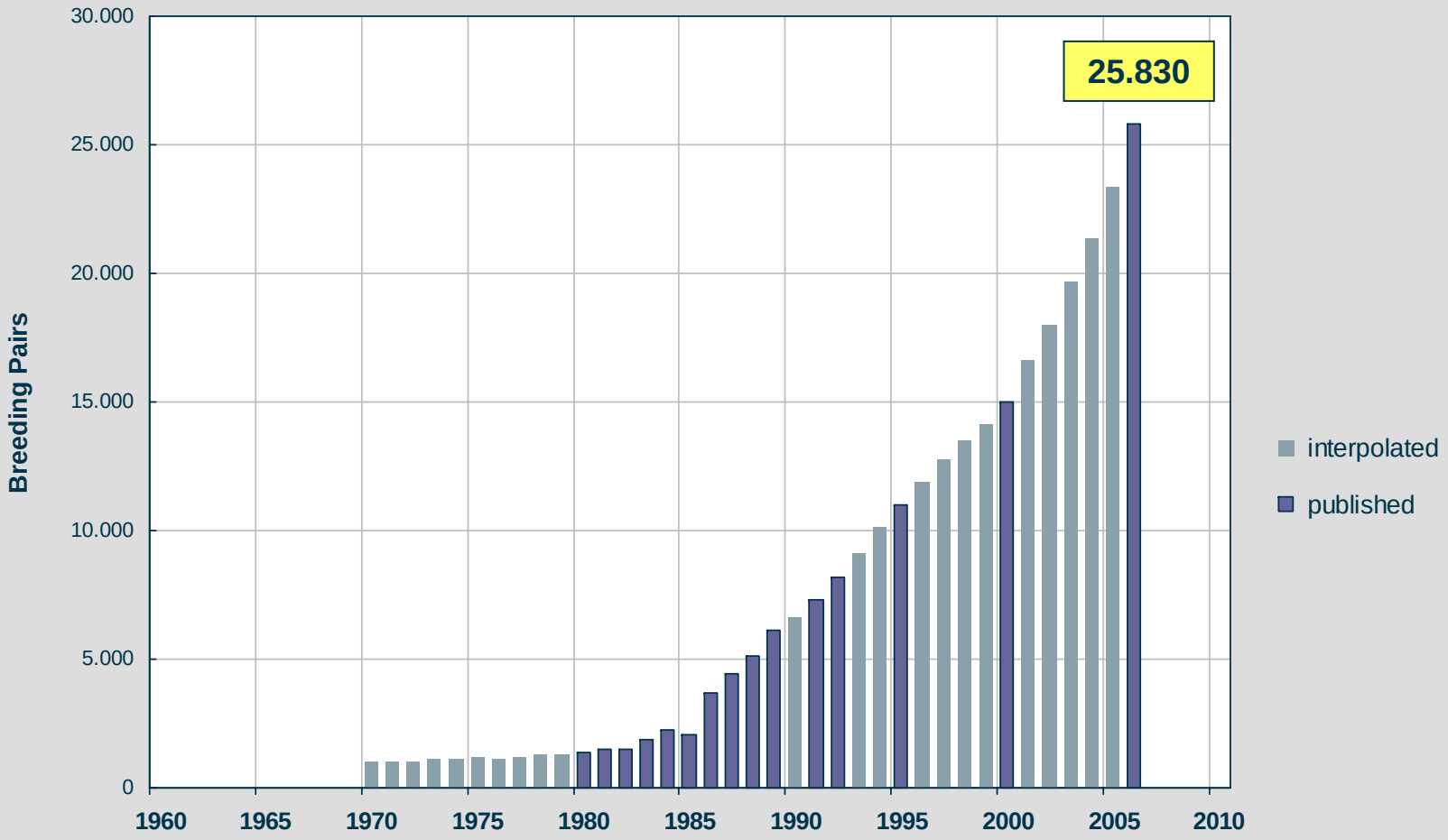


NL + DK fairly stable since mid 1990ies

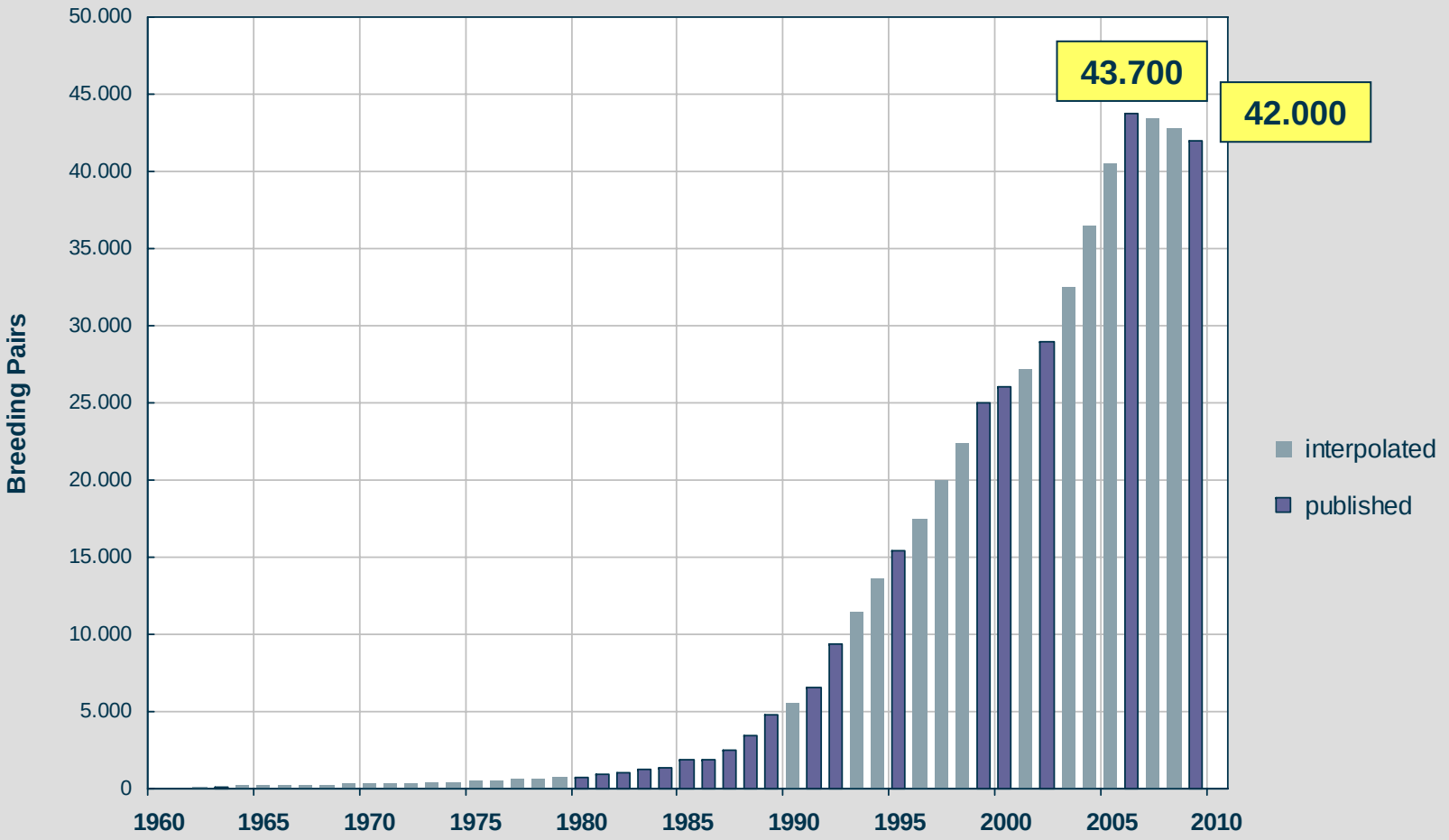
Cormorant Breeding Pairs - GERMANY



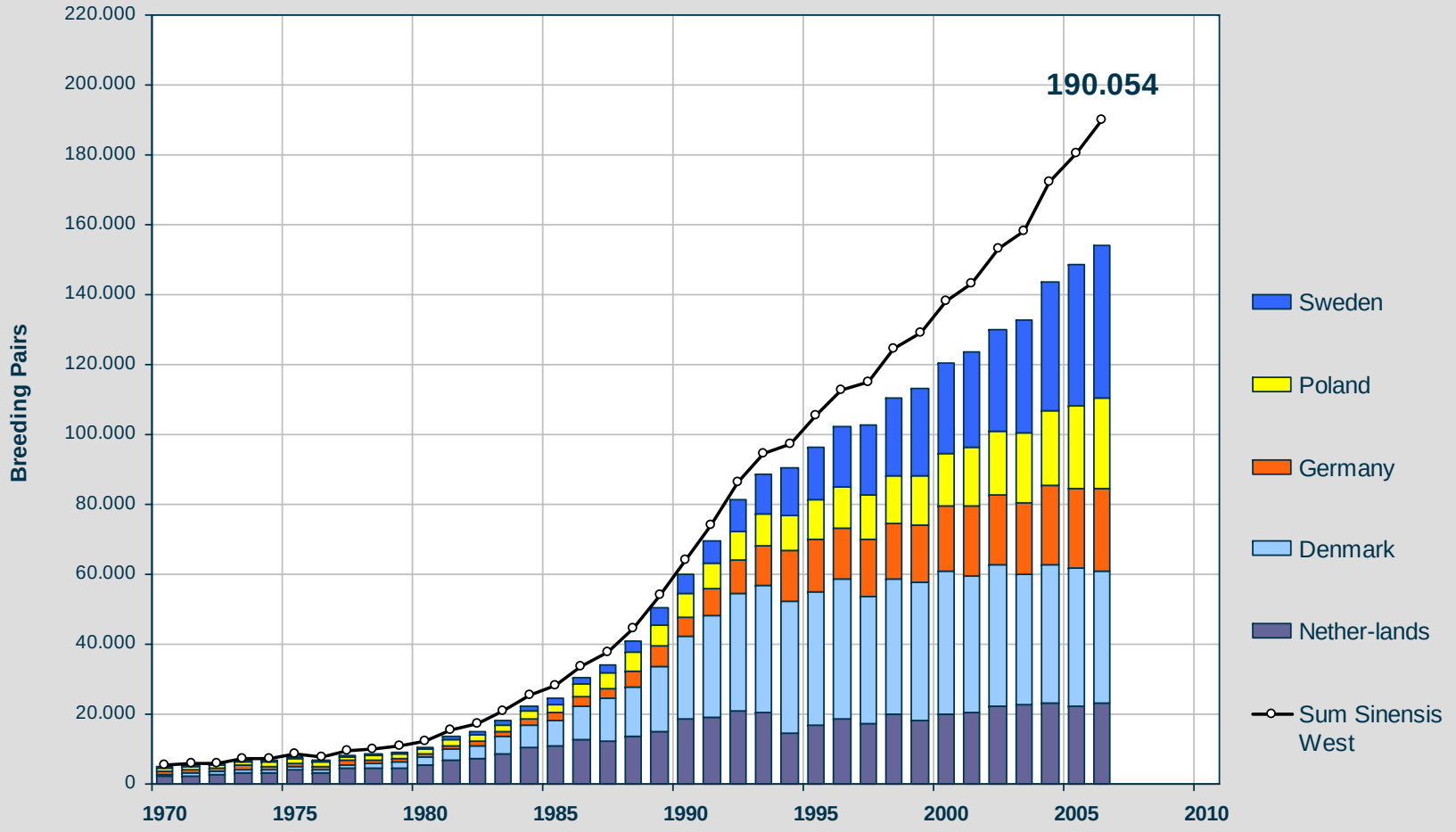
Cormorant Breeding Pairs - POLAND



Cormorant Breeding Pairs - SWEDEN



B3-1b. Breeding Pairs Sinensis West - Country Groups (2)



NL + DK fairly stable since mid 1990ies

followed by rapid growth in neighbouring D + PL + S

B3-2. Development of Sinensis West in Finland & Balticum

- The Baltic countries and Finland had not been traditional breeding areas of the Great Cormorant. Historically, no colonies have been recorded before 1985/1990.
- The 'Why' is a bit of a mystery. Given the geographical characteristics and the thin human population neither a possible scarcity of fish, the lack of breeding sites or a hypothetical human persecution can explain why for so long there was not a single cormorant colony in this area.
- Since 1990, in just 20 years, the cormorant breeding population in this area has grown from virtually zero to over 30.000 pairs. And the upward trend continues. This development clearly shows that the Balticum nowadays provides exceptionally good conditions for the Cormorant.
- No doubt that this was initiated and fuelled by "emigrants" from the overcrowded colonies in the 'old' breeding countries.
- But why haven't the cormorants colonised this area earlier? Even if one assumes that the conditions might have been a bit worse in the past - certainly also 50 years or 100 years ago there were enough space, enough fish and enough undisturbed places for at least one breeding colony. So what is a plausible explanation? Climate change?

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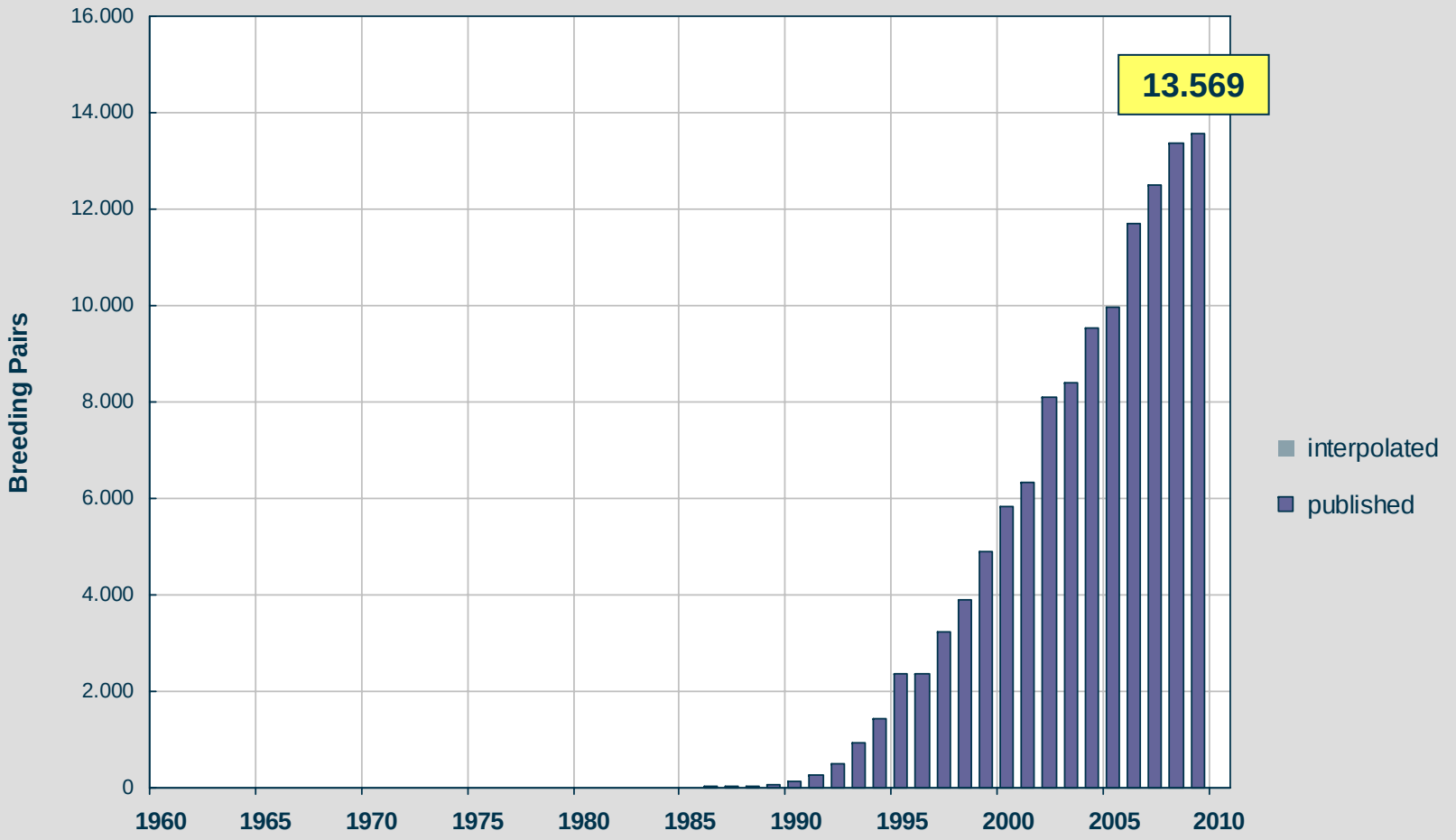
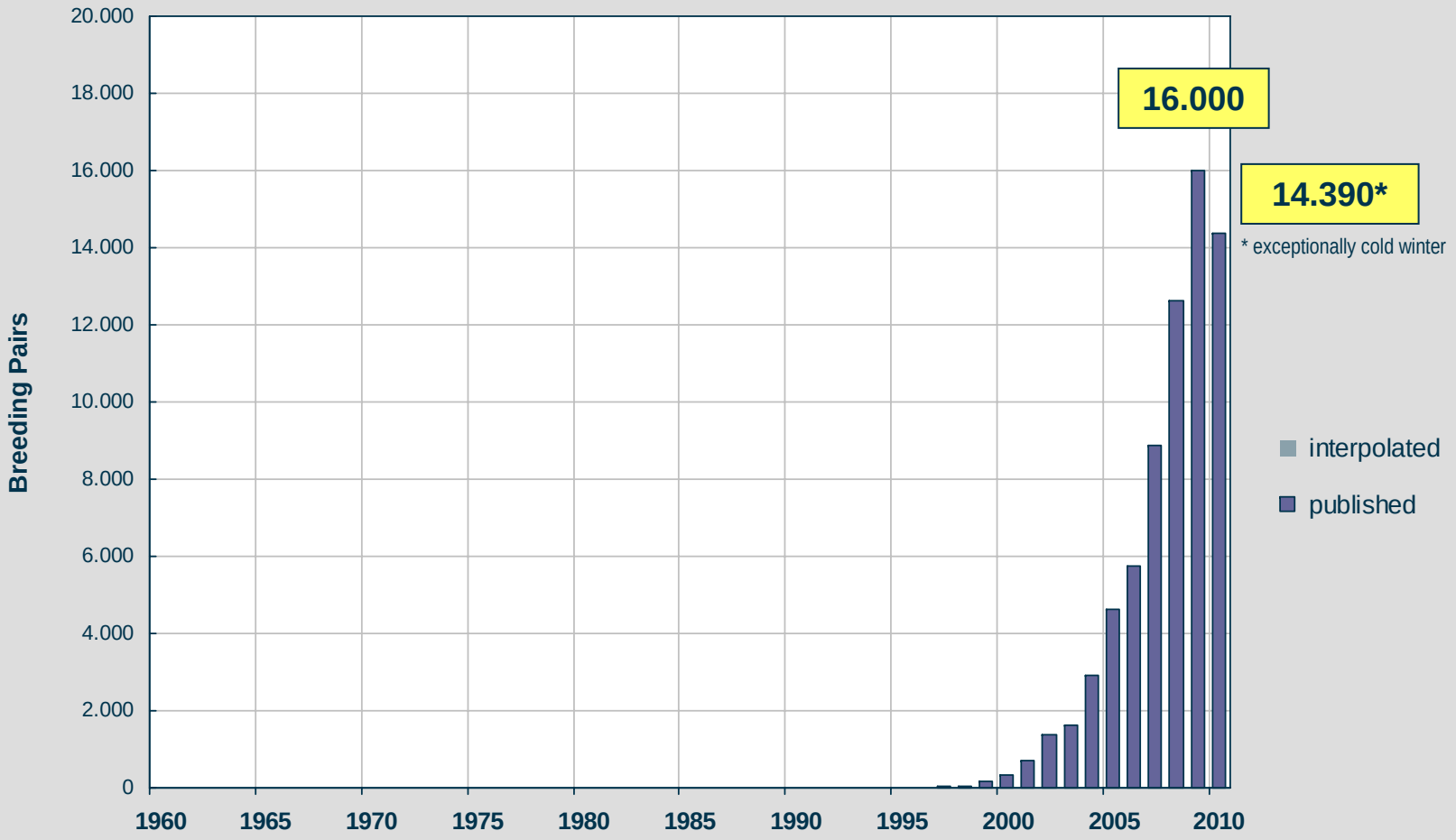
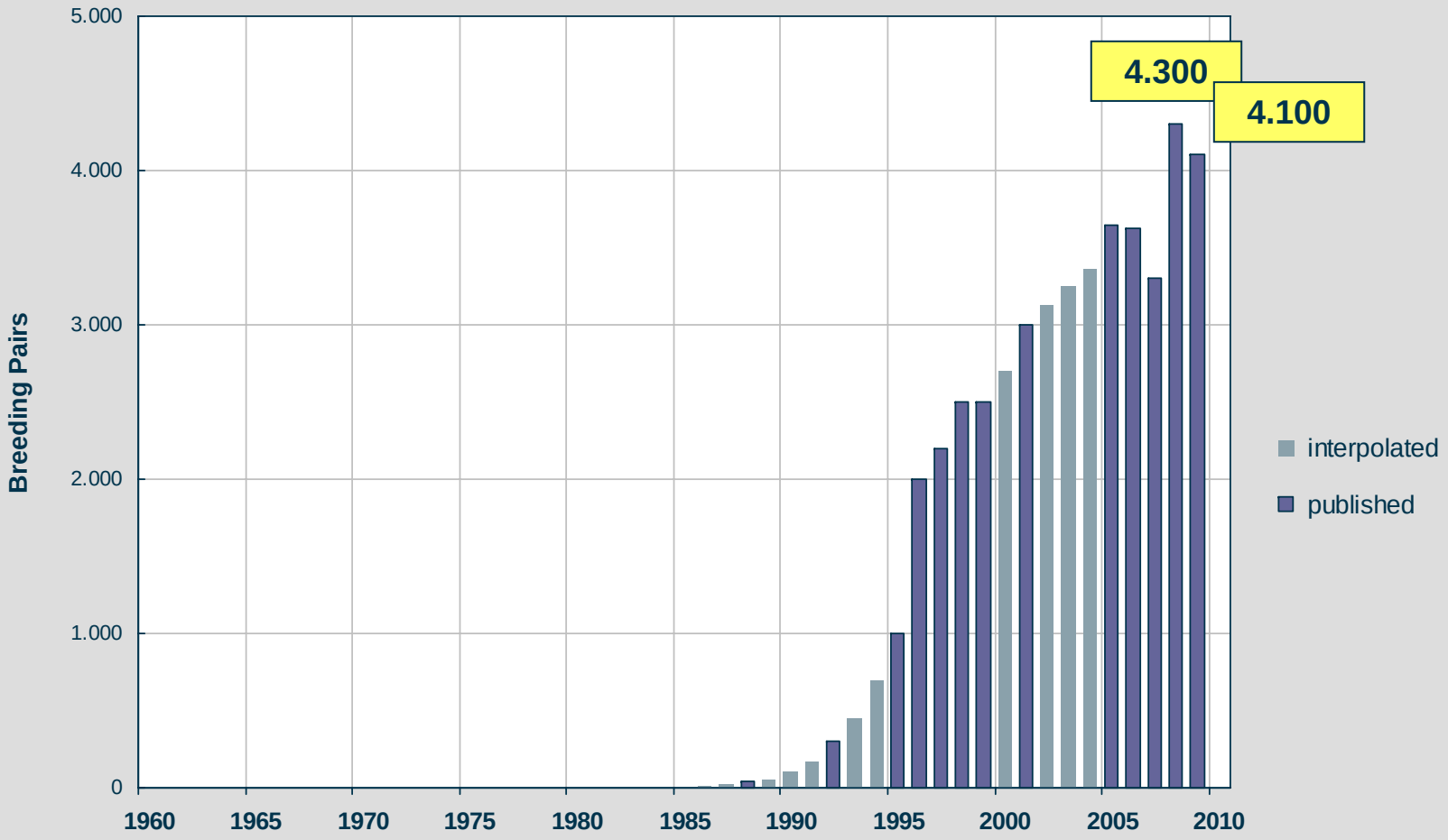
Cormorant Breeding Pairs - ESTONIA



