An assessment of the importance of the Dombes region, France, for wintering wildfowl

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Abstract

Trends in the numbers of wildfowl wintering in the Dombes, France, from 1981–2006 were assessed to determine the importance of the site for these species at a national and international level. Spatial distribution patterns in relation to the size, hunting status and geographical location of the ponds were also investigated to identify some of the factors affecting the birds' use of the site. Most species showed a moderate but significant increase in numbers (<5% per year) over the study period. Tufted Duck *Aythya fuligula* decreased in numbers from the early 1980s onwards whereas Shoveler *Anas clypeata* and Coot *Fulica atra* numbers started to decline in the early 1990s. Trends for the Dombes were similar to the national trends for each species except for Shoveler and Coot, which may have been influenced by local conditions. Within the Dombes, an increase in areas without hunting was found to explain local increases in numbers for most wildfowl species, but did not explain the decline in Shoveler and Coot. A management plan for the whole of the Dombes therefore should include assessing how the fishponds can improve the food supply for the birds, as well as providing further non-hunting areas.

Key words: *Anatidae*, Coot, Dombes wetland, status of the sites, trends in numbers, wildfowl, winter.

Twenty-four wetlands have been designated by the French government as wetlands of international importance for wildfowl (*Anatidae* sp.) under the Convention on Wetlands of International Importance especially as Waterfowl Habitat (more usually known as the Ramsar Convention). These 24 current and 12 candidate Ramsar sites together cover 3,170,000 ha of wetlands in the country (Société Nationale de Protection de la Nature 2009). Other sites within France also fulfil one or more of the Ramsar criteria, including the Dombes in eastern France (46°00'05"N 5°01'46"E; Fig. 1). The Dombes is a wetland area of around 1,500 fishponds, covering about 10,000 ha of water. Although it lacks national and international protection status, the site is known to be important for waterbirds at least at the national level (Lebreton *et al.* 1991; Bernard & Lebreton 2007), and it is included in the BirdLife International list of Important Bird Areas (IBAs) for France (Deceuninck *et al.* 2000).

Traditionally, the Dombes region included large estates and other private properties. The fishponds were managed to provide a balance between fish production, growth of cereal crops during summer dry-off periods and hunting in winter. All three

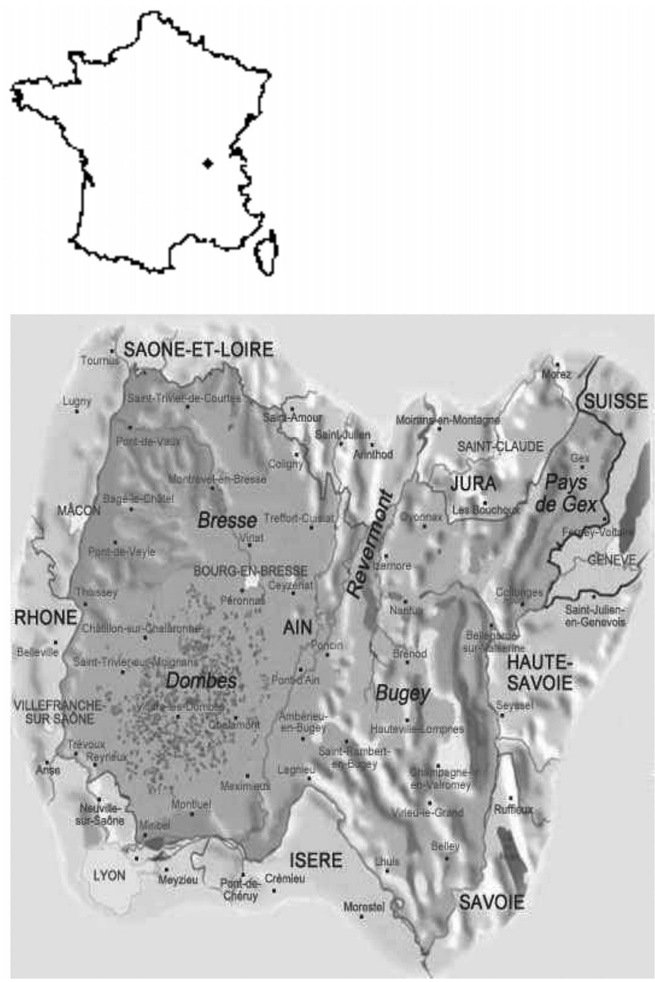

Figure 1. Location of the Dombes wetland in France and details of the area.