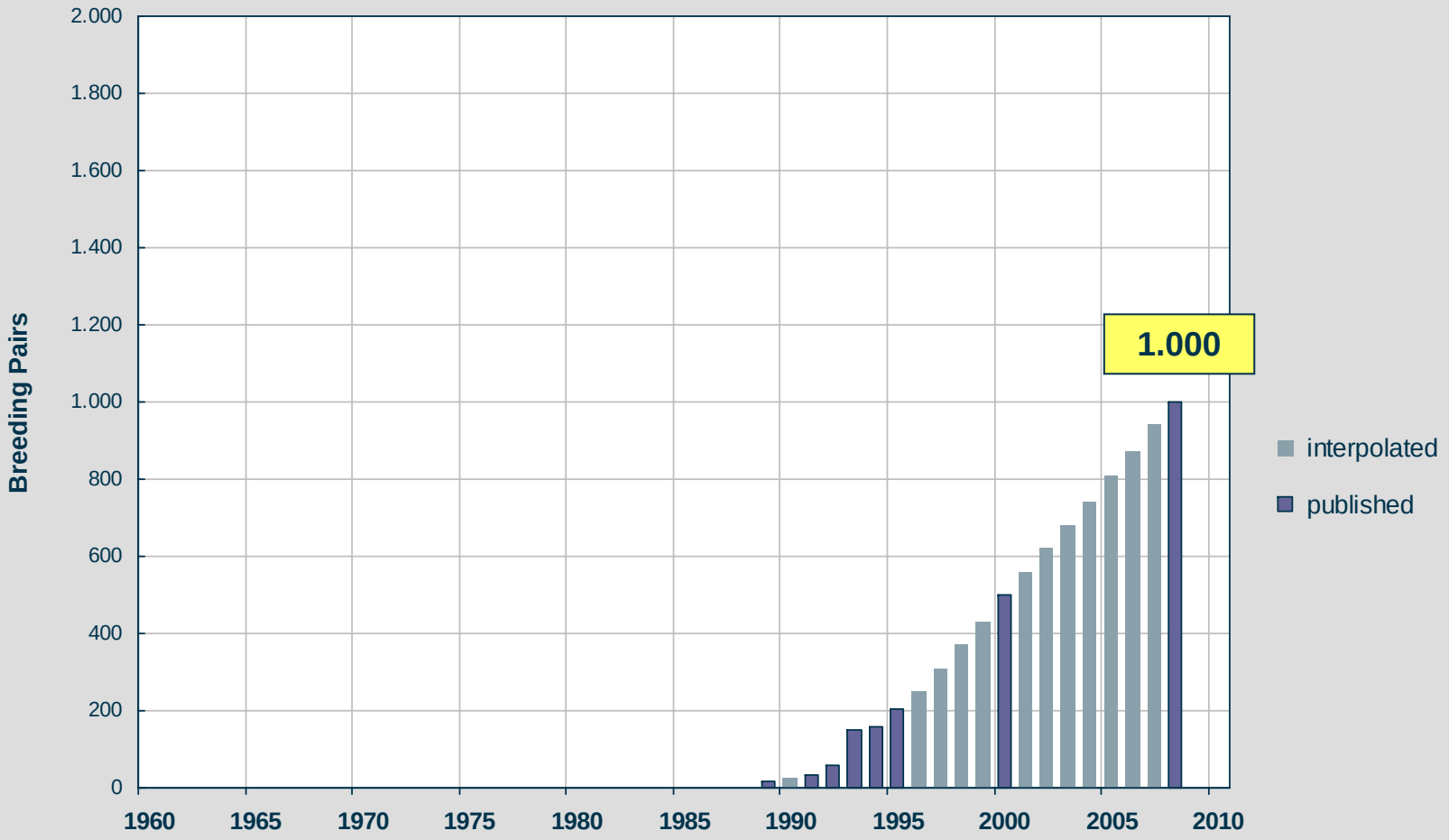
Cormorant Breeding Pairs - FINLAND



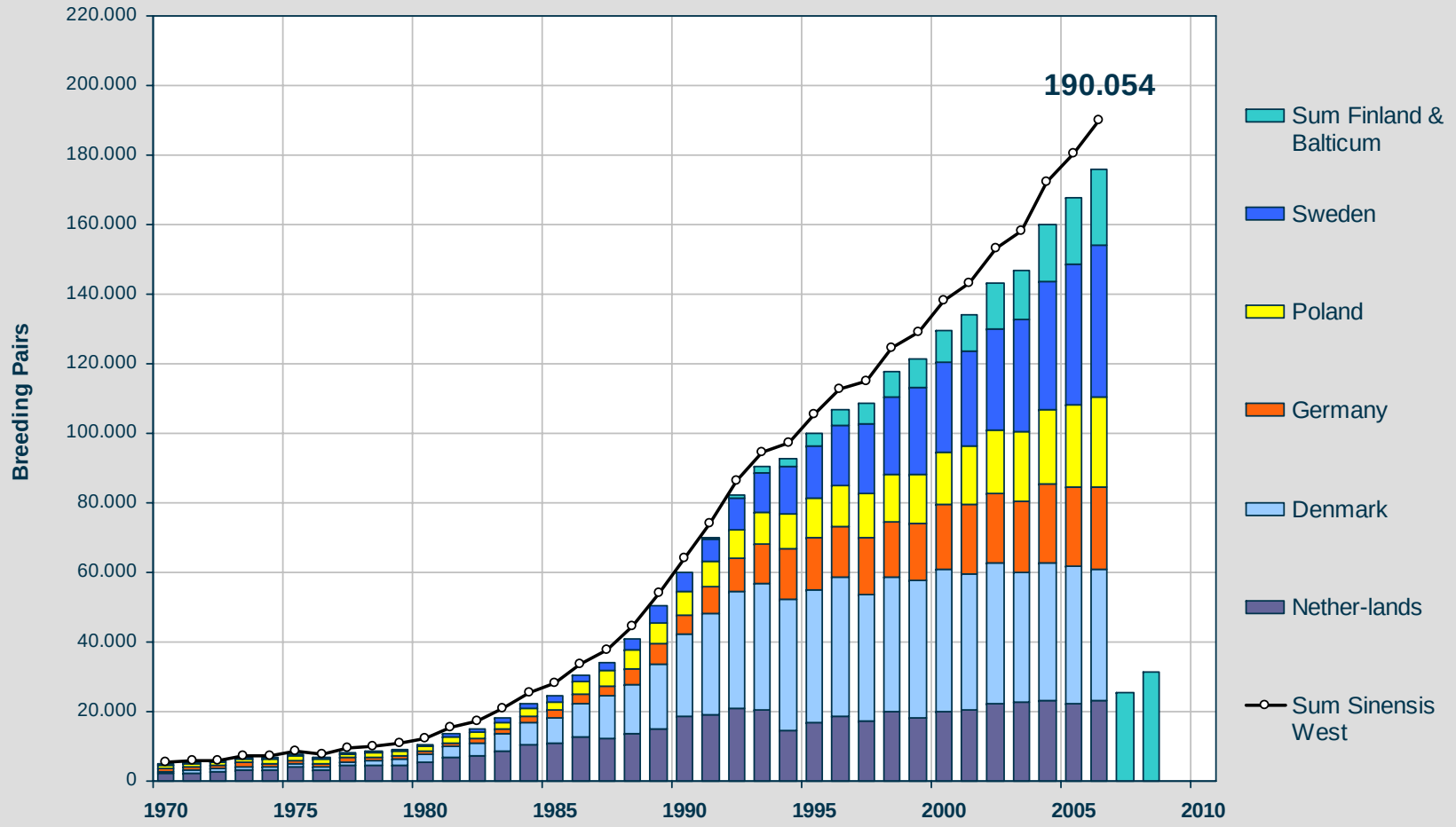
Cormorant Breeding Pairs - LITHUANIA



Cormorant Breeding Pairs - LATVIA



B3-2. Breeding Pairs Sinensis West - Country Groups (3)



NL + DK fairly stable since mid 1990ies, followed by rapid growth in D + PL + S

since 2000 very steep increase in Baltic area

B3-3. Development of Sinensis West in UK, France and Belgium

- France always had cormorant colonies on the atlantic coast, which - by definition - are regarded as "Carbo-cormorants". The inland waters of France are a prime wintering area, with actually about 100.000 cormorants each winter. In comparison to that, breeding of Sinensis-cormorants started rather late and despite steep growth rates does not exceed a level of 4.000 to 5.000 pairs (much below the levels in Baltic countries).
- In UK the Sinensis-cormorants - obviously originating from Dutch and Danish colonies - started to settle in the 1980ies, almost exclusively on inland waters in south of England. (*As in France, there are some 'mixed' colonies' with Carbo-cormorants, accurate distinction is difficult, but the majority is 'Sinensis*')
- In Belgium, there were breeding colonies until the mid-1950ies. Re-colonisation started about 40 years later, in the mid 1990ies. Countings are done separately for Belgium Vlanders (which borders to Netherlands) and for the 'frankophone' Belgium Wallonie - especially for Vlanders development is very well documented.

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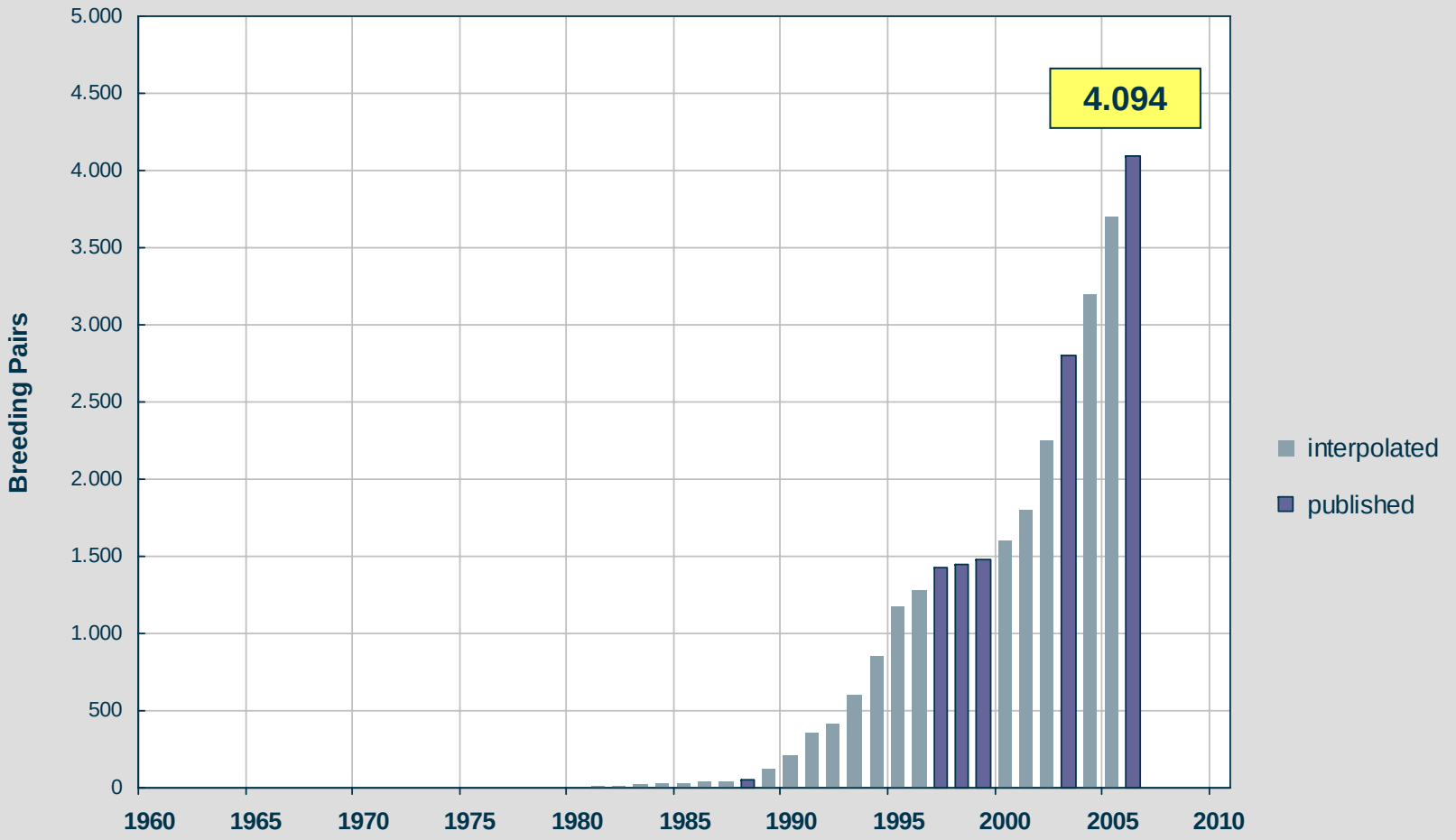
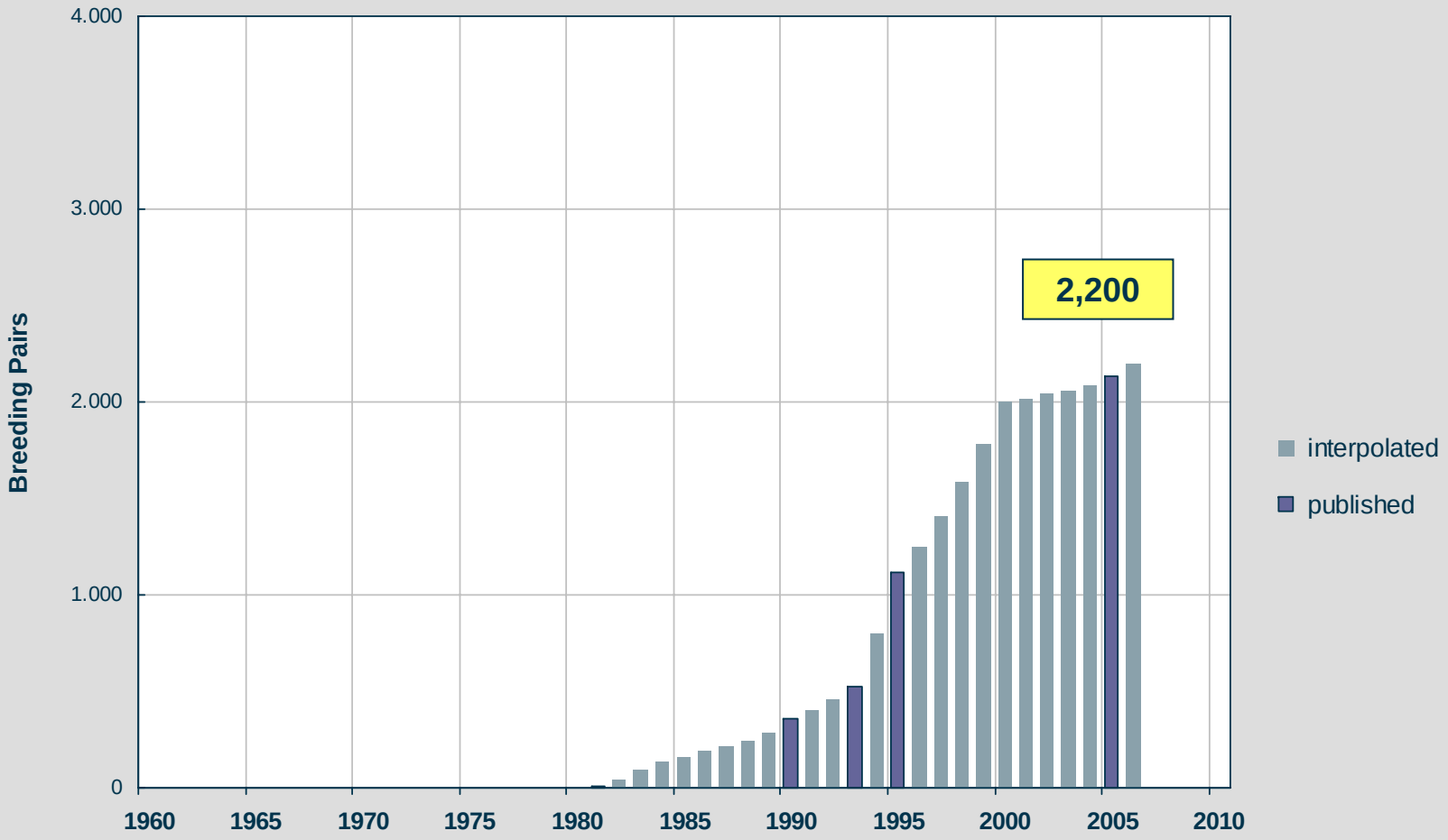
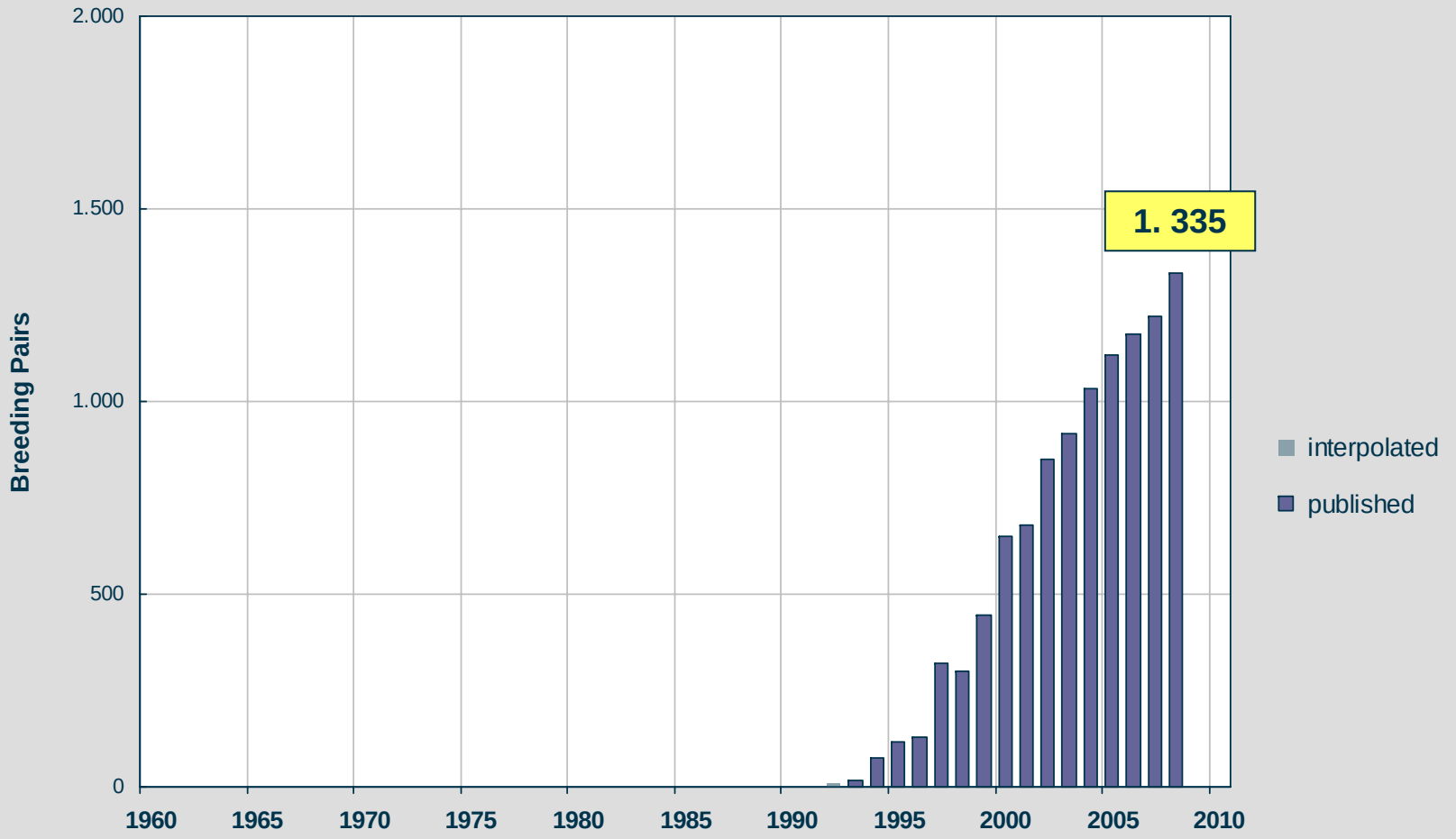
Cormorant Breeding Pairs - FRANCE inland (sinensis)*