activities often occurred on the same pond in annual or two-yearly cycles. As wildfowling took place at most of the fishponds, protection from hunting on some of the sample of ponds was introduced in 1960, to provide refuge areas for wildfowl during the hunting season. Some habitat conservation projects were developed under the ACNAT programme (Action by the Community Relating to Nature Conservation) and the LIFE programme (the EU's financial instrument for supporting environmental and nature conservation projects) in the 1990s. These aimed to provide managers at up to 40 sites the skills and ability to maximise carrying capacities of their ponds for waterfowl without decreasing their economical value below an acceptable level (Broyer 1995).

The aim of the study presented here was to assess the importance of the Dombes as wintering area for wildfowl populations in a national and international context and to describe long-term (25-year) trends in winter numbers, based on monitoring data (waterbird counts) recorded since 1981. Factors responsible for the spatial distribution patterns of wildfowl across the Dombes are investigated in relation to variables thought likely to influence their use of the wetland habitat, such as the size, hunting status and geographical location of the ponds in the region.

Methods

Sampling

Wildfowl and Coot *Fulica atra* were counted by a single observer (Jean-Yves Fournier) monthly from December–February inclusive from 1981/82–2005/06 on a sample of 91 fishponds, selected from a total of 1,465 ponds in the Dombes area as being the largest in size and also having the largest numbers of duck and Coot. A further 90 ponds were surveyed from 1987/88 onwards and these 181 fishponds hold almost all wildfowl wintering in the Dombes.

International importance of the Dombes wetland

The sample of 181 fishponds was used to estimate the numbers of wildfowl and Coot wintering in the Dombes and to evaluate the importance of the site. Mean monthly counts recorded in winters 2001/01–2005/06 for each species were compared with the size of its respective biogeographical population, as described by Wetlands International (2006). Those receiving ≥1% of the total population meet one of the Ramsar criteria for designating sites as being of international importance for a population or species. Whether at least 20,000 waterbirds winter at the Dombes each year was also considered, as this is also an indicator of an internationally important wetland site.

Trends in numbers at the Dombes and national scales

The sub-sample of 91 fishponds was used to calculate trends in numbers since 1981/82, the longest time series of count data available for the Dombes wetland. Trends in numbers for 11 species of wildfowl and for Coot were estimated using log-linear poisson regressions computed using TRIM software (Pannekoek & van

Strien 2005). The response variable was the annual mean of monthly winter counts (December, January and February) for each site. Missing values, corresponding to gaps in coverage for one pond in a winter, were estimated by the TRIM software and accounted for less than 1% of the whole dataset. For each species, TRIM produced bird abundance measures (annual indices and number of individuals) and multiplicative overall slope estimate. These last estimates were converted into annual rates of change of abundance (%). The direction, slope and confidence intervals for the rates of change were described by TRIM as one of the following categories: 1) strong increase/decrease (rate of change >5%), 2) moderate increase/decrease (rate of change <5%), 3) stable, and 4) trend uncertain. Further details of trend analyses for wildfowl wintering numbers are provided in Fouque *et al.* (2009, this volume). Trends in numbers wintering in the Dombes were compared to those for France (from Fouque *et al.* 2009) to assess whether they followed broader-scale patterns, or whether there were specific trends in the Dombes which could potentially be related to local environmental conditions or policy.

Spatial patterns

In addition to the wildfowl counts, other environmental variables have been recorded at the 91 fishponds monitored since 1981/82. Data for this sub-sample of sites was used to investigate factors responsible for the spatial distribution patterns of wildfowl species, by testing *a priori* hypothesis that waterbird numbers are affected by pond size, hunting activity and geographic location. Pond area was treated as a categorical variable with 4 size classes: 0–10 ha, 10–20 ha, 20–40 ha and 40+ ha. Hunting activity at a pond was grouped into 2 classes – hunting and non-hunting, known as the "hunting status" of the pond. Geographical location was also treated as a categorical variable with 2 classes, based on whether the pond was in the northern or the southern part of the Dombes. Because these three explanatory variables were inter-correlated, it was not possible to include them separately in generalised linear models (GLM). We used multivariate analysis (Multiple Correspondence Analysis, MCA) and hierarchical classification computed with SPAD software to aggregate the information into a single factor with nine categories (Table 1). The objective was to assess the effect of each site's spatial category on wintering importance, taking time trends (years) into account. GLM with poisson error distributions and log link functions, and using Pearson χ^2 as a scale parameter to control for overdispersion, were used to assess how waterbird numbers (imputed numbers from TRIM) were affected by years (included as a continuous variable), site category (determined by MCA, included as a categorical variable) and the interaction between these two terms. This most "complete model" was compared to the three other possible models that could be developed from a combination of these factors and variables by using Akaike Information Criteria (Anderson *et al.* 2001). Greylag Goose *Anser anser* was discarded from the analysis as wintering numbers were too low and the species was found strictly on non-hunting areas in the southern part of

Table 1: Nine fishpond categories were identified by hierarchical classification on MCA axes of three variables, recorded for each of 91 ponds (total area 1,801 ha): surface area (size) of the site, location in the Dombes and hunting activity. The first MCA axis balanced bird numbers at hunting sites (weight = 81%) located in the northern part of the Dombes (38%) with numbers at non-hunting sites (10%) located in the southern part of the Dombes (53%); the second axis balanced numbers at sites of 20–40 ha (16%) against those of 0–10 ha (33%) and 10–20 ha (30%); and the third axis balanced numbers at sites of 0–10 ha (33%) against those of 10–20 ha (30%) and 40+ ha (12%).

Category No. (*n*)	No. of sites	Whole surface area (ha)	Surface area of sites (range in ha)	Section of the Dombes	Hunting activity
1	14	75.1	0–10	North	Hunting
2	16	103.6	0–10	South	Hunting
3	15	228.4	10–20	South	Hunting
4	14	207.7	10–20	North	Hunting
5	7	202.6	20–40	South	Hunting
6	7	189.9	20–40	North	Hunting
7	6	90.9	0–40	South	Non-hunting
8	8	441.2	40+	North or South	Hunting
9	4	261.5	40+	South	Non-hunting

the Dombes, irrespective of the size of the fishpond.

Results

International importance after wetland criteria

The Dombes regularly supports 20,000 or more waterbirds, with Mallard *Anas platyrhynchos*, Common Pochard *Aythya ferina* and Coot being the most numerous species in winter. The Dombes also regularly supports ≥1% of four duck populations, regularly for Common Pochard and Northern Pintail *Anas acuta*, less regularly for Northern Shoveler *A. clypeata* and Gadwall *A. strepera* (Table 2). Maximum of counts were often reached in February for these species.

Trends in numbers in Dombes and comparison with national and flyway trends

Trends in numbers over 25 winters indicated a strong increase for two species (Mute Swan *Cynus olor* and Greylag Goose) (Table

Table 2: Monthly mean counts (individuals) over the last 5 years (2000/01–2005/06) for the 181 fishponds counted in the Dombes, together with the current criteria (20,000 birds or 1% of the population) for designation of sites of international importance for waterbird populations in NW Europe (Wetlands International 2006).