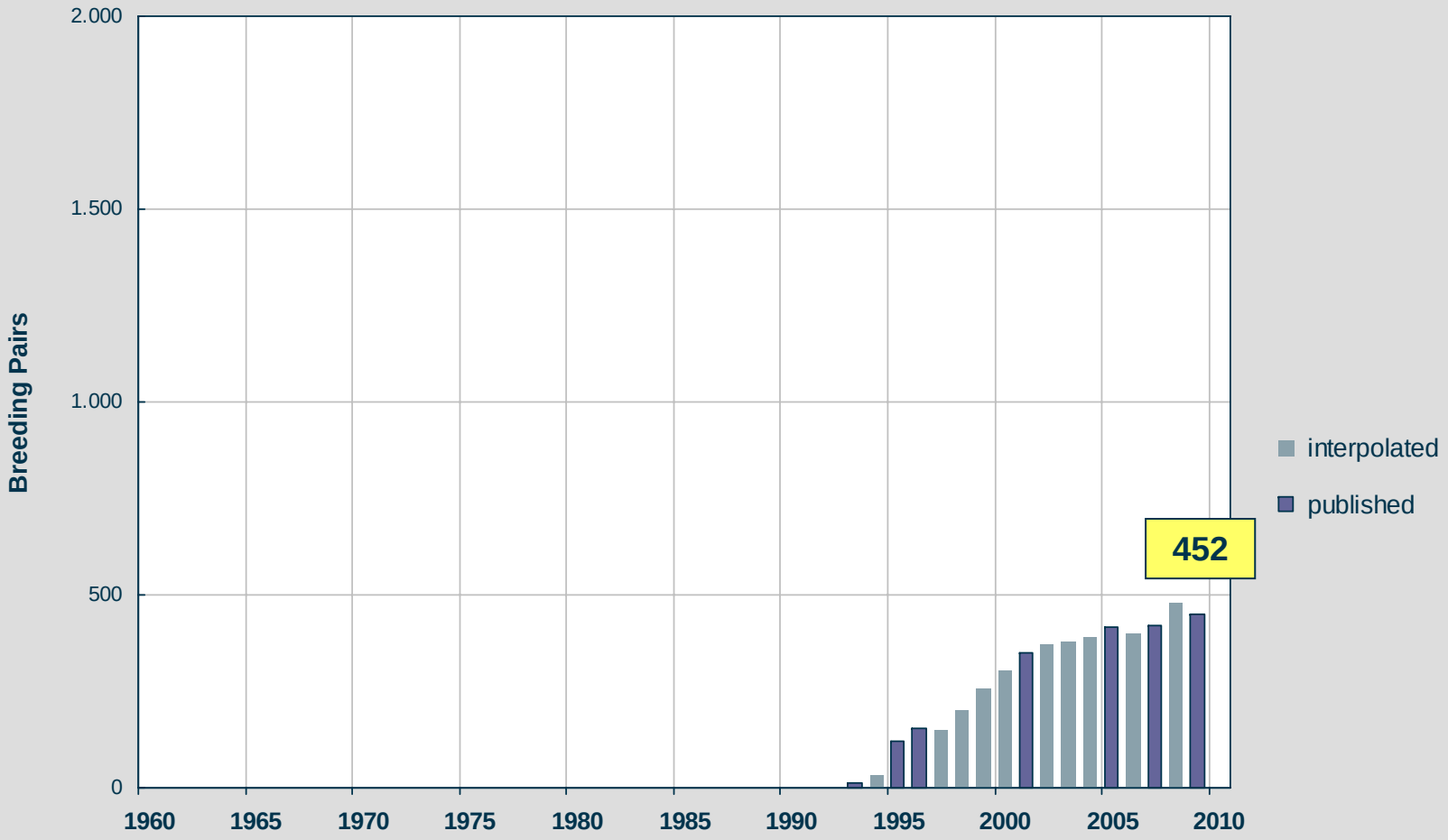
Cormorant Breeding Pairs - UK sinensis*



Cormorant Breeding Pairs - BELGIUM Vlanderen



Cormorant Breeding Pairs - BELGIUM Wallonie

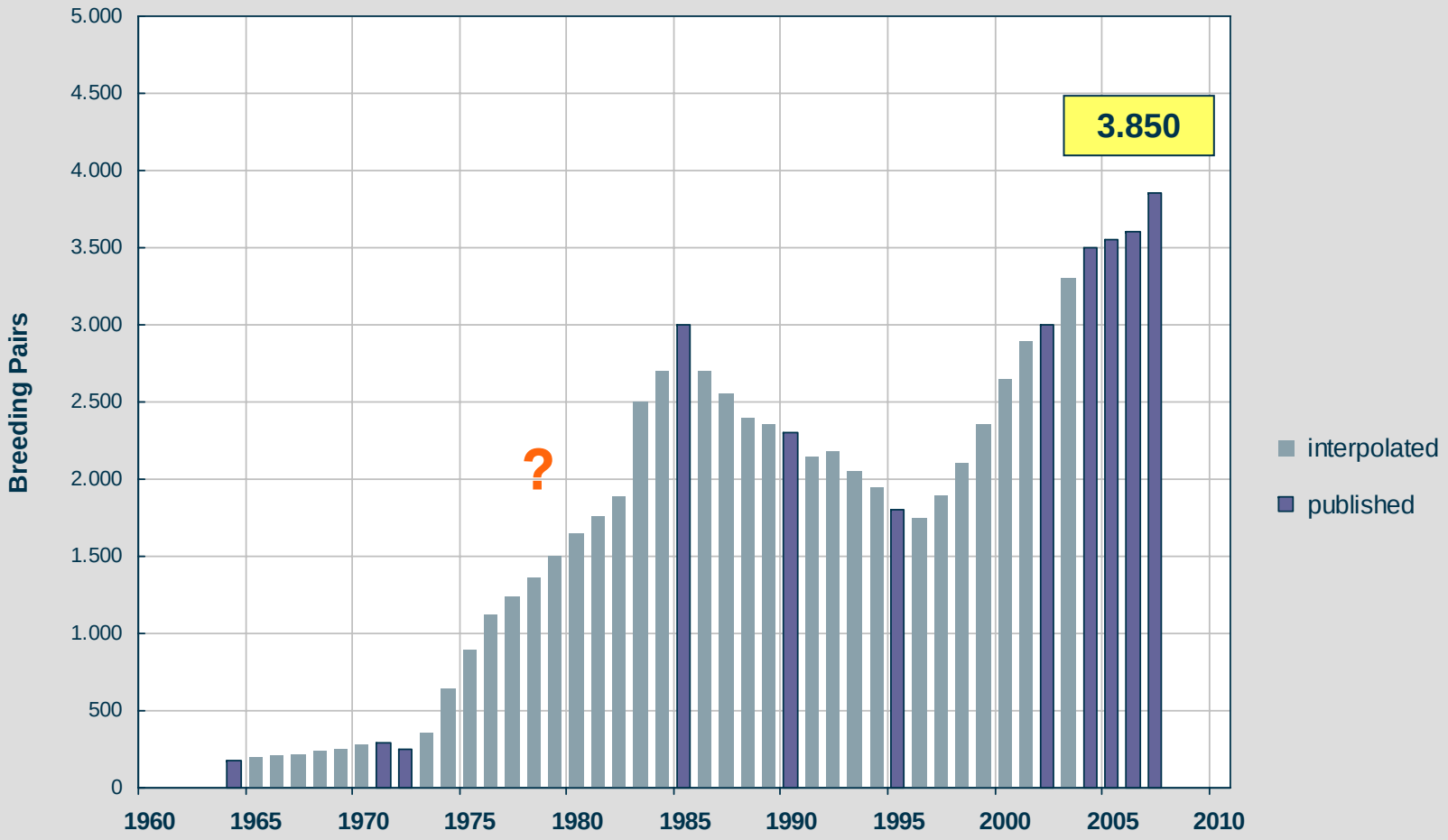


B3-4. Development of Sinensis West in Central Europe

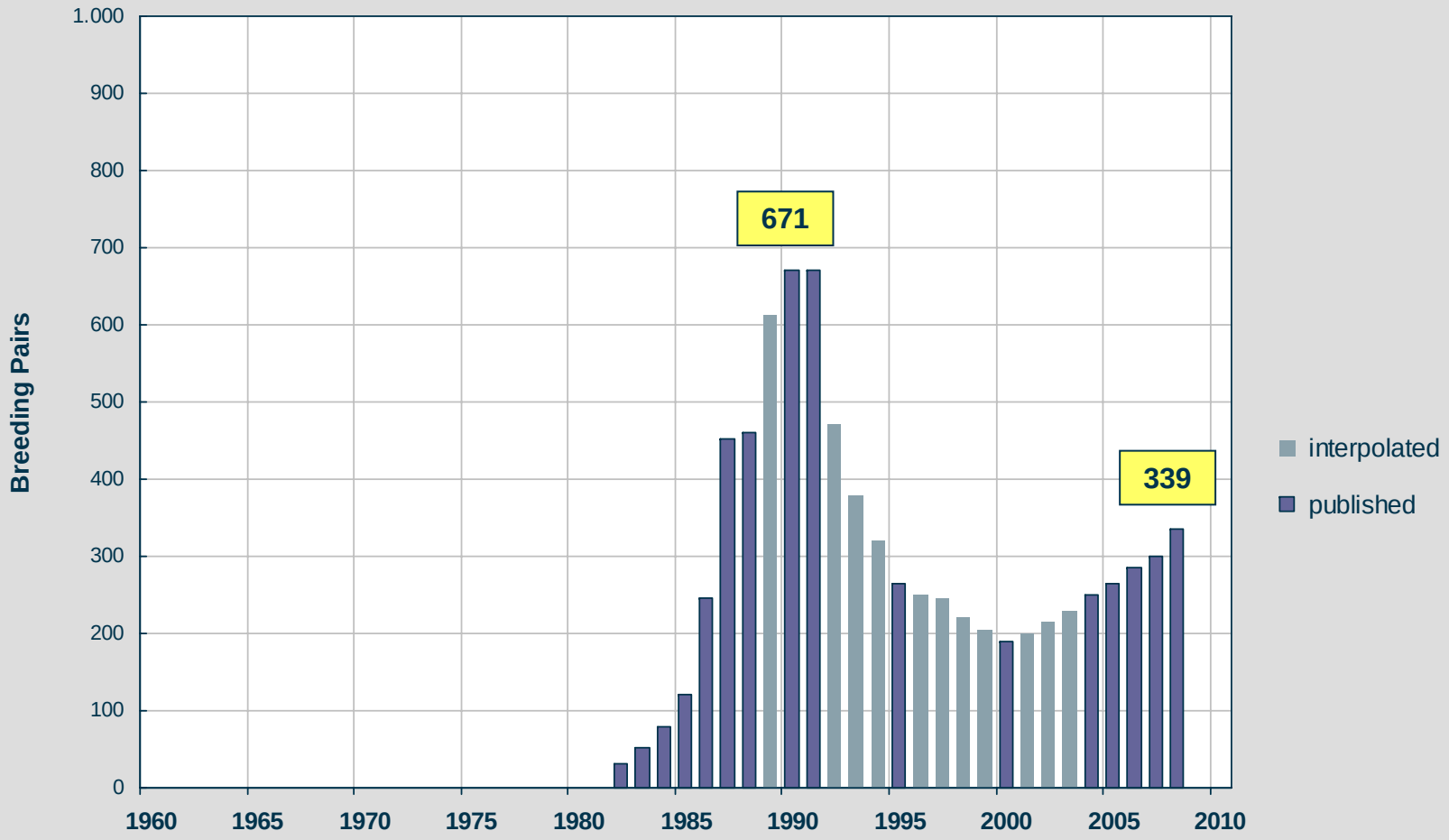
- This group comprises "purely continental inland countries",
- Historically, Hungary, Slovakia and Austria always had breeding colonies in the Danube catchment area. In Hungary this presence was never interrupted. In Slovakia the last small breeding colony disappeared in the mid 1960ies, re-colonisation started around 1990.
- In Austria the last Danube colony lapsed about 1973, new colonies were established only after 2000. The colony on the March (on Slovakian border) stays small, the colony on Lake Constance grew rapidly to 230 pairs, but since 2009 there are attempts to reduce it by management (removal of breeding trees, selective shooting)
- In Czech Republic cormorants started to breed in the mid 1980ies, the first time since the 16th century. Colonies, located near fish-pond areas, grew rapidly in the first years, but in the following years numbers decreased sharply afterwards (a unique development !!)* and only since 2000 show a slight rise again.
- In Switzerland, already since the 16th century the large lakes had been a traditional target area for wintering cormorants. But no breeding activity had been observed until 2001. Since then, numbers are sharply rising (*prediction of further growth, however, is difficult because the cantonal governments recently allowed a reproduction management in the largest colony*)
- Overall, breeding populations in inland countries apparently stay relatively low - "*no optimal habitat conditions for raising chicks*". Which poses the question whether the labelling of Sinensis as "*continental race*" is adequate

*) According to Z. Adamek (pers. comm. per April 2010) the decrease was caused by the breakdown of the large old trees which originally were used as nesting trees. "*The reason for the decline was that the breeding colonies which appeared in late 80s´/early 90s´ were located on big dead trees which were left on the newly constructed reservoirs in the nature reserve Nove Mlyny. After several years the trees fall down due to decomposition of their trunks and cormorants lost their very convenient nesting sites."*

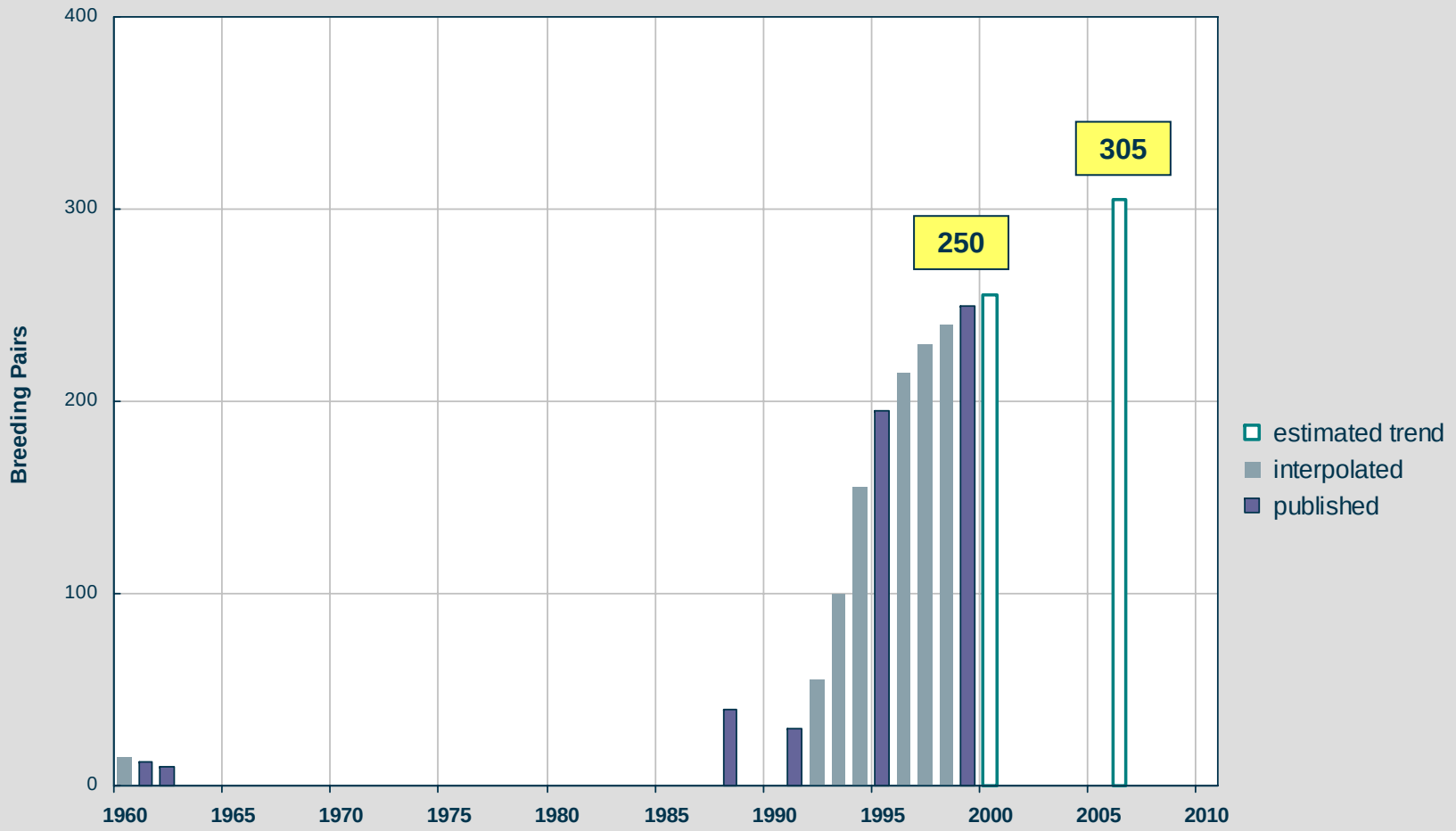
Cormorant Breeding Pairs - HUNGARY



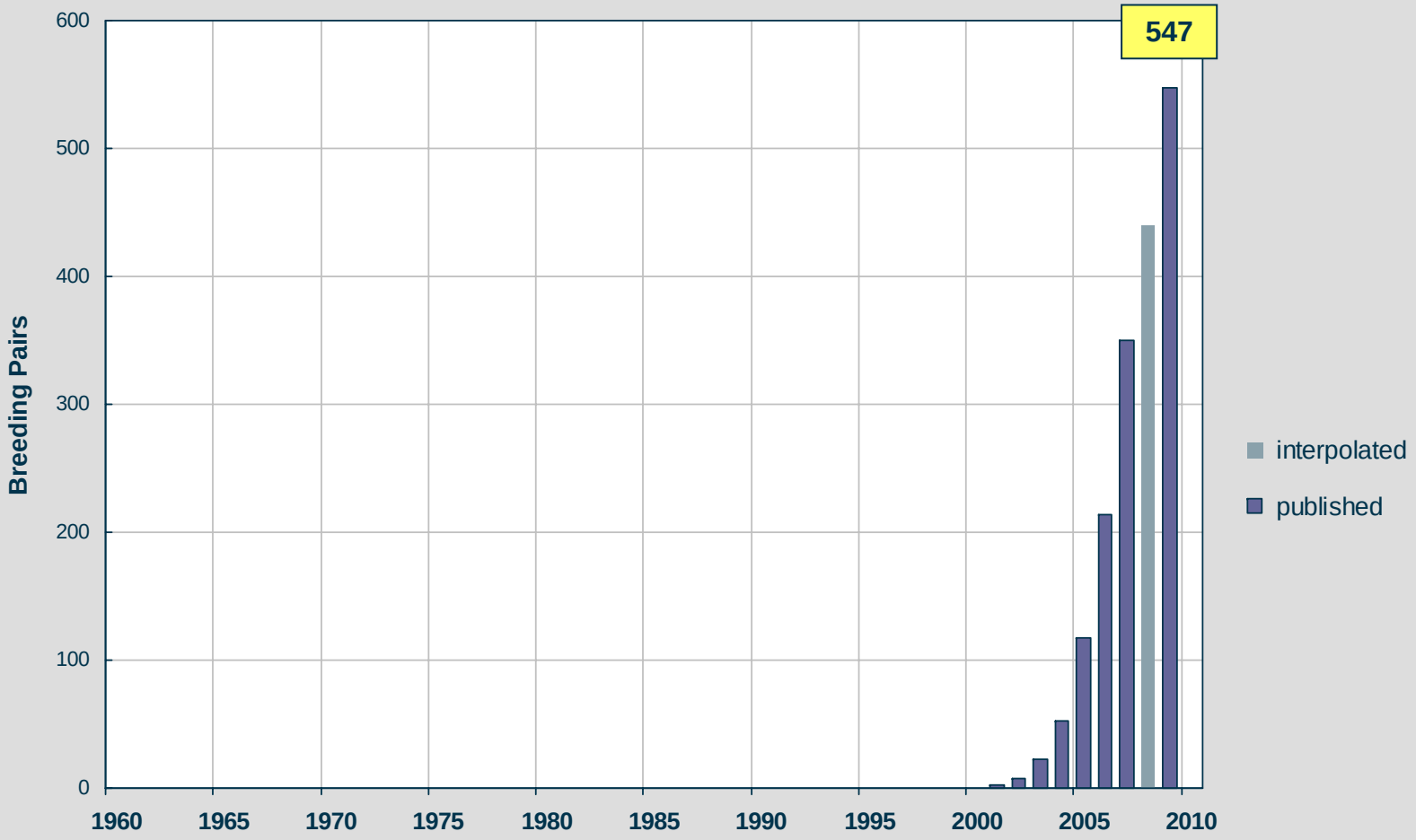
Cormorant Breeding Pairs - CZECH REPUBLIC