Species	Ramsar criteria (20,000 birds or 1%) for populations in NW Europe	Months which fulfilled the Ramsar criteria	December 2000/01–2005/06		January 2000/01–2005/06		February 2000/01–2005/06	
			Mean ± s.e.	Maximum	Mean ± s.e.	Maximum	Mean ± s.e.	Maximum
Mute Swan	2,500		552 ± 213	738	558 ± 144	809	396 ± 124	615
Greylag Goose	5,000		129 ± 811	229	121 ± 78	215	122 ± 62	202
Common Shelduck	3,000		8.6 ± 9.6	25	7.4 ± 7.0	18	4.3 ± 3.1	9
Eurasian Wigeon	15,000		287 ± 207	649	570 ± 436	1,101	399 ± 105	576
Gadwall	600	Feb.	265 ± 139	451	346 ± 314	711	612 ± 228	873
Common Teal	5,000		1,245 ± 811	2,501	718 ± 553	1,381	1,191 ± 314	1,561
Mallard	20,000		13,070 ± 1,988	15,248	13,745 ± 3,573	18,841	5,127 ± 1,838	7,513
Northern Pintail	600	Feb.	124 ± 64	234	140 ± 119	352	809.8 ± 310	1,035
Northern Shoveler	400	Feb.	233 ± 166	462	191 ± 136	392	551.7 ± 306	1,058
Red-crested Pochard	500		30 ± 57	94	25 ± 26	61	260 ± 195	489
Common Pochard	3,500	Dec., Jan., Feb.	3,799 ± 4,479	12,581	4,349 ± 5,424	13,996	17,499 ± 4,875	23,774
Ferruginous Duck	450		1.7 ± 0.6	8	2.7 ± 1.5	12	2.6 ± 0.9	21
Tufted Duck	12,000		77 ± 72	187	146 ± 213	551	811 ± 478	1,539
Goldeneye	11,500		3.7 ± 4.6		7.3 ± 1.1		13 ± 11	
Greater Scaup	3,100				7.0	7		
Red-breasted Merganser	1,700		75 ± 37				9.0	9
Coot	17,500		2,146 ± 721	2,926	2,077 ± 734	3,242	3,290 ± 1,195	5,387
All species	20,000	Dec., Jan., Feb.	21,966 ± 7,551	35,863	23,029 ± 6,372	35,108	31,093 ± 6,551	46,111

Table 3: Parameters taken into account by TRIM software (overdispersion and serial correlation), average annual rate of change and its 95% confidence interval and trends in numbers over 25 years for each of the 12 wildfowl species, following TRIM classification. Mean winter numbers are the means of the maximum counts for each species in winters 2000/01–2005/06. The proportion in parentheses is the percentage of birds recorded at the 91 most important sites for wildfowl in the Dombes. *P* values indicate the significance of the trends.

Species	Mean winter numbers 2000/01–2005/06 (Individuals and % of the total counted in the 181 fishponds)	Annual rate of change (%)	95% confidence intervals (%)	*P* value (%)	Trends in numbers over 25 years 1981/82–2005/06
Mute Swan	345.2 (53.3%)	22.4	12.2; 32.5	<1%	Strong increase
Greylag Goose	116.7 (93.7%)	19.7	9.7; 29.7	<1%	Strong increase
Eurasian Wigeon	181.5 (39.0%)	4.3	2.0; 6.6	<1%	Moderate increase
Gadwall	331.5 (76.1%)	4.4	2.8; 5.9	<1%	Moderate increase
Common Teal	748.3 (68.0%)	3.4	2.0; 4.7	<1%	Moderate increase
Mallard	8,475.0 (71.9%)	2.2	1.5; 2.9	<1%	Moderate increase
Northern Pintail	325.0 (88.4%)	16.6	10.8; 22.3	<5%	Moderate increase
Northern Shoveler	273.5 (78.8%)	1.5	–0.1; 3.1		Stable
≤1992/93		–3.4	–8.0; 1.3		Uncertain
>1992/93		–8.0	–10.8; –5.2	<5%	Strong decrease
Red-crested Pochard	58.5 (53.0%)	11.9	1.4; 22.4	<5%	Moderate increase
Common Pochard	6,055.2 (64.6%)	4.3	2.9; 5.7	<1%	Moderate increase
Tufted Duck	204.3 (52.8%)	–1.6	–3.2; –0.1	<1%	Moderate decrease
Coot	1,883.0 (66.0%)	–0.0	–1.1; 1.1		Stable
≤1995–96		5.8	3.5; 8.1	<1%	Moderate increase
>1995–96		–11.2	–13.9; –8.5	<1%	Strong decrease
Dabbling ducks	10,334.0 (71.2%)	2.3	1.6; 3.0	<1%	Moderate increase
Diving ducks	6,322.0 (63.9%)	3.9	2.6; 5.2	<1%	Moderate increase

3, Fig. 2); a moderate increase for seven species (Northern Pintail, Gadwall, Teal *Anas crecca*, Mallard, Common Pochard, European Wigeon *A. penelope* and Red-crested Pochard *Netta rufina*); and a moderate decline for Tufted Duck *A. fuligula*. The trend in Northern Pintail wintering numbers was considered to be only moderate because of its relative uncertainty. Trends in Coot and Northern Shoveler numbers could be divided into two distinct periods (≤1995/96 and >1995/96 for Coot; ≤1992/93 and >1992/93 for Northern Shoveler), with an indeterminate trend and a moderate increase, respectively, in the first period and a strong decline recorded for both species thereafter.

Local trends were the same as the national ones except for Shoveler and Coot, and were more positive than the ones found at the flyway scale except for Tufted Duck (Table 4).

Factors responsible for difference in distribution and trends between site categories

The "complete model" always appeared to be the most parsimonious one that fitted the data except for Red-crested Pochard and Eurasian Wigeon (Table 5, Fig. 3 and Fig. 4). Northern Pintail was rarely found at sites >40 ha in size (site classes 8 and 9). Three species (Gadwall, Common Pochard and Northern Shoveler) were significantly more numerous on non-hunting fishponds located in the southern part of the Dombes (site classes 7 and 9). Common Pochard and Northern Shoveler could also be found on fishponds with hunting, and also occurred in the northern part of the Dombes if the pond surface area was >40 ha (site class 8). Common Teal and Mallard were also more numerous on non-hunting fishponds <40 ha in size located in the southern part of the Dombes region, but showed a preference for ponds <10 ha in size (site class 7). Coot was also found in this site category (site class 7) but mostly occurred on hunting fishponds >40 ha (class 8) associated with Tufted Duck, which was rarely found on sites <10 ha in size. Mute Swan was the only species more numerous on hunting sites in the northern part of the Dombes.

For Gadwall and Common Pochard, trends in numbers were significantly more favourable in the largest non-hunting fishponds (>40 ha) located on the southern part of the Dombes (site class 9). Mute Swan trends were more favourable at the hunting fishponds 0–10 ha and 20–40 ha in size, with the geographical location of the site having no effect on the trends for this species (*i.e.* in site classes 1 or 2 compared with site classes 5 or 6).

Discussion

Even without any protection status (regional, national or international), wildfowl have become increasingly numerous in the Dombes wetland over the years. The area is important for these birds under both national and international criteria, not only in winter as shown in this paper, but also as a staging site during migration in mid-March (J.Y. Fournier, unpubl. data). These results are in accordance with other publications concerning the Dombes region (Bernard & Lebreton 2007). The non-hunting sites played a crucial role and were mainly