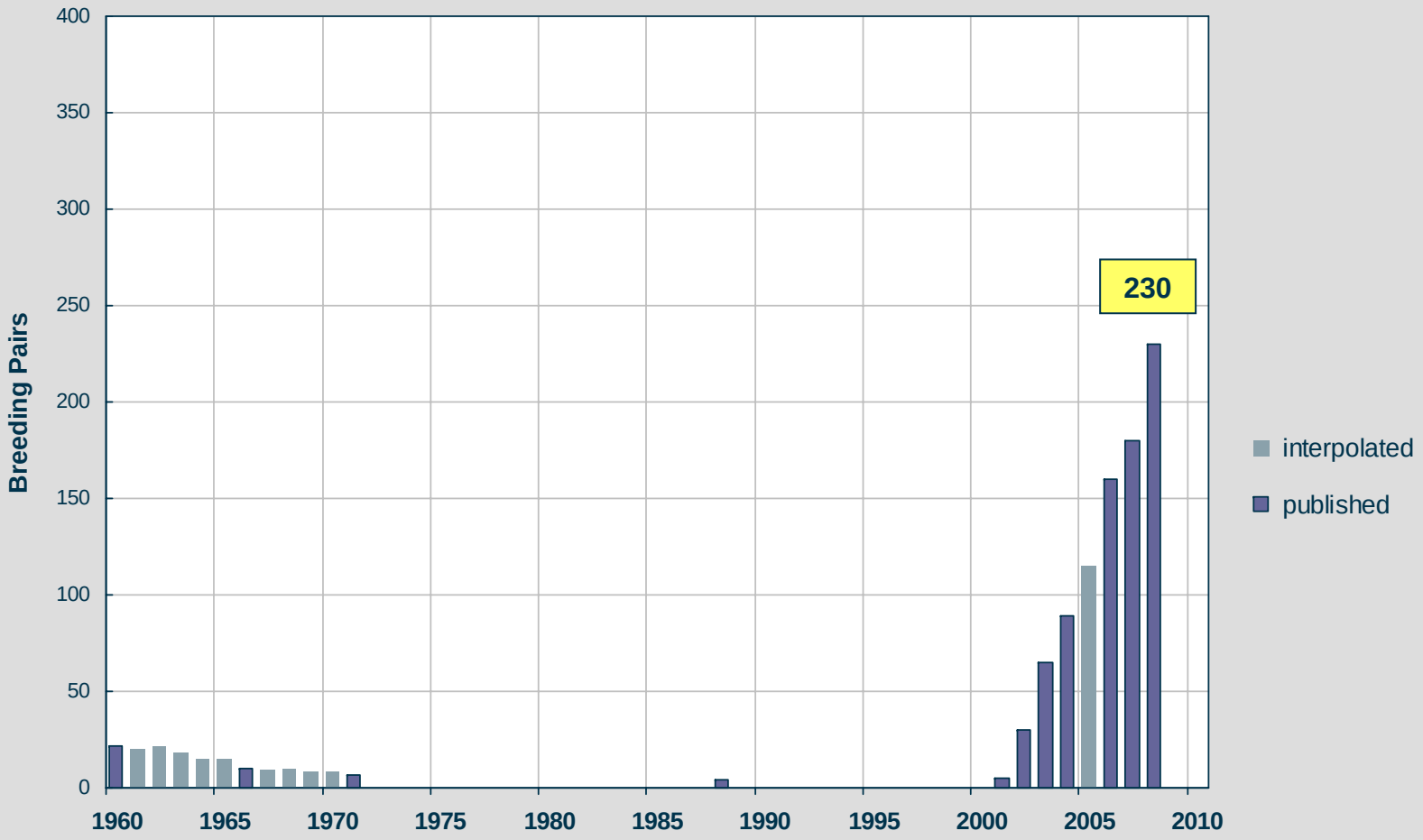
Cormorant Breeding Pairs - SLOVAKIA



Cormorant Breeding Pairs - SWITZERLAND



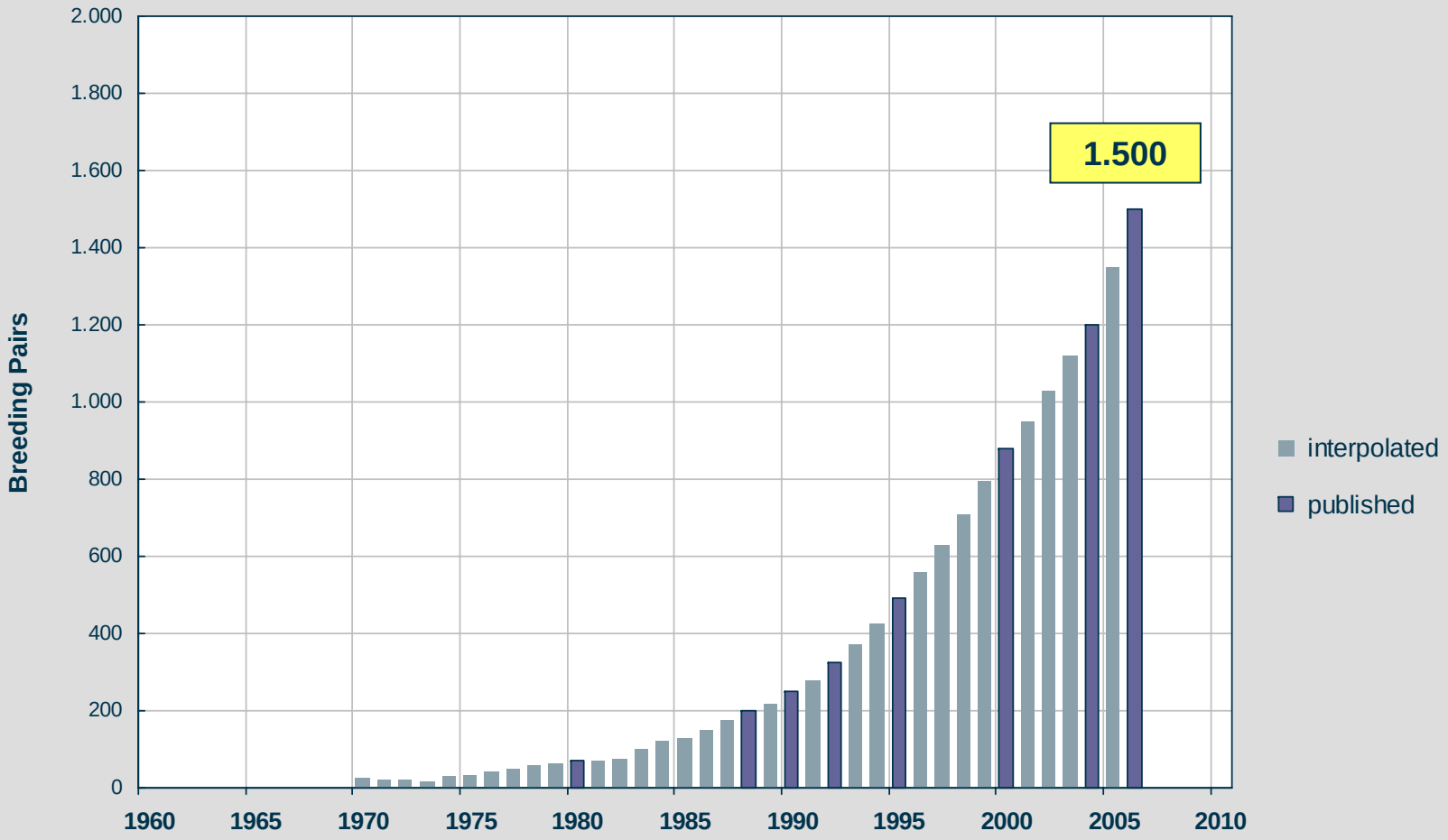
Cormorant Breeding Pairs - AUSTRIA



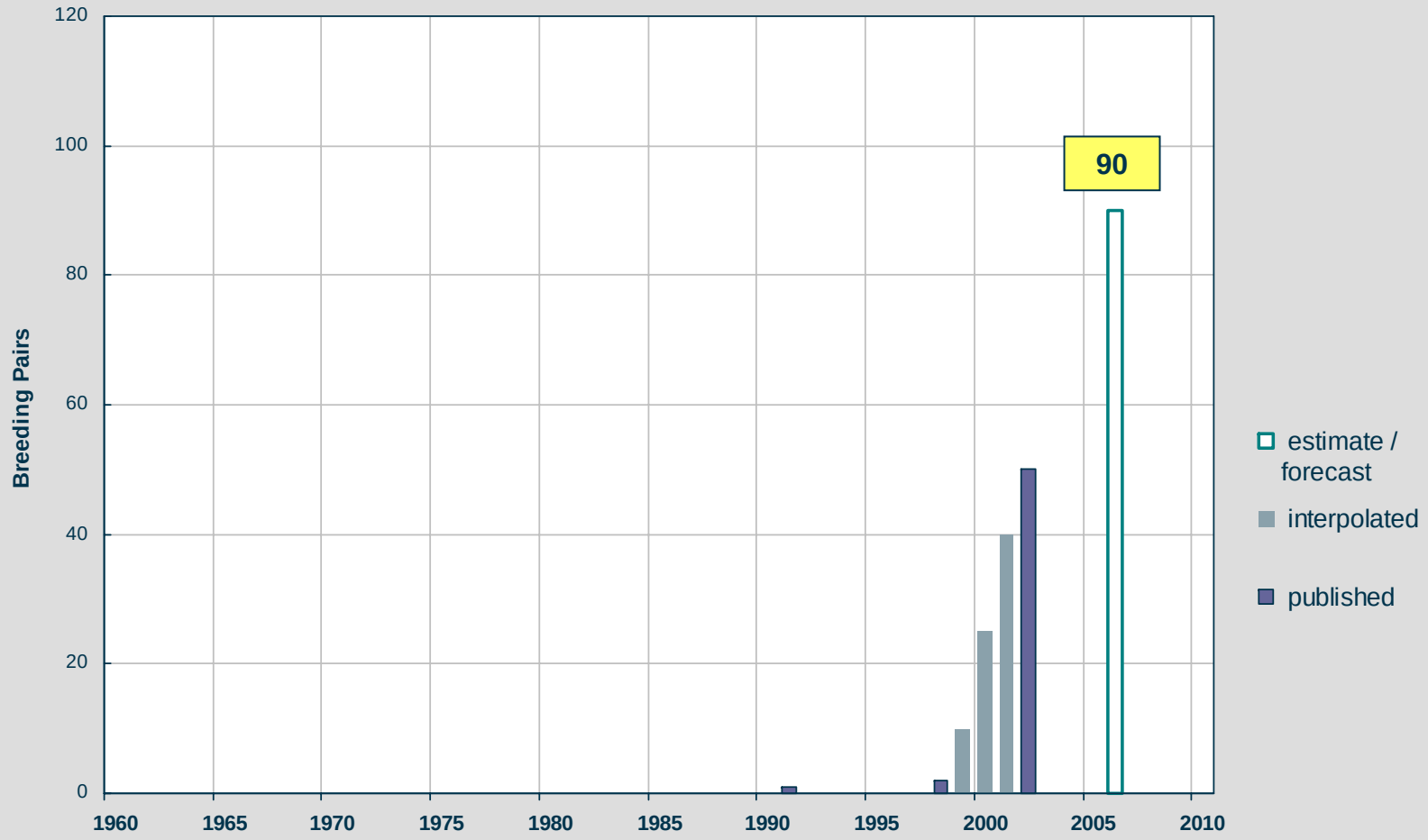
B3-5. Development of Sinensis in Italy and Spain

- In Italy a small population of cormorants always had survived throughout the 20th century - however, only in tiny colonies on Sardinia and Sicily. Colonisation on mainland started 1985 in the Po-Delta, showing a continuous growth in all years until now. (However, by far not as steep as for example in Finland - Italy still predominantly is a wintering country)
- In Spain, which holds enormous numbers of cormorants in winter (>65.000), some small breeding colonies appeared only shortly before 2000. Up to now they are still very few colonies, mostly in Ebro valley (one colony is reported also in north-west coastal area, but this should belong to the Carbo-race). No good actual data are published, however, breeding population seems insignificant (*probably still clearly less than 100 pairs)* compared to the large number of wintering cormorants.

Cormorant Breeding Pairs - ITALY

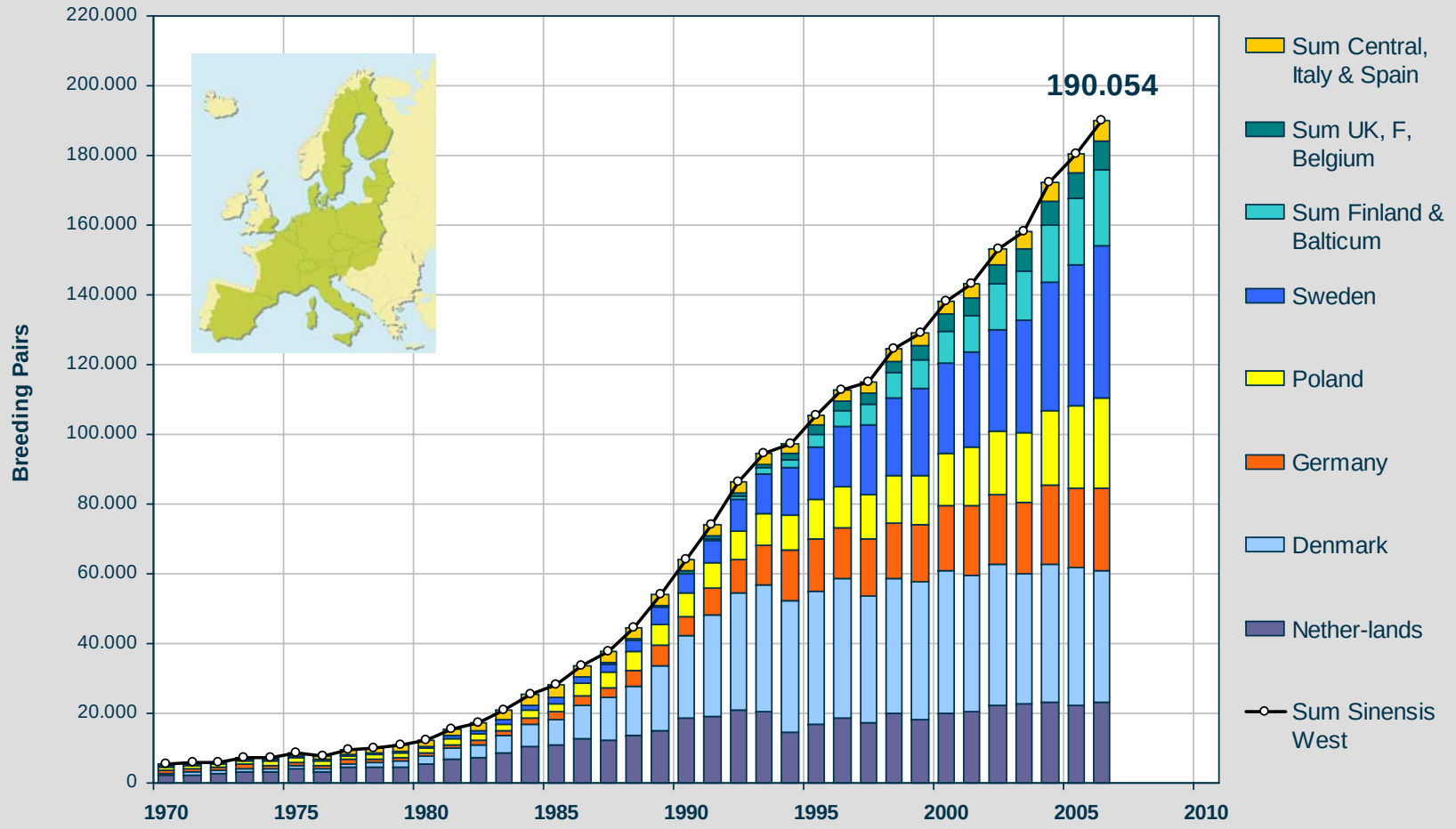


Cormorant Breeding Pairs - SPAIN Total*



*) Per 2006, 4 colonies have been documented - 3 sinensis, 1 carbo. With exception of the 2 - 50 pairs reported in BirdLife Factsheet for 1998-2002 no quantitative information has been found. The recorded figures have been allocated 1/3 carbo, 2/3 sinensis. Up to now the number Spanish breeding pairs is insignificant anyway.

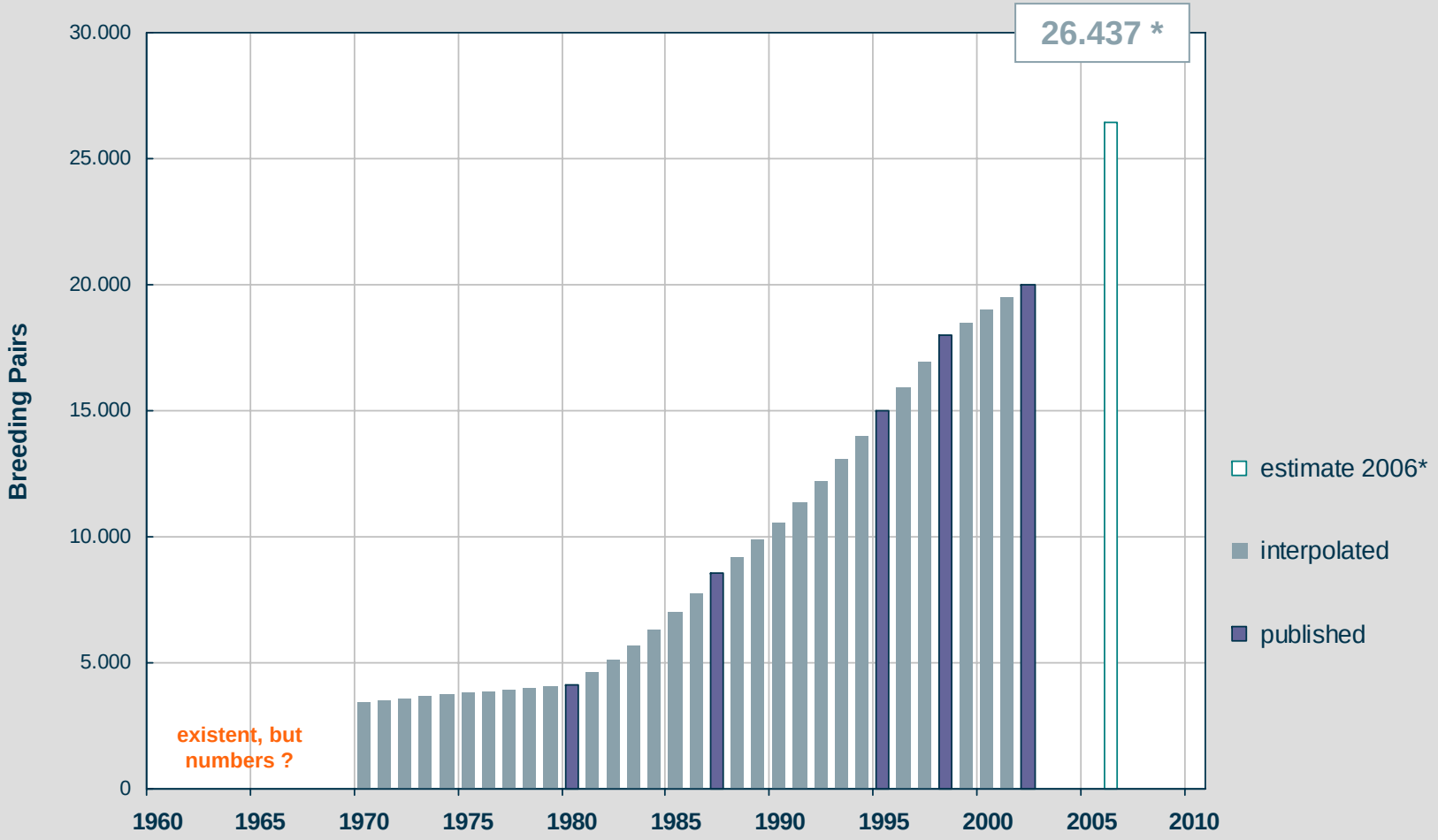
B3-6. Cormorant Breeding Pairs - Overview Sinensis West



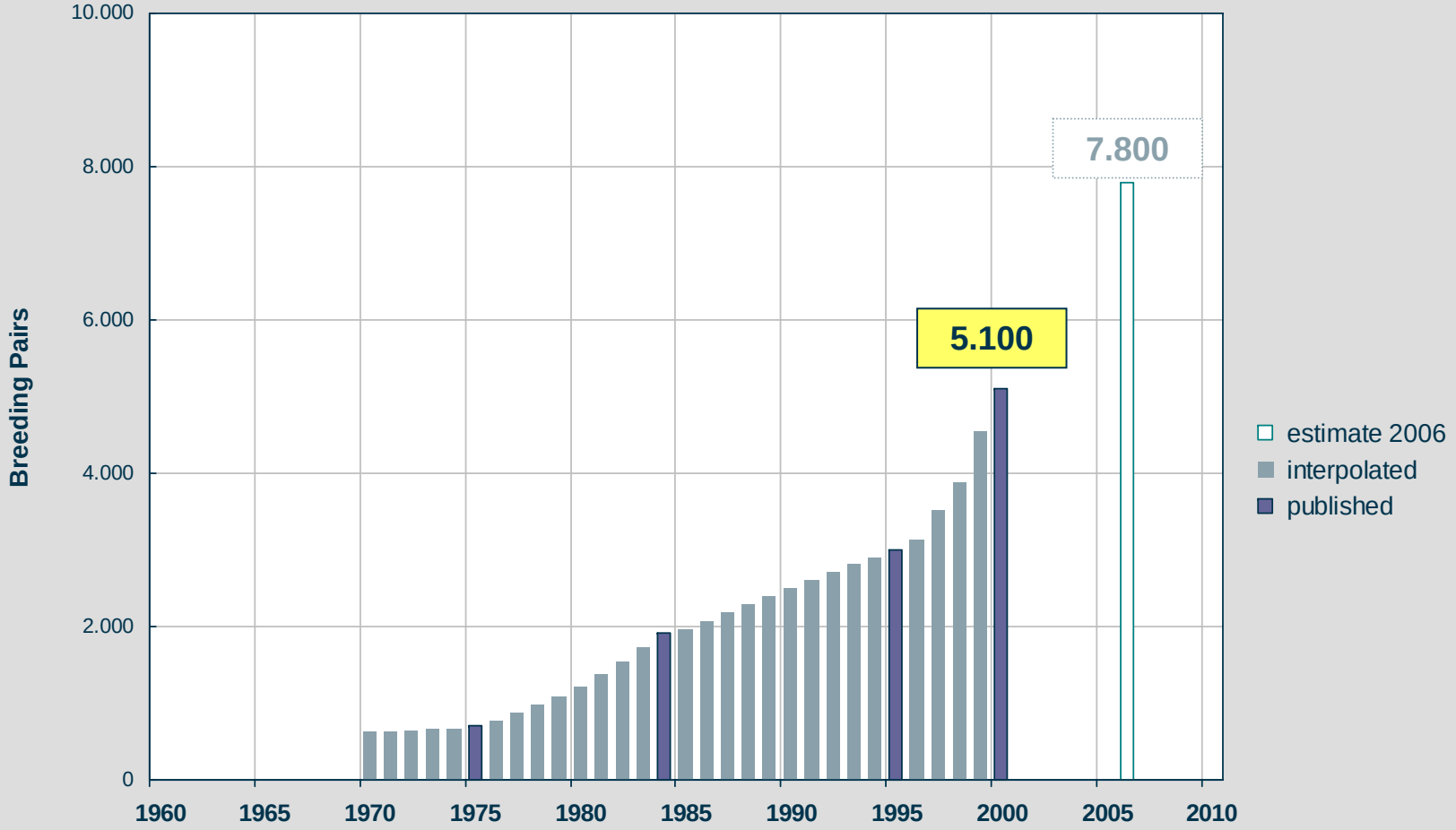
B3-7. Development of Sinensis East (Romania, ex-Yug, Bulgaria, Greece)

- In eastern Europe cormorants had never vanished and sizeable breeding colonies existed throughout the last century.
  - In Romania the core area is the Danube delta, from where colonies extend westwards up the Danube (*and also eastwards to Ukraine / Krim peninsula*)
  - In ex-Yugoslavia colonies existed in Serbia (along the Danube), Croatia (esp. Kopacki Rit) and Macedonia (Lake Ochrid).
  - In northern Greece (Axios delta) a breeding colony was first recorded in 1944, but numbers stayed low before the 1990ies
  - In Bulgaria existed smaller colonies on islands in the Danube (one holding up 387 pairs in the 1970ies).
- Generally, for these countries there is much less information about cormorant population development than in western Europe. 'Historical' data are scarce and even for the last decade counting data are available only in irregular intervals.
- However, available information shows clearly enough that there has been a steep increase over the last two decades.

Cormorant Breeding Pairs - ROMANIA

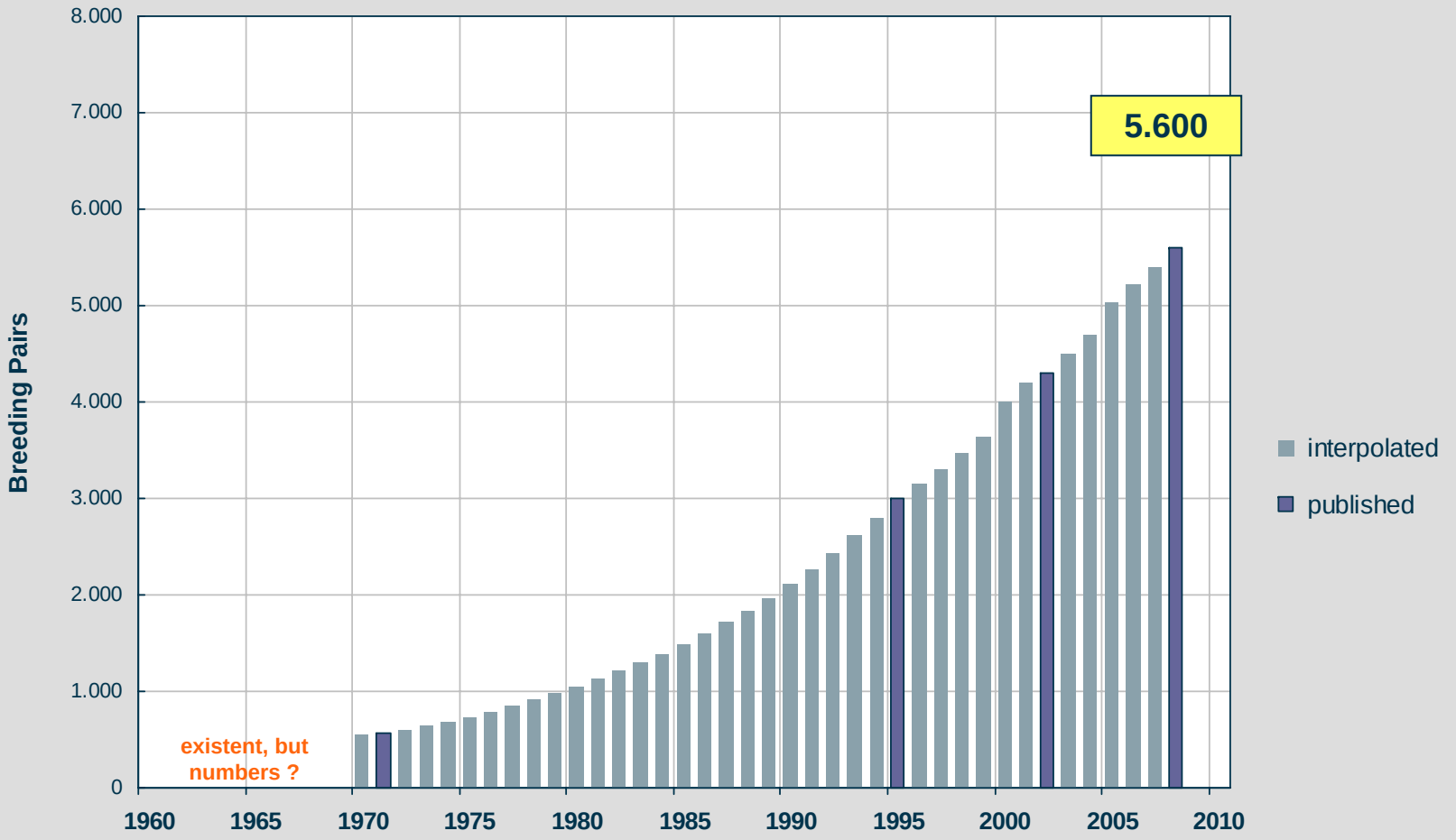


Cormorant BPs - Countries of ex-YUGOSLAVIA*

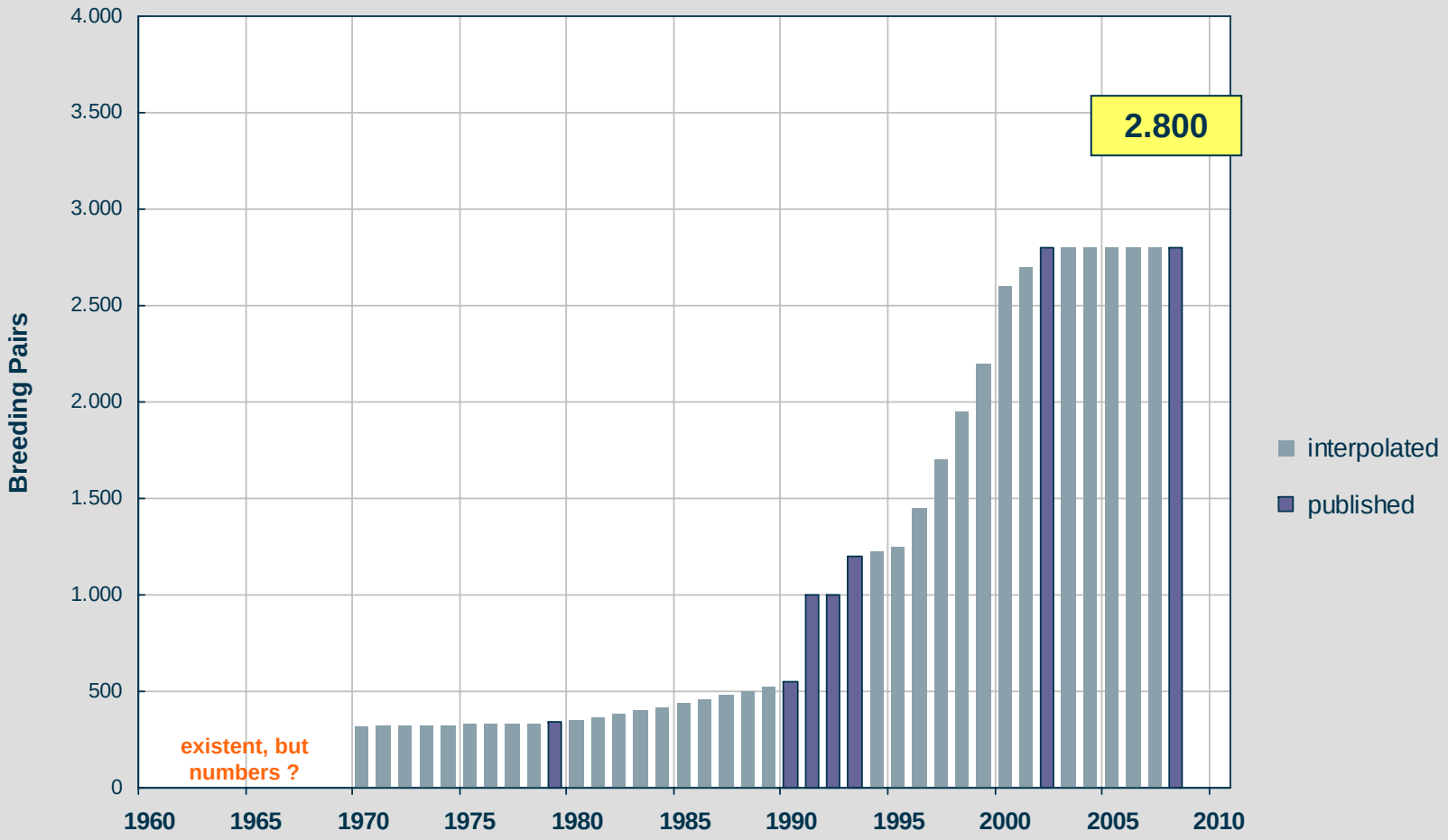


*) Unfortunately, sources before 1990 show only aggregated figures for "Yugoslavia" and there are no published (accessible) national data since the BirdLife Factsheet for 2000 (then there were 3.000 BP in Croatia, 2.400 in Serbia/Montenegro and 600 in Macedonia). Therefore only the development for "ex-Yugoslavia Total" can be shown.

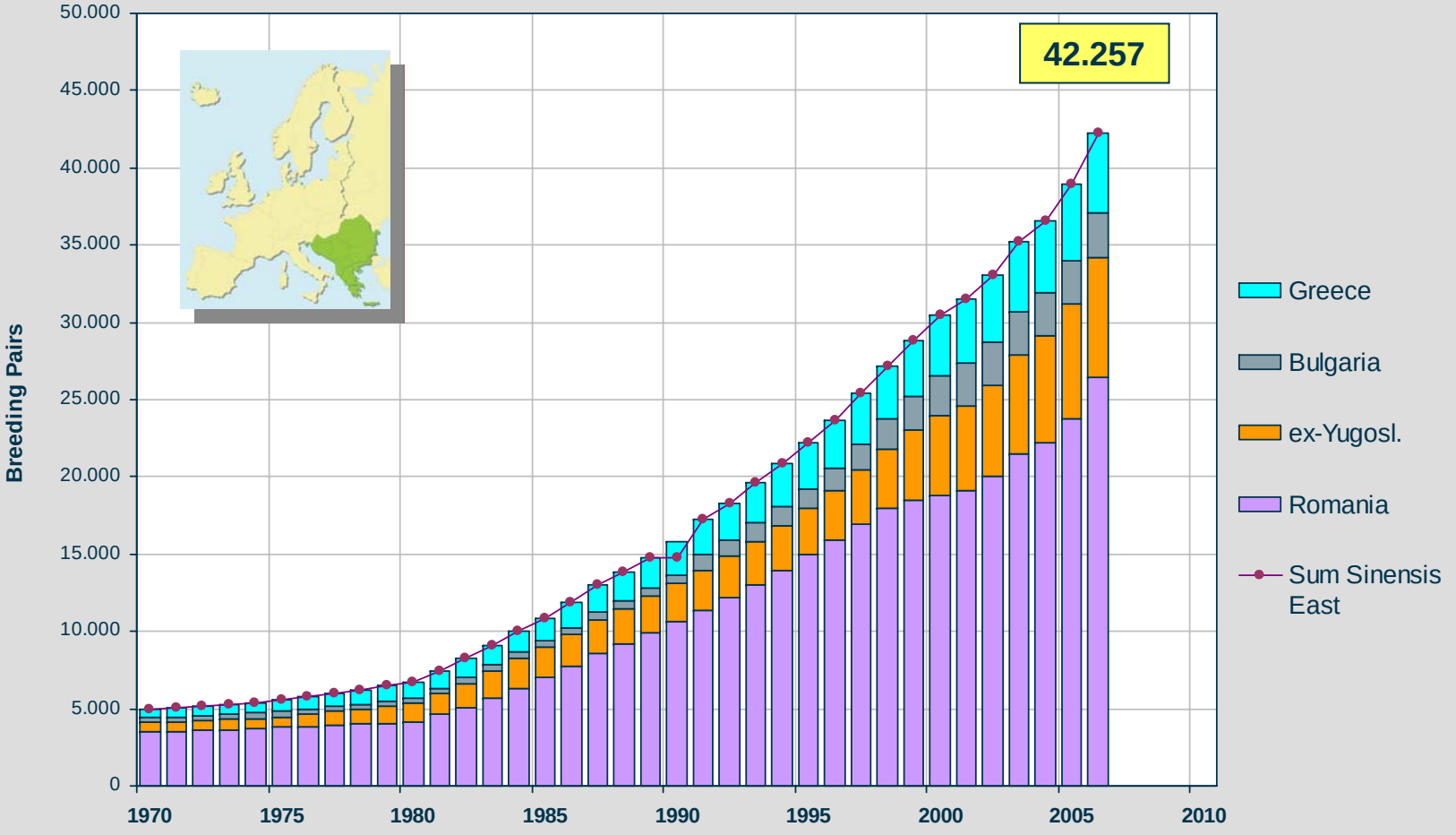
Cormorant Breeding Pairs - GREECE



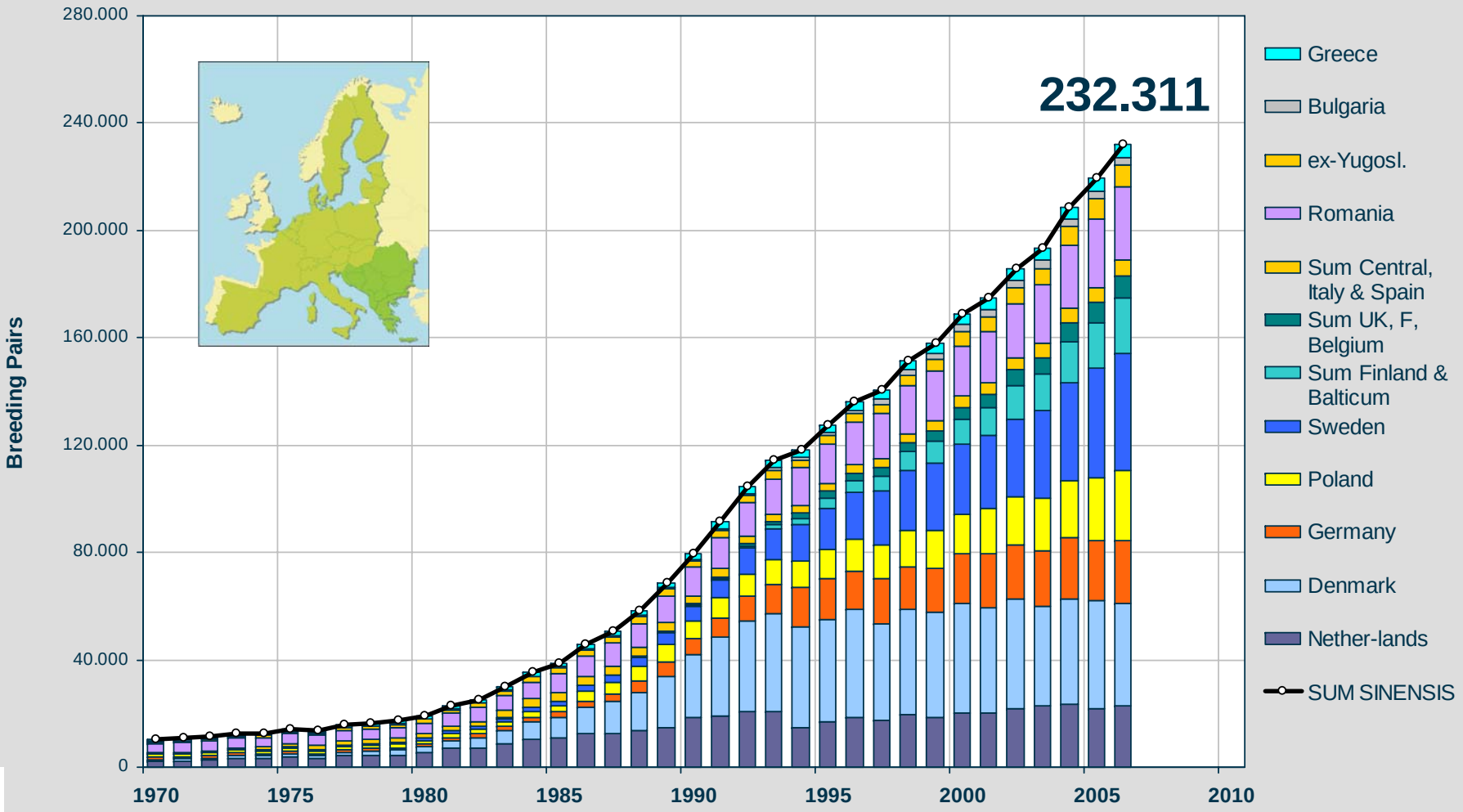
Cormorant Breeding Pairs - BULGARIA



B3-8. Cormorant Breeding Pairs - Overview Sinensis East

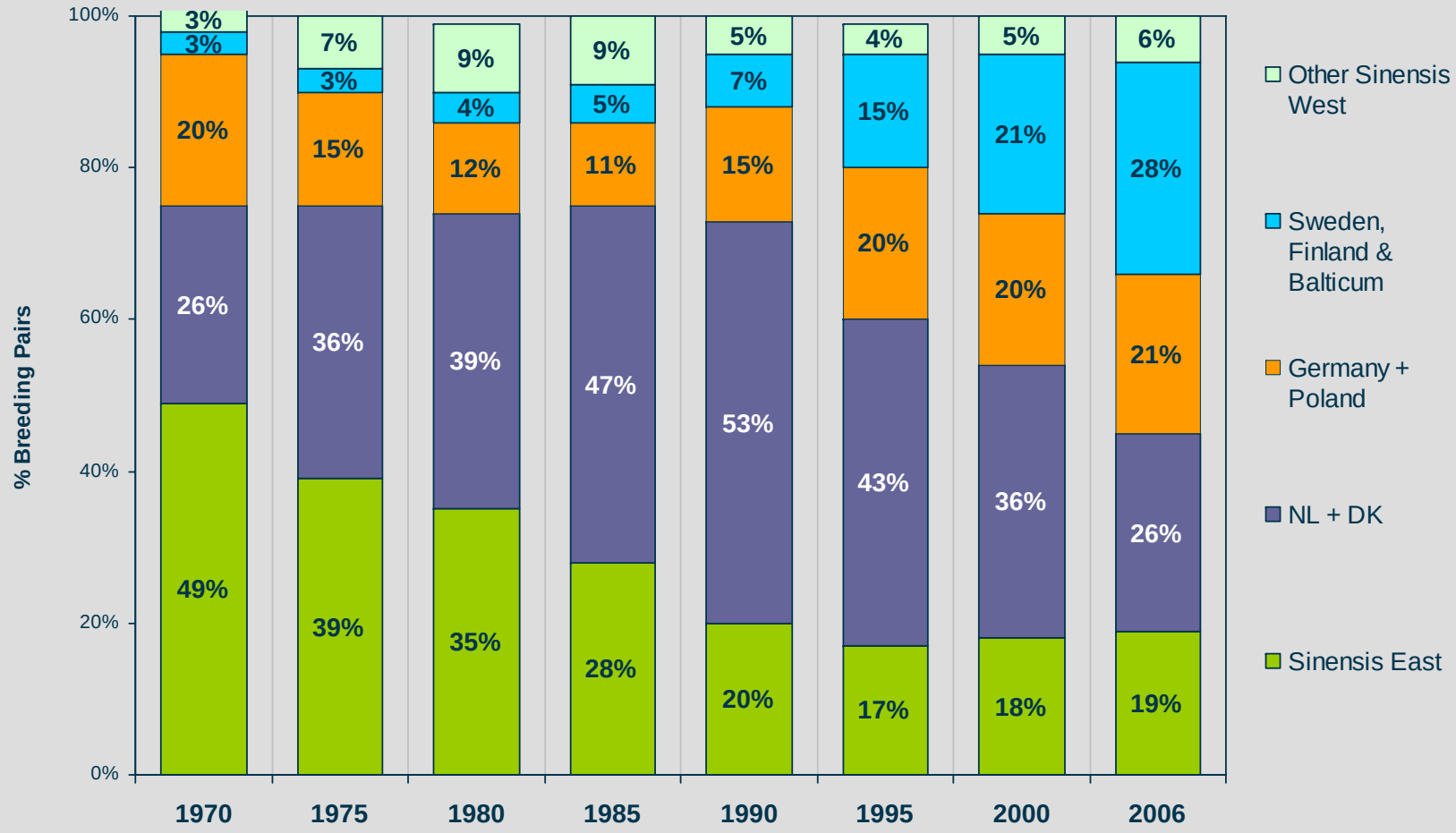


B4-1. Overview Sinensis Total: Breeding Pairs 1970-2006



B4-2. Relative importance of regional sub-populations (Sinensis Total)

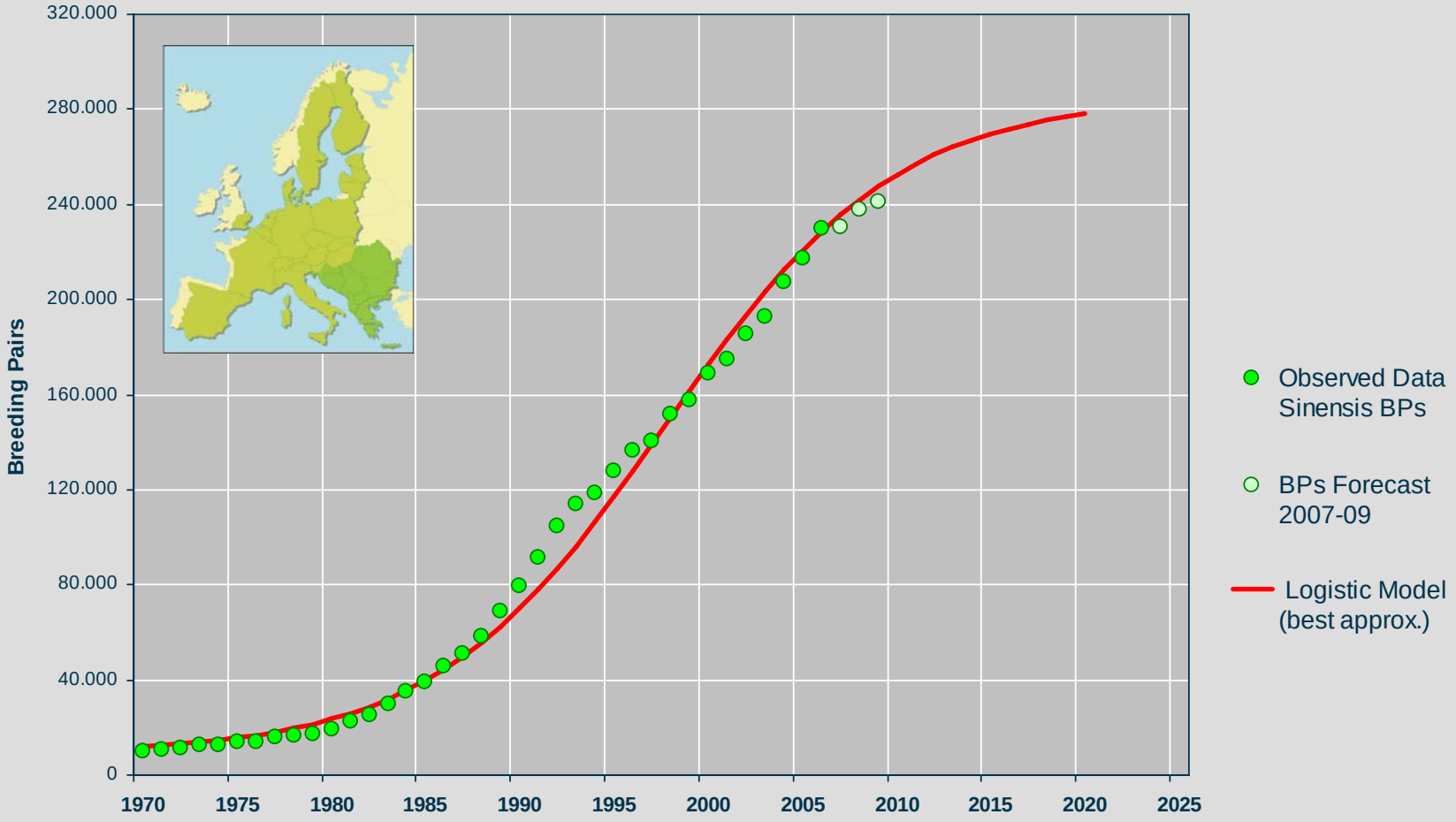
Basis: Breeding Pairs Sinensis-Cormorants = 100 %



Marked shift from the Eastern subpopulation to the West. Within the Western subpopulation NL and DK clearly dominated between 1985-95; since then the Baltic Sea region rapidly took first place

B5-1. Development Sinensis Breeding Population: Logistic Growth Model

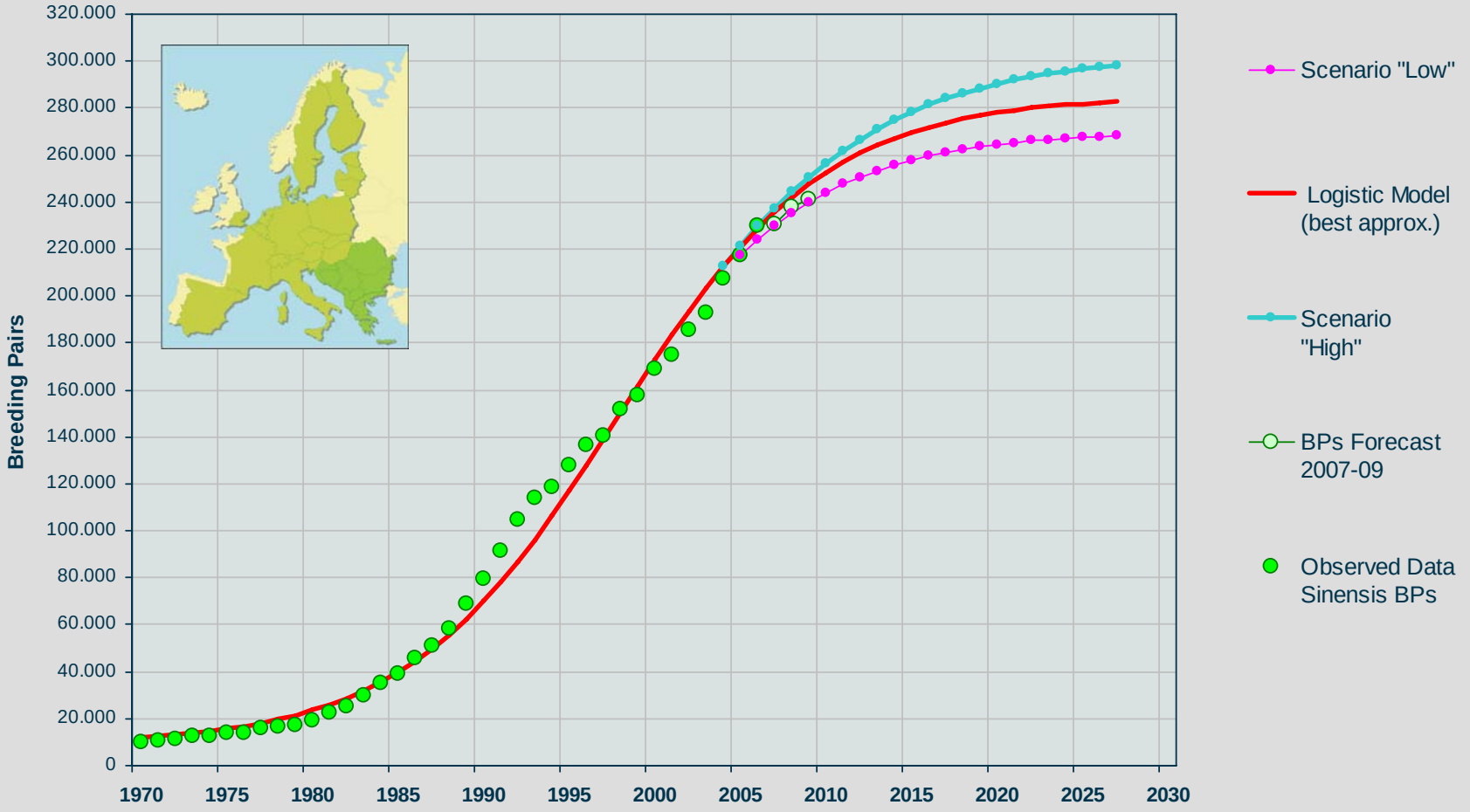
Basis: Sum Sinensis in Core Europe (excl. Russia, Belarus, Ukraine, Moldova), Breeding Pairs



Logistic Function ⇨⇨ BP in year t = a + (b-a)/(1+Exp(-(t-c)/d))
"Best Approximation" with a=9.210, b=285.000, c=28,7, d=6,1

B5-2. Logistic Model Breeding Population Sinensis: Scenarios high - low

Basis: Sinensis Total (West + East) in Core Europe Assumption: No serious population management measures



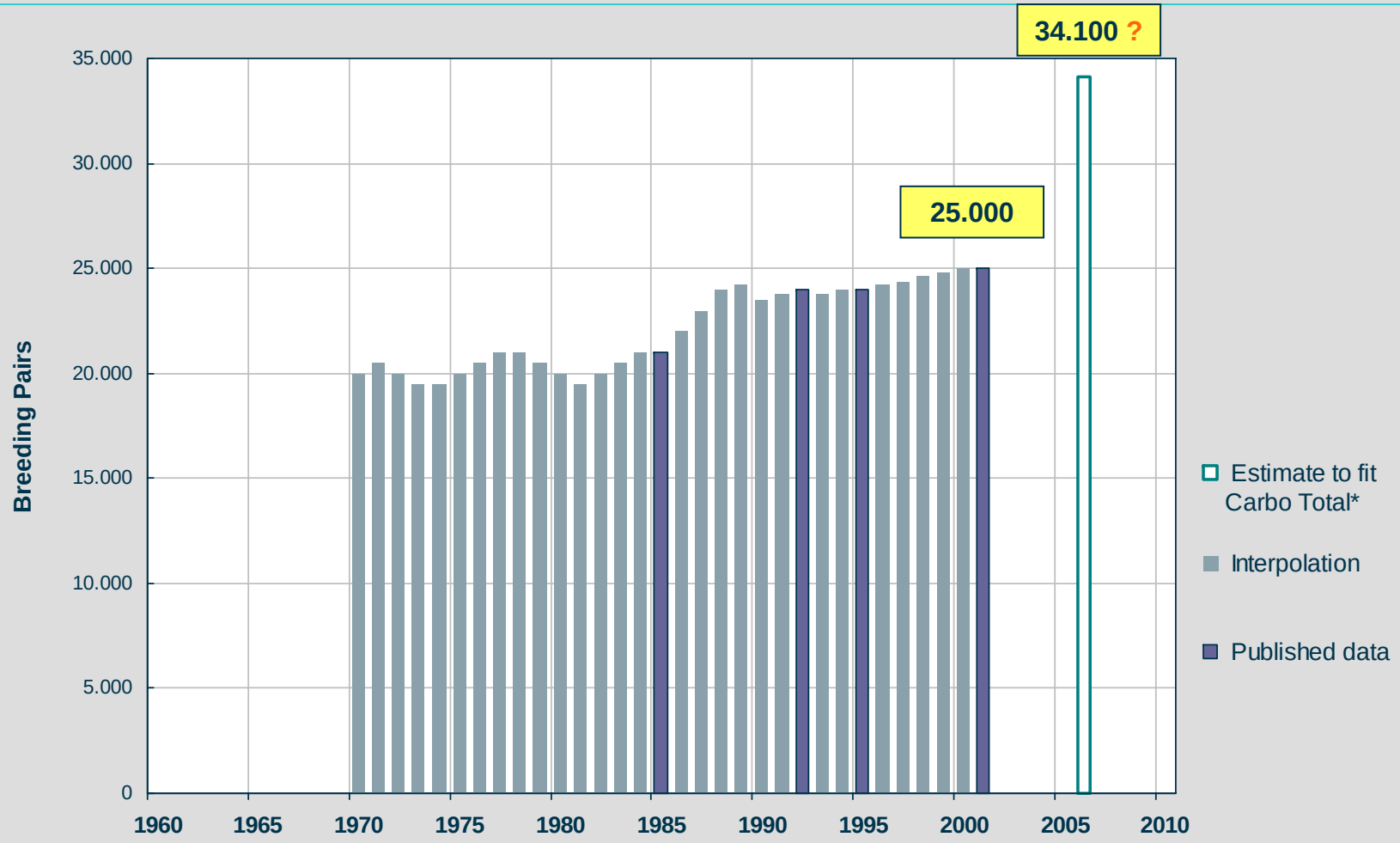
Logistic Function ⇨⇨ BP in year t = a + (b-a)/(1+Exp(-(t-c)/d))
"Best Approximation" with a=9.210, b=285.000, c=28,7, d=6,1

Charts B6. Development of Carbo carbo ("atlantic race")

- The european breeding range of the Carbo-subspecies includes Iceland*, Norway, Ireland, the largest part of UK, the western coast France and - since recently - a small colony on the atlantic coast of Spain. For 2008 also a first breeding is reported from Portugal, but no info on size and recent development could be found.
- While counting data for the Sinensis-subspecies is often available year by year, nationwide countings for the Carbo-cormorant are less frequent. In UK there is a regular Seabird Monitoring Program, which investigates population trends on basis of a sample of colonies, while in Norway counting apparently is done only in irregular intervals.
- Nevertheless, between 1970 and 2000 the numbers can be regarded as sufficiently reliable because the Carbo-population stayed quite stable in this period.
- Since 2000, however, figures show a marked increase from ca. 42.000 pairs (BirdLife Factsheet) to ca. 52.000 in the 2006-census of Wetlands International.
- As Wetlands International only published the overall sum, and no national figures, it is not transparent which country is responsible for this growth. However, as publications for UK and Ireland showed fairly stable figures, most of the increase was allocated to Norway. (*We hope this can be clarified in near future*.)

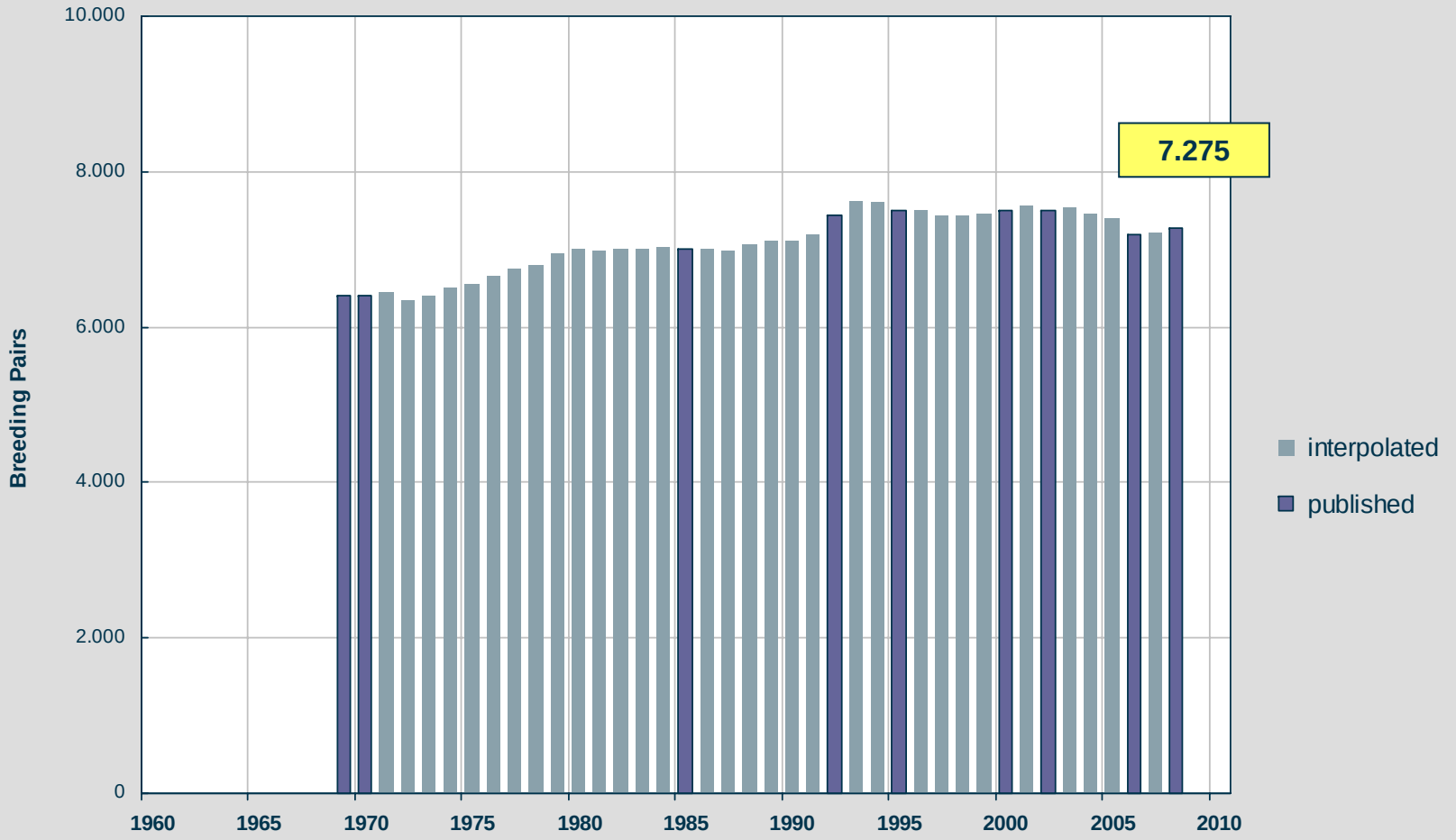
Additional Remarks: There are also some breeding pairs on the Faroe islands, fragmentary records mention about 10 pairs. The number is insignificant, however, they were included in the "total sum" for completeness sake. In England, France and Spain there are also Sinensis-colonies, some of them also mixed with Carbo. Clear distinction is difficult, where separate figures are lacking (as in Spain), numbers were allocated proportionally

Cormorant Breeding Pairs - NORWAY

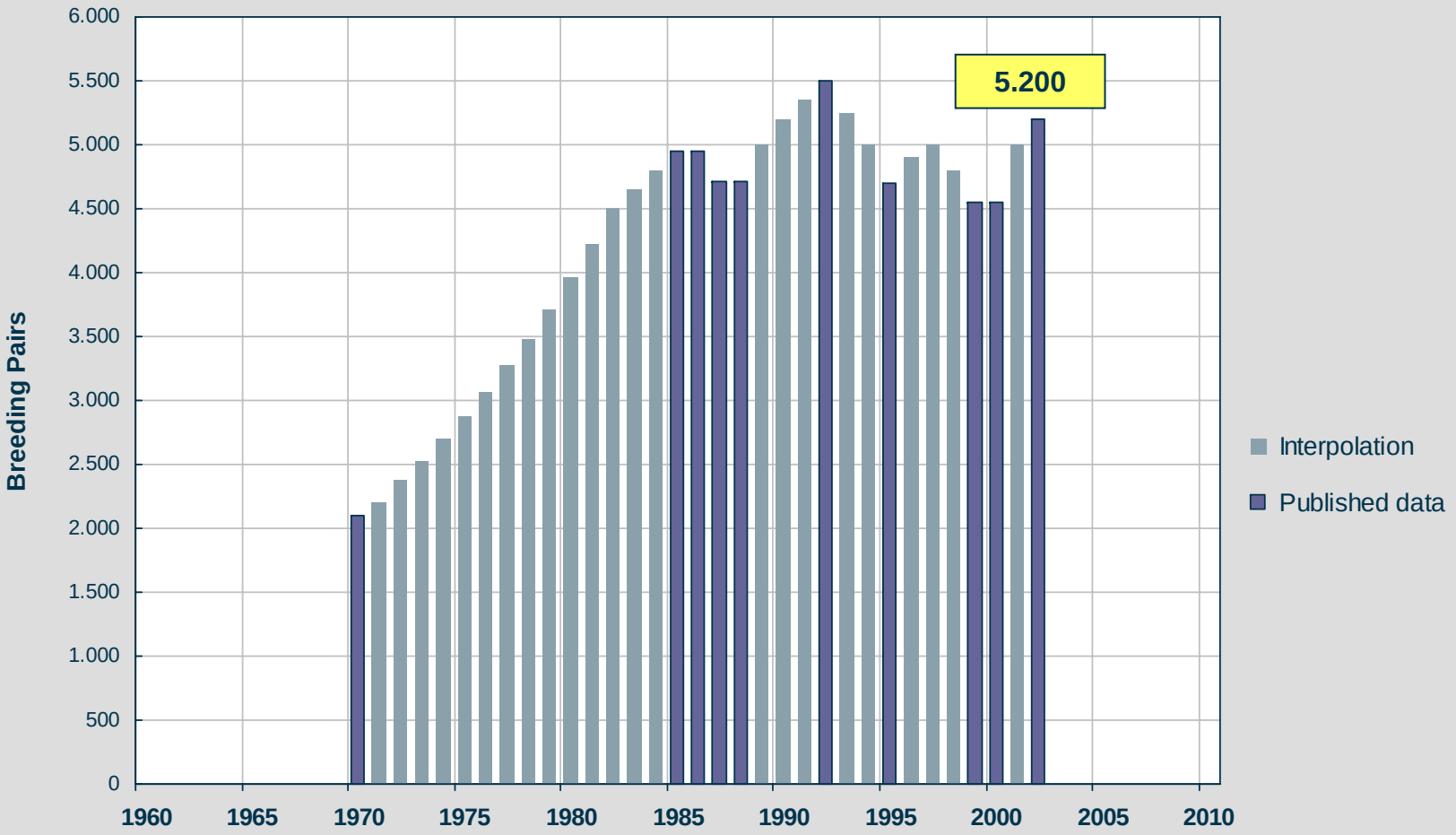


*) According to Wetlands International total number of Carbo was ca. 52.000 Breeding Pairs, about 10.000 more than in year 2000 (BirdLife Factsheet). As Ireland and UK were recorded to be "stable", most of this growth was estimated to have occurred in Norway. As data for Norway are there (just not published) this should be clarified in near future.

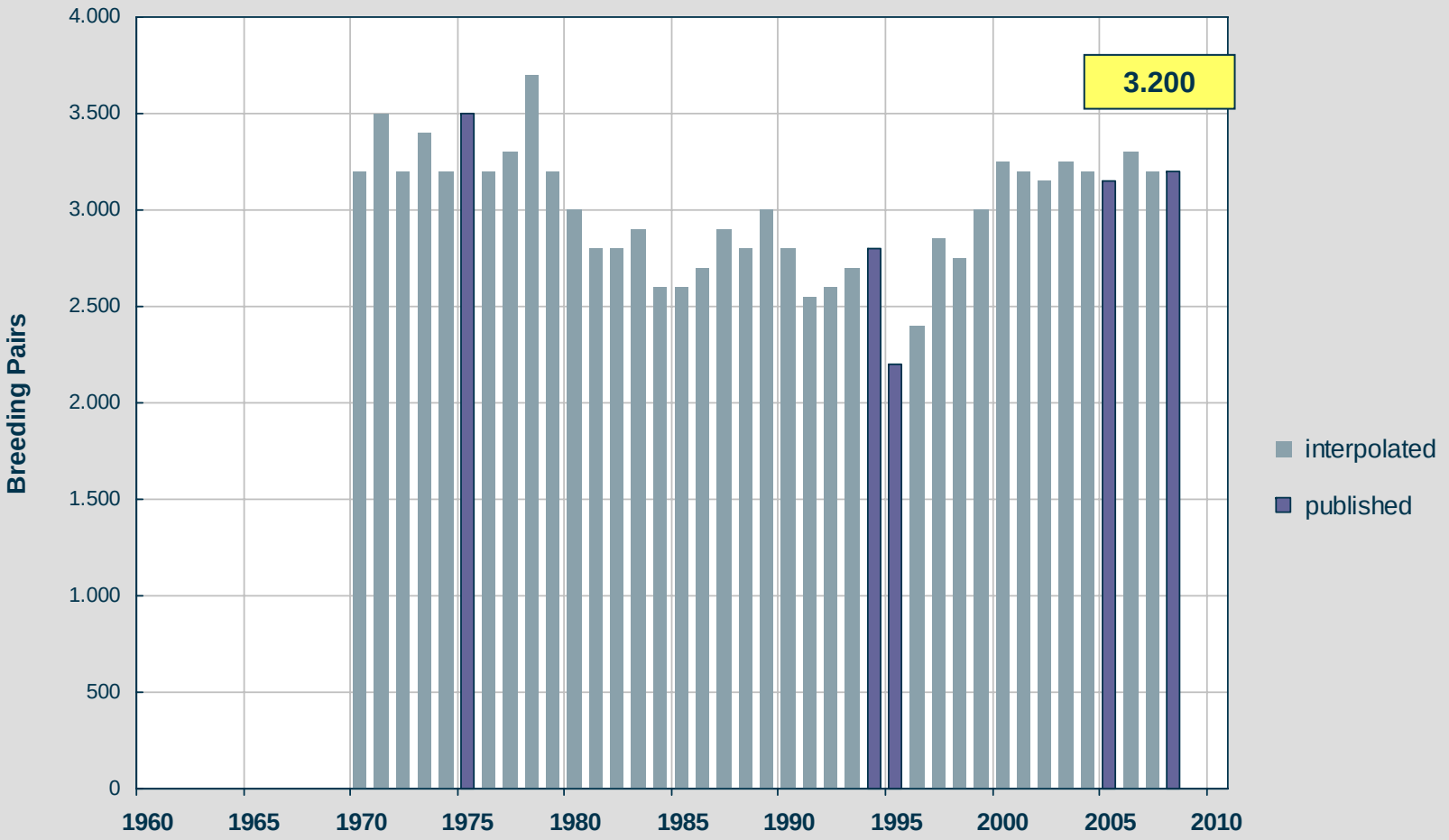
Cormorant Breeding Pairs - UK carbo



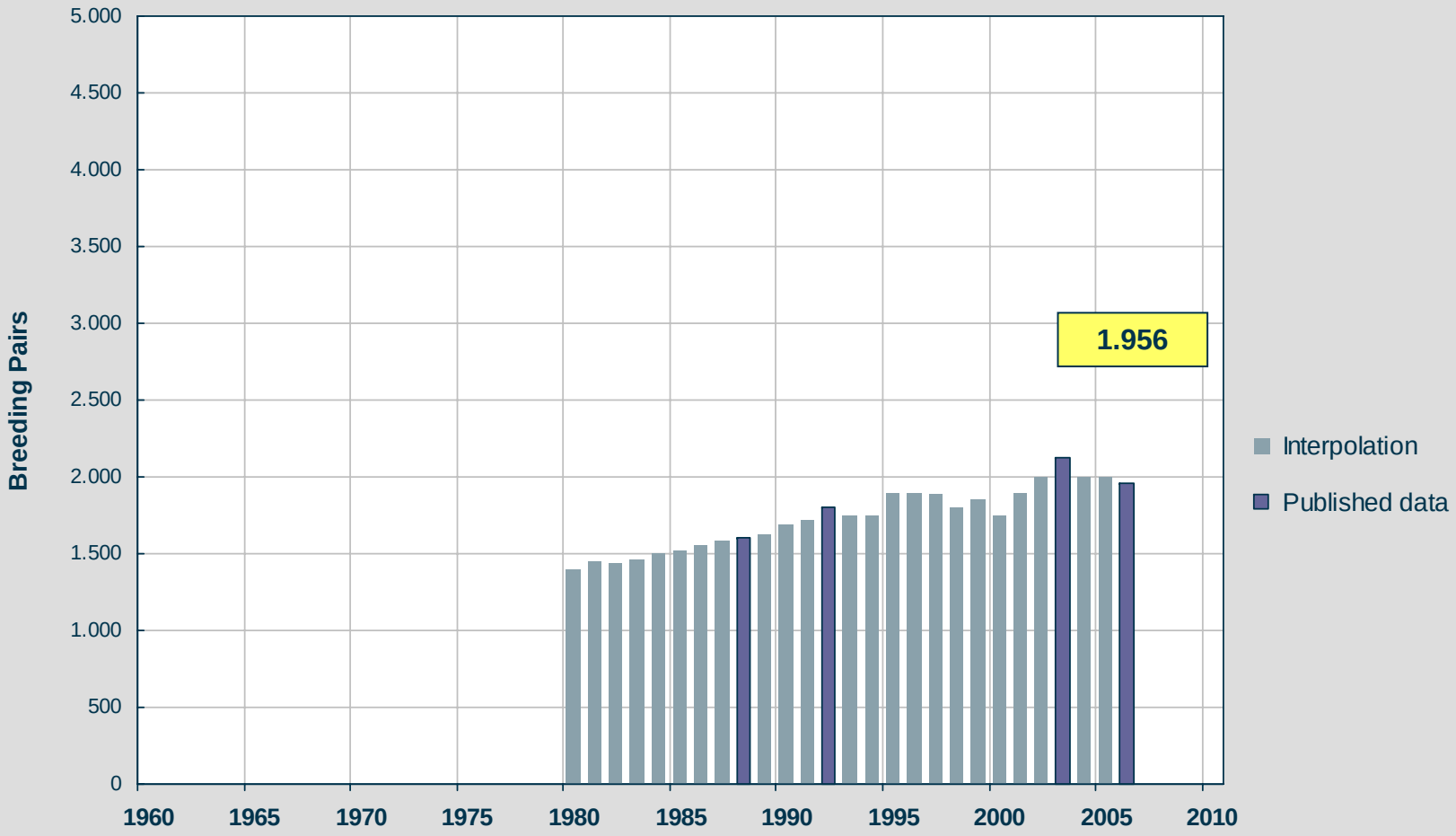
Cormorant Breeding Pairs - IRELAND



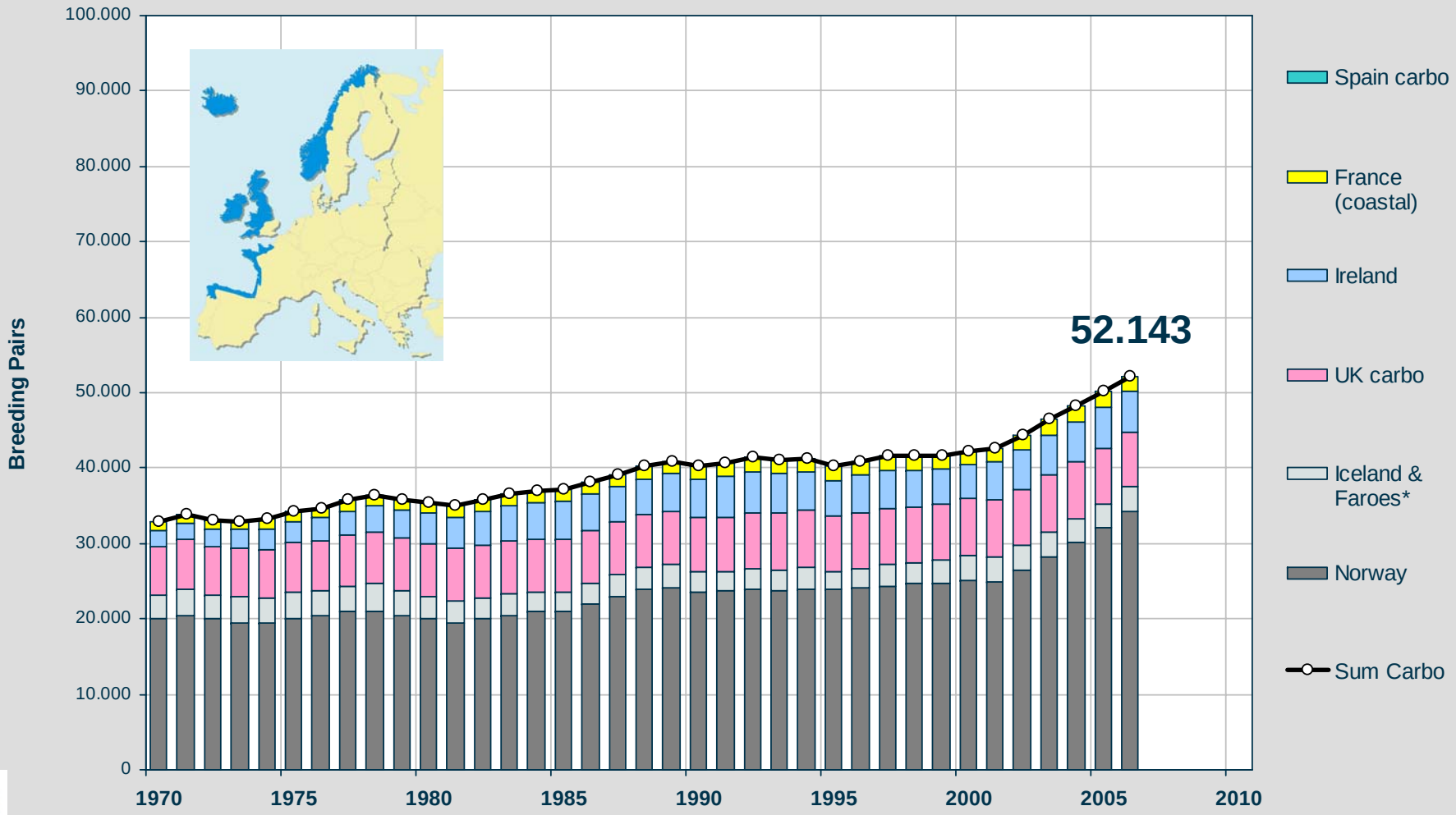
Cormorant Breeding Pairs - ICELAND



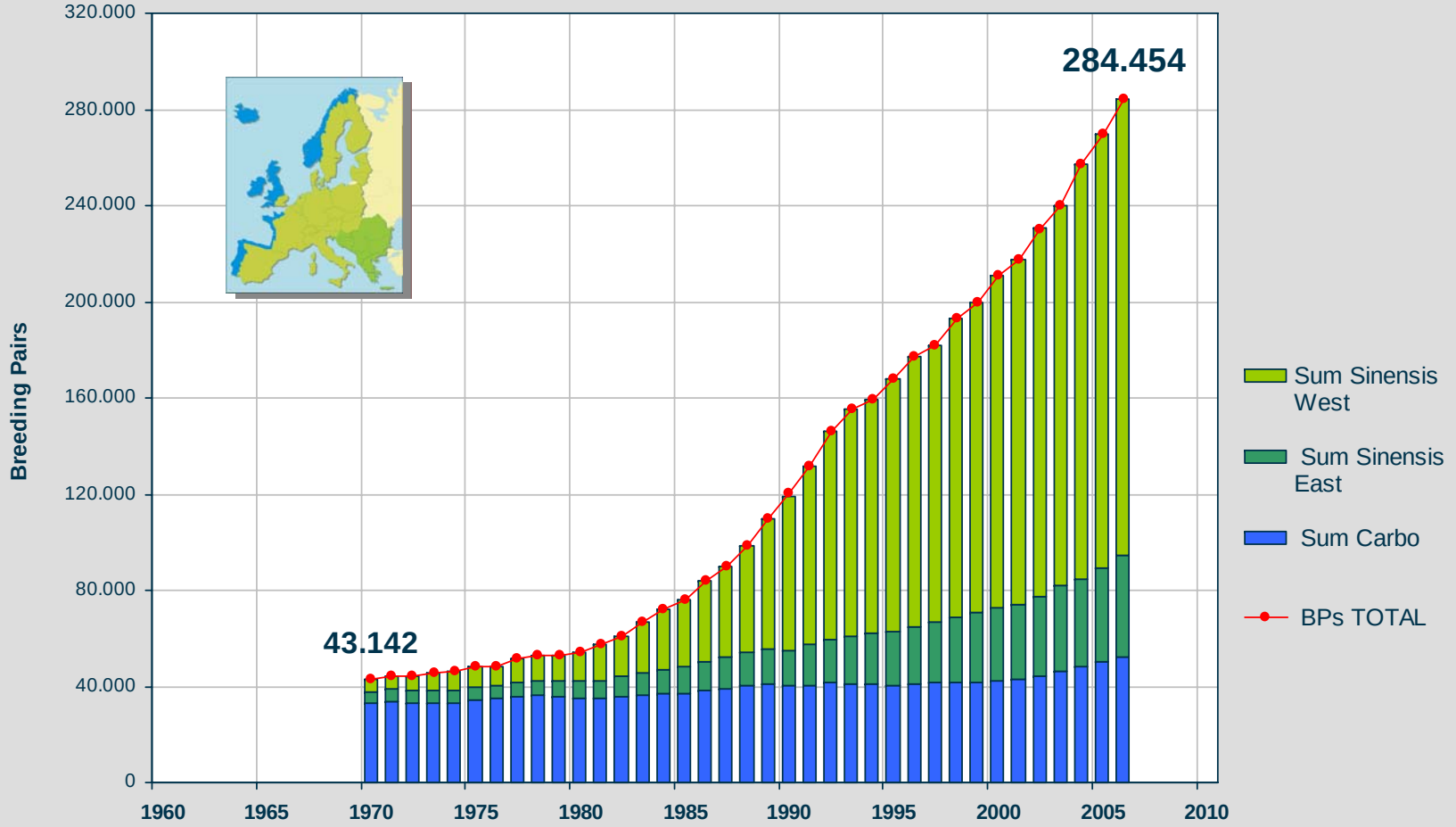
Cormorant Breeding Pairs - FRANCE coastal (carbo)*



B6-1. Breeding Pairs 1970-2006 - Carbo Total



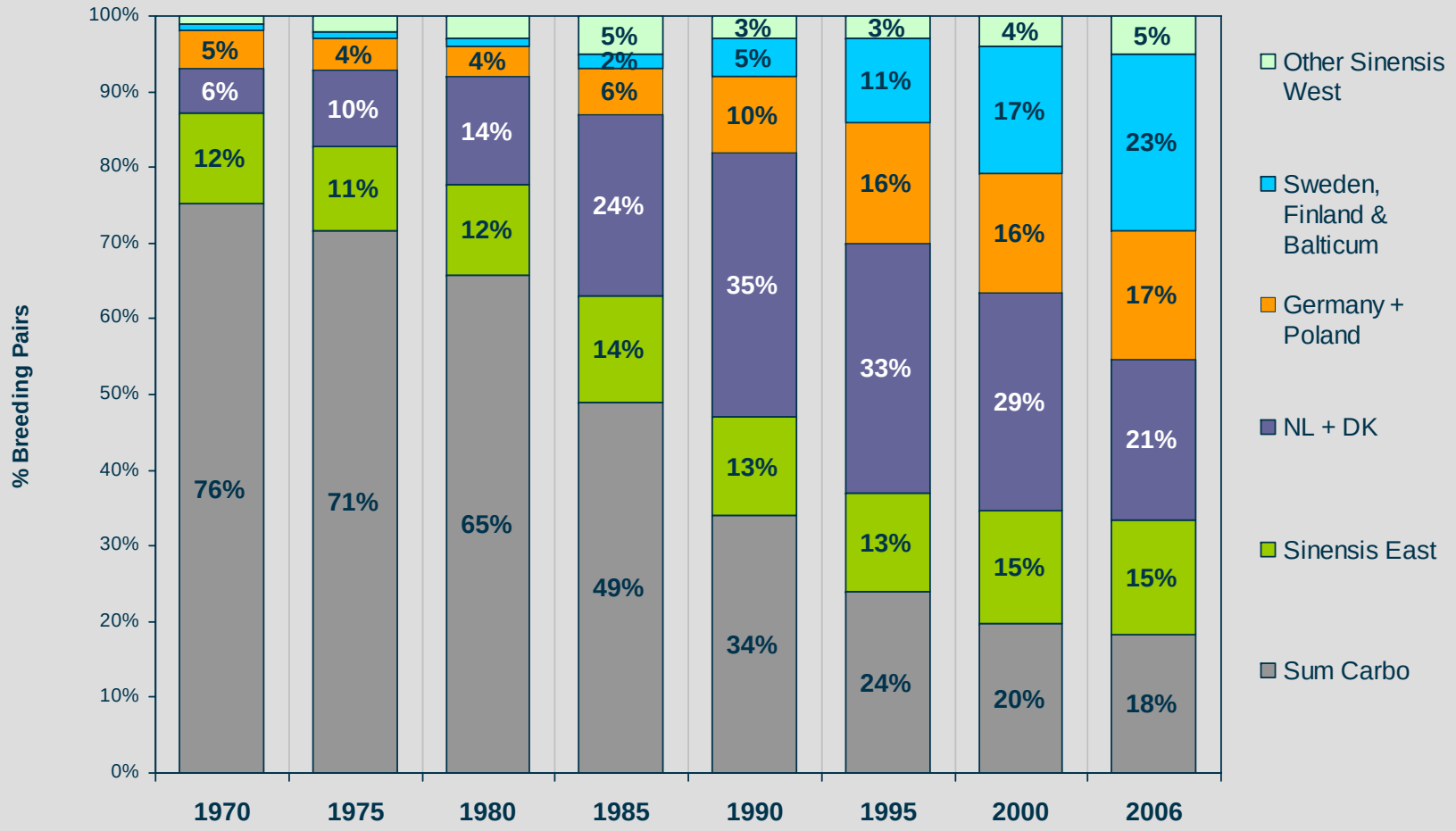
B7: Breeding Population Trends : Carbo + Sinensis East + Sinensis West



Within 35 years the cormorant breeding population in Core Europe increased from 43.000 to almost 285.000 pairs. This growth comes mainly from the western subpopulation of the Sinensis. In 1970 three quarters of all cormorants were of the Carbo-subspecies ("atlantic race"), now it is only 19%.

B7-1: Breeding Pairs - Relative importance of regional sub-populations

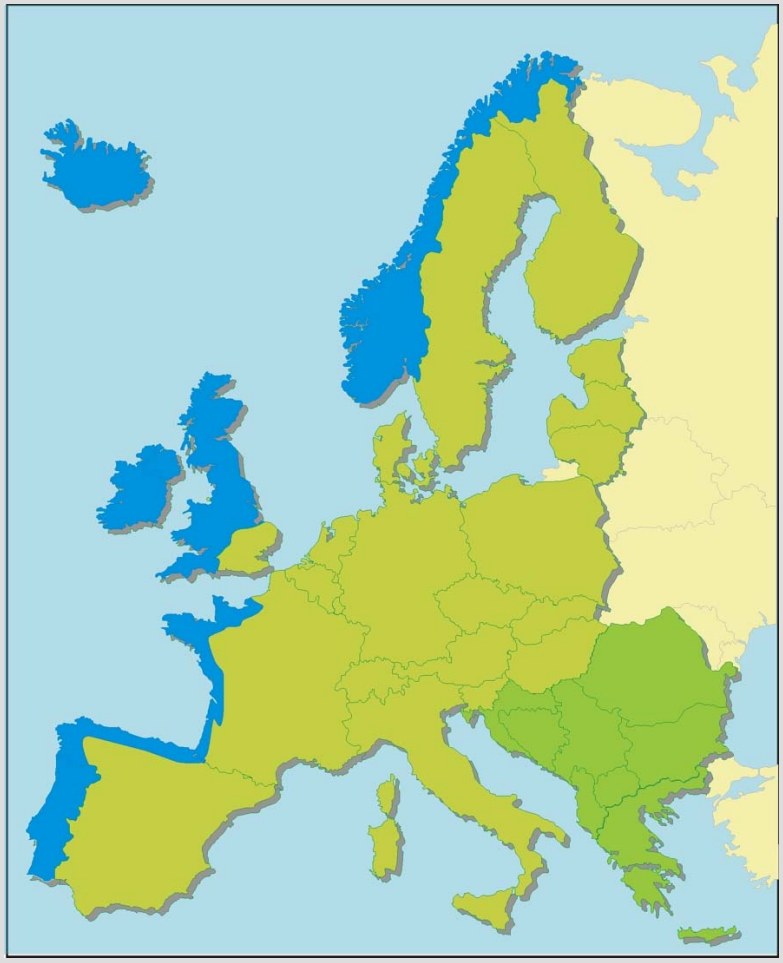
Basis: Cormorants Total (carbo + sinensis) = 100 %

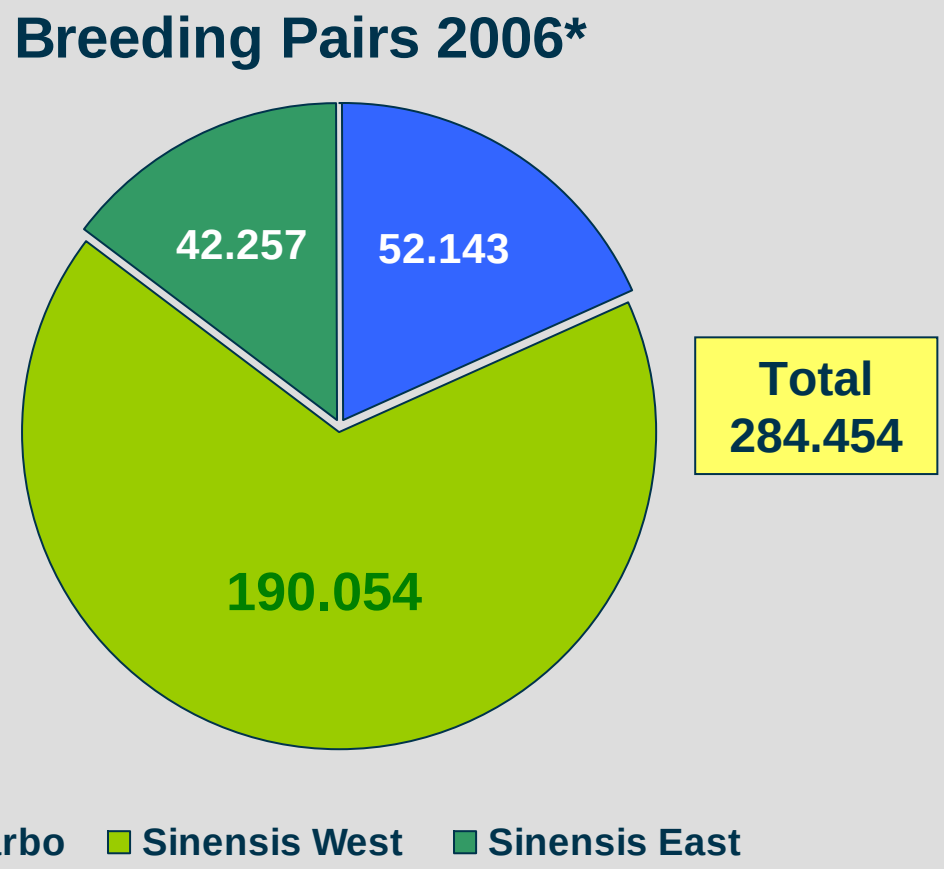


In 1970 three quarters of all cormorants were of the Carbo-subspecies ("atlantic race"), now their share dropped to 19%. Most important strongholds now are the countries/regions around or near the Baltic Sea. Breeding colonies are present also in almost all countries, however, relative importance of inland colonies is low.

B7-2. Breeding Pairs: Carbo vs Sinensis West vs Sinensis East - Status 2006

Basis: Core Europe - excluding Russia, Belarus, Ukraine & Moldova





*) Totals according Wetlands International CRG, pan-European Breeding Population Census 2006

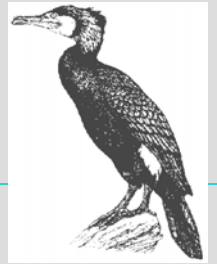
Part C: Estimate of Total Cormorant Population

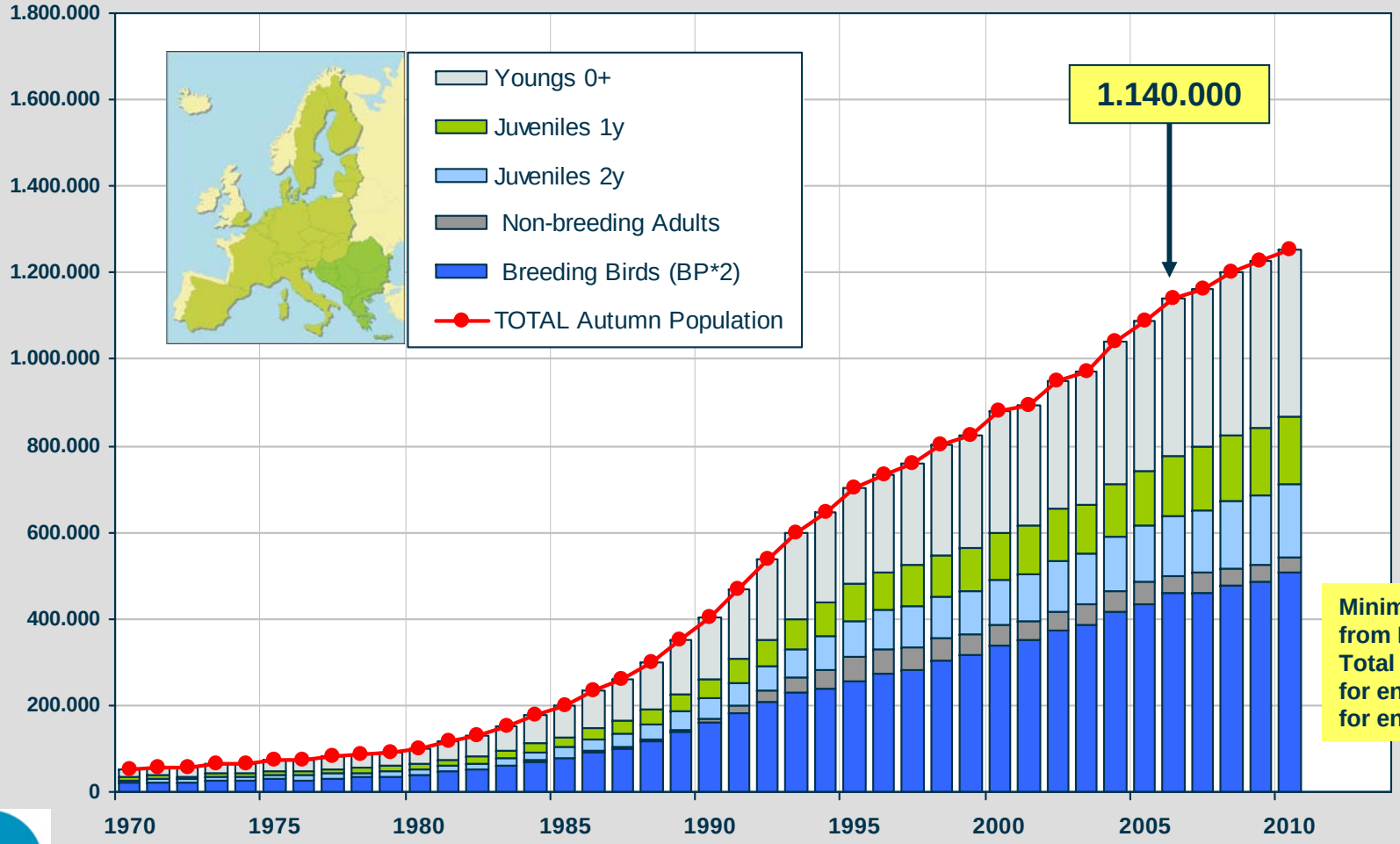
- Cormorants start breeding with 3 - 5 years, so breeding pairs represent only a part the total population
- A direct count of the non-breeding birds is not feasible. However, if the development of Breeding Pairs is known (% of increase/decrease) then the size of the non-breeding population can be estimated by using observed mortality- and fertility rates.
  - in case of stable number of breeding pairs the number of first-time breeders must be equal the mortality of last year's breeders
  - and in case of an increasing breeding population the number of first time breeders must be adequately more (*to balance the mortality of adult birds + to make up for the increase*)
- Consequently, the percentage of non-breeding juveniles will be relatively higher when the population grows and relatively lower in case of stable or shrinking populations.
- The following estimates are based on a calculation model with the following simplified assumptions:
  - cormorants start breeding with 3 years, almost all (> 95%) adults do effectively breed
  - constant mortality rates: 1st winter 40%, 2nd and 3rd winter 30%, after 3rd year 20%.
  - average fertility may vary in a range between 1,5 - 1,9 fledged youngs per nest
- With this parameter values the model delivered a good fit with the development of breeding pairs
- Under these assumptions the total population (carbo + sinensis) per summer 2006 was estimated at ca. 1.425.000 cormorants in core Europe, a tentative forecast for summer 2010 would be 1.550.000.
- However, it must be reminded that number of non-breeders and consequently the total population could be significantly differ if there is a higher number of adult non-breeders.

EAA European Anglers Alliance

C1. Development of Sinensis-Cormorants in Europe 1970 - 2009

Total Sinensis-Population - Estimate F. Kohl (ÖKF/EAA)*

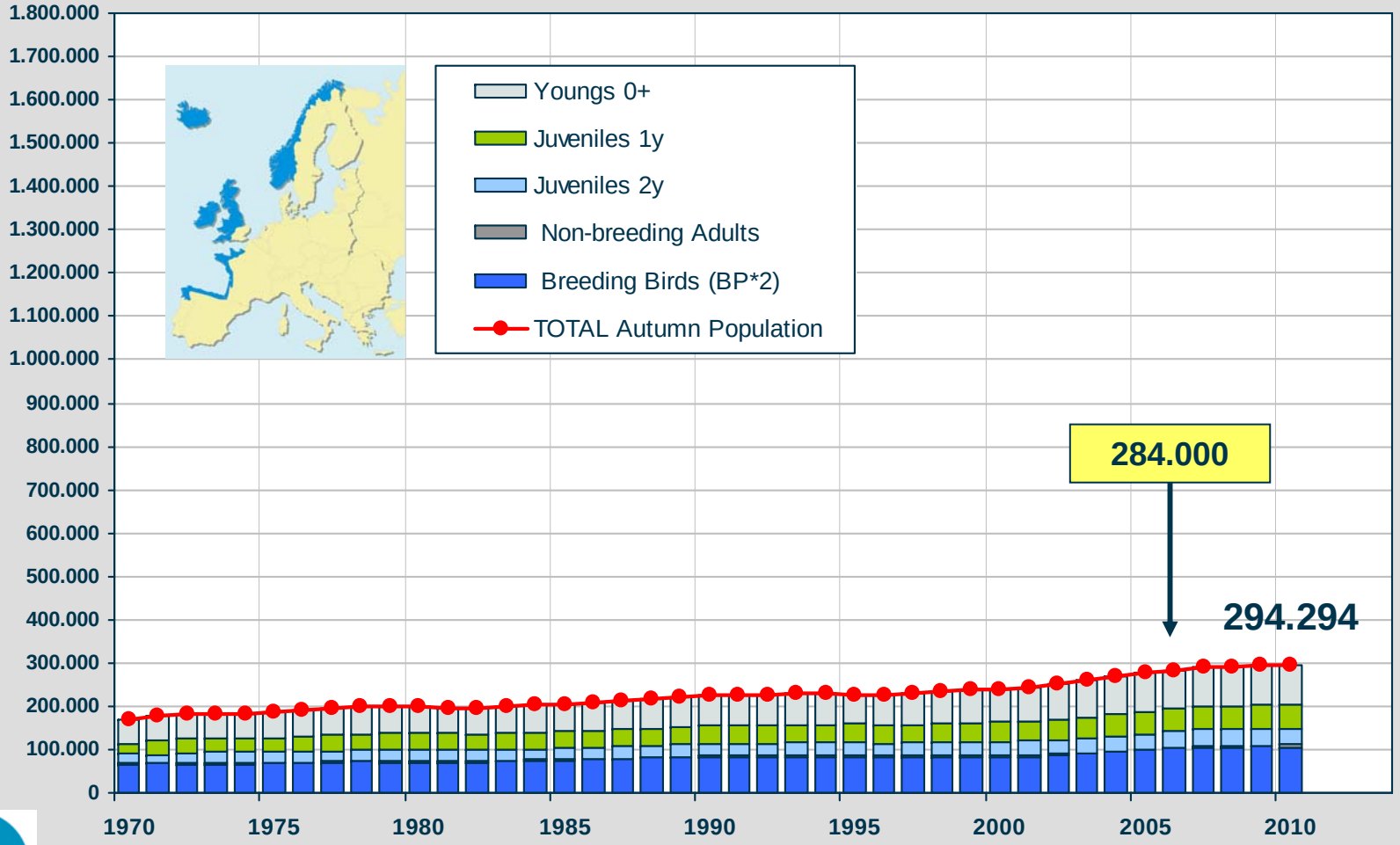




*) Estimates based on following simplified assumptions: Cormorants start breeding with 3 years, average fertility and mortality rates as suggested by Wetlands International CRG (mortality 40% in first winter, 30% from first to second, 30% from second to third year).

C2. Development Carbo-Cormorants in Core Europe 1970 - 2010

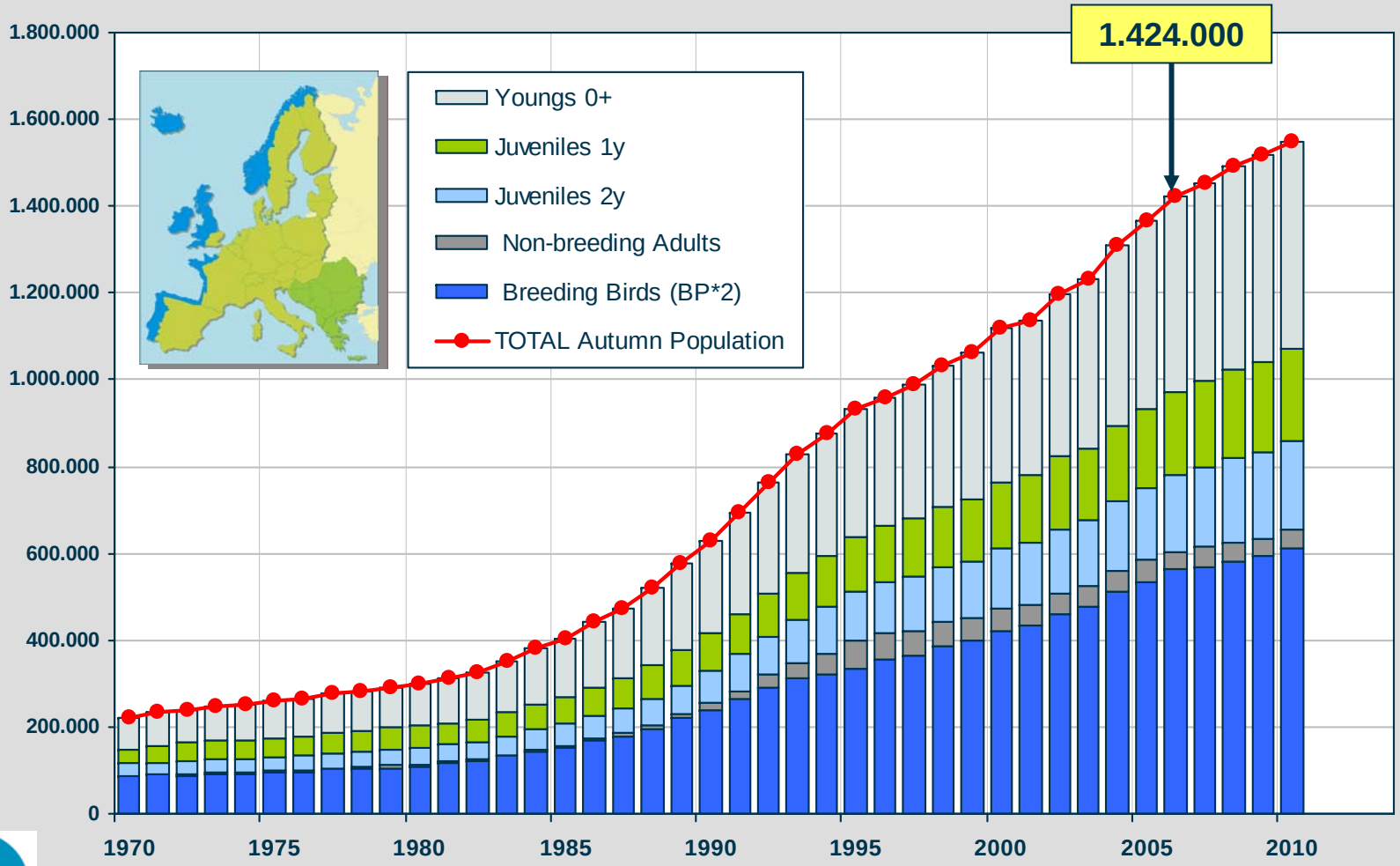
Total Carbo Population - Estimate F. Kohl (ÖKF/EAA)*



*) Estimates based on following simplified assumptions: Cormorants start breeding with 3 years, average fertility and mortality rates as suggested by Wetlands International CRG (mortality 40% in first winter, 30% from first to second, 30% from second to third year).

C3. Development Cormorants (Carbo + Sinensis) in Core Europe

Total Cormorant Population - Estimate F. Kohl (ÖKF/EAA)*



*) Estimates based on following simplified assumptions: Cormorants start breeding with 3 years, average fertility and mortality rates as suggested by Wetlands International CRG (mortality 40% in first winter, 30% from first to second, 30% from second to third year).

Part D: Cormorants in Russia, Belarus, Ukraine & Moldova

- In this east-eastern part of Europe there are few regular counts of cormorant breeding population. However, for completeness sake we should try to assess the probable range.
- BirdLife Fact Sheet shows the following figures for the years around 2000

Breeding Pairs around year 2000

Country	**Period**	Min	Max	**Average**	**Trend**	*Estimate 2006*
Ukraine	1990-2000	65.000	75.000	**70.000**	increasing	*>. 100.000*
Russia	1990-2000	35.000	60.000	**48.000**	stable	*55. - 60.000*
Belarus	1997-2000	1.300	1.500	**1.400**	increasing	*ca. 2.000*
Moldova	1990-2000	300	500	**400**	stable	*ca. 500*
Sum East-East		101.600	137.000	**119.800**		*160. - 170.000*

- For Ukraine the increasing trend meanwhile is confirmed: Nemtzov (2008) reports an estimated 100.000 breeding pairs, with further expansion into inland waters.
- Increasing numbers are also reported in western regions of Russia: Gaginskaya (2010) reports that in Gulf of Finland there were only a few nests in 1995, now there are 5.000. Also new inland colonies were founded in Karelia region.
- On basis of these indications it can be concluded: A plus of minimum 30.000 pairs in Ukraine is confirmed, in Russia plus 10.000 seems plausible. Adding this to the (cautious) 120.000 which are reported by BirdLife for 2000 one can estimate a minimum of **160. - 170.000 breeding pairs** per 2006

Part E: Total Cormorant Population incl. East-East Europe 2006

Basis: Whole Europe - including Russia, Belarus, Ukraine & Moldova

- Adding the east-eastern numbers to the population and applying a medium expansion factor from Breeding Pairs to total population the following estimates are possible.

Cormorant Population Europe 2006	Breeding Pairs	Expansion Factor	Individuals (Summer)
Sum Core Europe	**284.454**	5,0	**1.424.000**
Sinensis East-East	**165.000**	5,2	**858.000**
Sum Cormorants Total Europe	**449.454**		**2.282.000**

- Looking at European continent, in 2006 there were about 450.000 breeding pairs of the Great Cormorant. The total population (breeders + non-breeders) per summer 2006 amounted to about 2,2 - 2,3 million individual birds.

Appendix I: Sources for Maps of Cormorant Colonies Europe (1)

THREE CATEGORIES OF SOURCES

1."Multi-national" Publications: which provide an overview of many European countries. Concretely these are the ARDEA-special issue from 1995 (which is very good for all covered countries) and the REDCAFE Country Reports from 2005 (*where information comprehensiveness may differ per country*).
2.National Publications: Sources which provide colony-information for one country (which where used either as a substitute for countries for which there was no sufficient information in 'multi-national' publications or as a source for additional detail).
3.Site-specific, regional/local sources: Typically, information for one specific cormorant colony (e. g. in national parks, or near fish farms etc - often yielding more up-to-date info on colony size).

MULTI-NATIONAL

Van Eerden, M. R., K. Koffijberg & M. Platteeuw (eds.), 1995. Riding on the Crest of the Wave. Ardea 83(1), (Debout, G., N. Røv, & R. M. Sellers for Ph. carbo carbo, Van Eerden, M. R. & J. Gregersen for Ph. carbo sinensis in western flyway, Lindell, L. and P. Mellin, J. Musil, & H. Zimmermann. 1995 for Ph. carbo sinensis in eastern flyway)
Carss, D. N. & M. Marzano (eds.) 2005. REDCAFE Summary & National Overviews (various country reports by national experts, not in all countries information about colony locations).

NATIONAL & LOCAL

UNITED KINGDOM & IRELAND

Seabird 2000, Census UK, Numbers of breeding Great Cormorants (AON) in Britain and Ireland 1969–2002, http://www.jncc.gov.uk/PDF
Seabird 2006, Census UK, ed. Mavor, R.A., Heubeck., M. Schmitt, S. and Parsons,. M, Seabird numbers and breeding success, 2006 (2008). http://www.jncc.gov.uk/page-4363
Hughes B, J. Bruce, G. R. Ekins and S. Newson (2000), Movements and distribution of inland breeding Cormorants in England. English Nature Research Report No 360
Carss, DN; & Ekins, GR (2002): Further European integration: Mixed sub-species colonies of Great Cormorants Phalacrocorax carbo in Britain. Ardea Vol. 90, no. 1, pp. 23-41. Abstract.

NORWAY

Rov, Niels.2006. Cormorant Breeding Colonies (Norsk Fugle Atlas – Storskarv). www.birdlife.no/fuglekunnskap/fugleatlas/pdf/storskarv.pdf.

Appendix I: Sources for Maps of Cormorant Colonies Europe (2)

SWEDEN
Engström, Henri (2001) Effects of Great Cormorant Predation on Fish Populations and Fishery, Uppsala Dissertations
FINLAND
Lehikoinen, Aleksi (2006), Cormorants in the Finnish archipelago, Ornis Fennica 83:34–46. 2006
Finnish Environment Institute (2004). Rapid growth of cormorant breeding population. http://www.ymparisto.fi.
Finnish Environment Institute (2006), Cormorant populations still growing in the Archipelago Sea and the Gulf of Bothnia, www.environment.fi.
Finnish Museum of Natural History (2006). Bird Atlas Merimetso (=Cormorant) 1974 - 2006. http://www.hatikka.fi/birdatlas_public_result.
Finnish Environment Institute (2007). Cormorant Population and Breeding Colonies http://www.ymparisto.fi/default.asp?contentid=244630&lan=en.
Finnish Environment Institute (2007). Cormorant population grew by more than fifty percent, http://www.ymparisto.fi/default.asp?contentid=244630&lan=en.
Finnish Environment Institute (2010). Press release. Numbers of breeding cormorants declined due to harsch winter conditions http://www.ymparisto.fi/default.asp?contentid=364476&lan=en.
RUSSIA White Sea (Ph. carbo carbo)
Bianki, V; Boiko, N. & Kokhanov, V (1997) The cormorant Phalacrocorax carbo in Kandalaksha Bay (White Sea, Russia) in: Ekologia Polska Vol. 45, no. 1, p. 15. 1997. Abstract
Lehikoinen, Aleksi & Alexander V. Kondratyev, Timo Asanti, Esko Gustafsson, Olli Lamminsalo, Nikolay V. Lapshin, Jorma Pessa and Pekka Rusanen (2005). Survey of arctic bird migration and staging areas at the White Sea, in the autumns of 1999 and 2004. http://www.ymparisto.fi/download.asp?contentid=56350&lan=fi.
SPAIN
Onrubia, A., (1999) Cormoran Grande Phalacrocorax carbo carbo: Breeding at Reservoir Ullibarri-Gamboa. Noticiario Ornitologico www.ardeola.org/files/ardeola_499.pdf.
Lekuona, Jesús M. 2002. Ecologia Trófica Del Cormoran Grande Phalacrocorax Carbo Sinensis Durante La Época Reproductora En Una Zona De Reciente Colonización (Valle Del Ebro), in: Ardeola 49(2), 2002, 241-247.
De la Cruz. M. A. (2004). Most important Spanish Cormorant colony Embalse de Rosarito. Noticiario Ornitologico www.ardeola.org/files/Ardeola_51(2)_543-557.pdf.

Appendix I: Sources for Maps of Cormorant Colonies Europe (3)

LITHUANIIA
Jusys, V. (1997). The cormorant Phalacrocorax carbo in western Lithuania
Ekologia Polska Vol. 45, no. 1, pp. 69-70. Abstract.
Zydelis, R., et al. 2002, Expansion of the Cormorant (Phalacrocorax Carbo Sinensis) population in Western Lithuania, Acta Zoologica Lituanica, 2002, Volumen 12, Numerus 3.

POLAND
Gmitrzuk K. 2004. Influence of cormorant *Phalacrocorax carbo* on water and forest ecosystems of Wigierski National Park, http://www.wigry.win.pl/kormorany.htm.
Pajkert, Z; & Gorski, W (1997) Breeding ecology of cormorants Phalacrocorax carbo sinensis in Slowinski National Park (northern Poland). Ekologia Polska Vol. 45, no. 1, pp. 181-183. Abstract.
Poluda, AM; Chernichko, II; Serebryakov, VV; Siokhin, VD; Korzyukov, AI; Zhmud, ME; Koshelev, AI; Shchegolev, I; Belashkov, ID (1997) The cormorant Phalacrocorax carbo in Ukraine Ekologia Polska Vol. 45, no. 1, pp. 105-110. 1997. Abstract.
Przybysz, J; Mellin, M; Mirowska-Ibron, I; Przybysz, A; Gromadzka, J. 1997.Recent development of the cormorant Phalacrocorax carbo sinensis population in Poland.
Ekologia Polska Vol. 45, no. 1, pp. 111-115. Abstract.

GERMANY, MECKLENBURG
Müller Siegmar, 1999. Kormoran Phalacrocorax carbo: Brutvorkommen, Ornithologische Arbeitsgemeinschaft Mecklenburg-Vorpommern, Jahresbericht 1999

DENMARK
Bregnballe, Thomas & Jörn Eskildsen (2008). Danmarks ynglebestand af skarver i 2007 (Breeding Population of Cormorants). http://www.dmu.dk – NyhedsbrevVIBI.

NETHERLANDS
Meininger, Peter L. & Rob C.W. Strucker (2001), Kustbroedvogels in het Deltagebied in 2001, NL, Directoraat Generaal Rijkswaterstaat
SOVON Vogelonderzoek Nederland (2008). Aalscholver: Verspreiding en aantalsontwikkeling. Published http://www.sovon.nl/soorten.asp?euring=720, (last retrieved 2010-03-29

Appendix I: Sources for Maps of Cormorant Colonies Europe (4)

BELGIUM
Jacob, J. P. et al. (1999) Le cormorans en Wallonie (Belgique, map of breeding colonies). http://mrw.wallonie.be/dgrne/sibw/organisations/OFFH/progISB/oiseaux/cormoran.html.
Coussement M. (2004) De impact van aalscholvers op visbestanden in private wateren in Vlaanderen, Milieucel V.V.H.V.

FRANCE
Conseil Superieur de la Peche, France / Alsace(2006), Le Grand Cormoran, Evolution de la population hivernante e de la population nicheuse de 1997 a 2005

SPAIN
Onrubia, A., (1999) Cormoran Grande Phalacrocorax carbo carbo: Breeding at Reservoir Ullibarri-Gamboa. Noticiario Ornitologico www.ardeola.org/files/ardeola_499.pdf.
Lekuona, Jesús M. 2002. Ecologia Trófica Del Cormoran Grande Phalacrocorax Carbo Sinensis Durante La Época Reproductora En Una Zona De Reciente Colonización (Valle Del Ebro), in: Ardeola 49(2), 2002, 241-247.
De la Cruz. M. A. (2004). Most important Spanish Cormorant colony Embalse de Rosarito. Noticiario Ornitologico www.ardeola.org/files/Ardeola_51(2)_543-557.pdf.

ITALY
Veronesi, Eva , Bregnballe, Thomas & Jens Gregersen (1999). Evoluzione di due grandi colonie di cormorano (Italy).
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Appendix I: Sources for Maps of Cormorant Colonies Europe (5)

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Appendix II: Sources for Breeding Population / Breeding Pairs (1)

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Appendix II: Sources for Breeding Population / Breeding Pairs (1a)

(1) BirdLife Fact Sheet

http://www.birdlife.org/datazone/species/BirdsInEuropeII/BiE2004Sp3679.pdf)

Phalacrocorax carbo
GREAT CORMORANT

Non-SPEC (1994: —) Status Secure
Criteria —
European IUCN Red List Category —
Criteria —
Global IUCN Red List Category —
Criteria —

Phalacrocorax carbo breeds patchily across much of Europe, which accounts for less than half of its global breeding range. Its European breeding population is large (>310,000 pairs), and underwent a large increase between 1970–1990. The species continued to increase during 1990–2000, with almost all national trends either stable or increasing, including those of key populations in Denmark, Ukraine and Russia. Consequently, it is evaluated as Secure.

Country	Breeding pop. size (pairs)	Year(s)	Trend	Mag.%	References
Albania	0 – 0	96–02	–	X	
Austria	0 – 33	03	+	N	
Azerbaijan	2,000 – 4,000	96–00	(0)	(0–19)	
Belarus	1,300 – 1,500	97–00	+	50–79	2
Belgium	900 – 1,000	01–02	+	>80	1
Bosnia & HG	Present	85–89	?	–	1
Bulgaria	2,000 – 2,800	95–02	+	>80	
Croatia	2,000 – 3,000	02	0	0–19	26
Czech Rep.	170 – 190	00	–	50–79	
Denmark	36,000 – 41,000	97–00	0	0–19	1
Greenland	5,000 – 5,000	95–00	+	0–19	4
Estonia	9,000 – 10,000	98	+	50–79	1
Finland	800 – 1,200	02	+	N	
France	3,350 – 3,350	00	+	50–79	1
Georgia	Present	03	?	–	
Germany	16,800 – 16,800	95–99	+	0–19	
Greece	4,300 – 4,300	02	+	20–29	
Hungary	1,800 – 3,000	95–02	+	>80	
Iceland	2,600 – 3,700	75–94	(F)	(–)	13
Rep. Ireland	4,550 – 4,550	99–02	+	0–19	
Italy	880 – 880	00	+	30–49	18
Latvia	400 – 500	90–00	+	>80	17
Lithuania	2,500 – 3,000	99–01	+	>80	20
Luxembourg	Present	02	?	–	
Macedonia	(400 – 600)	98–00	(F)	(30–49)	
Moldova	300 – 500	90–00	0	0–19	
Netherlands	18,400 – 19,500	98–00	+	10	1
Norway	20,000 – 25,000	96–01	+	0–19	35,20,63
Poland	12,500 – 12,500	00	+	200–230	2
Romania	18,000 – 20,000	99–02	+	0–19	47
Russia	35,000 – 60,000	90–00	0	0–19	8,11,120,59,60, 62,120,154,155
Serbia & MN	2,100 – 2,400	00–02	+	50–79	163,65,186,272, 230,198,231
Slovakia	50 – 250	80–99	+	50–79	
Spain	0 – 50	98–02	+	>80	10
Sweden	25,000 – 26,000	99–00	+	>80	
Switzerland	0 – 7	00–02	+	N	
Turkey	3,000 – 4,500	01	+	30–49	
Ukraine	65,000 – 75,000	90–00	+	50–79	
UK	9,100 – 9,100	99–02	+	27	20
Total (approx.) Breeding range	310,000 – 370,000 >1,000,000 km²	Overall trend Large increase Gen. length 11 % Global pop. 25–49 (See p. 38, bottom, for data quality graph)			
Winter pop. size (individuals)					
Total (approx.) % in European BAs	>420,000 41–44	Overall trend Large increase Gen. length 11 % Global pop. 25–49			

Appendix II: Sources for Breeding Population / Breeding Pairs (2)

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Appendix II: Sources for Breeding Population / Breeding Pairs (3)

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