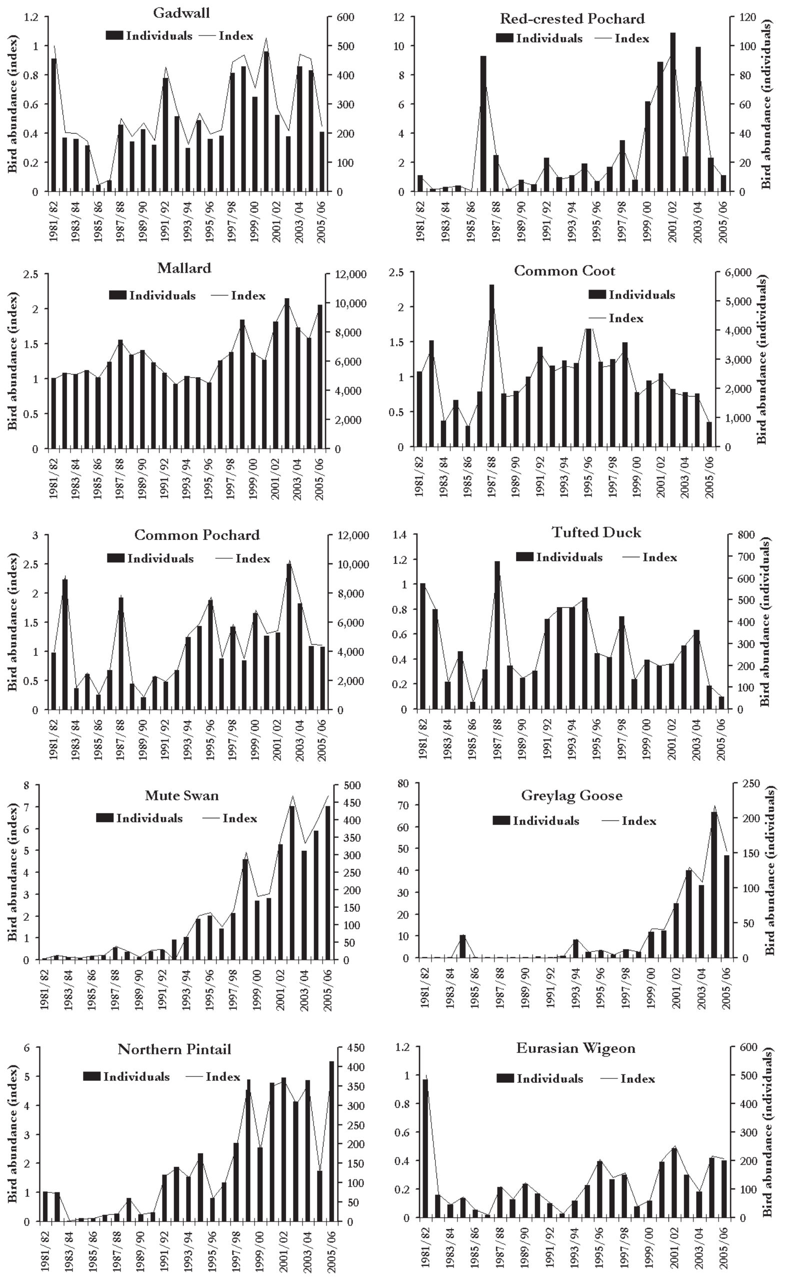

Figure 2. Abundance (individuals and indices, including imputed data) and variation in numbers (TRIM trends) for 11 species of wildfowl and for Coot wintering in the Dombes from 1981/82–2005/06.

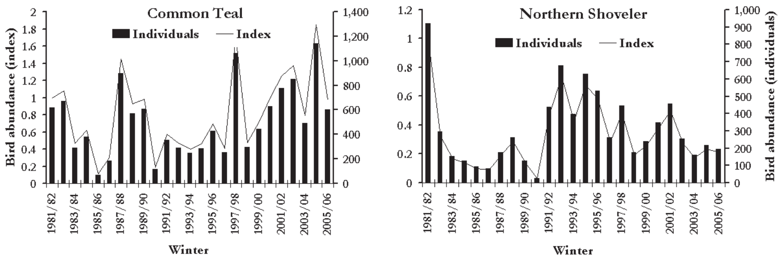

Figure 2 (*continued*).

Table 4: Comparison of trends in wintering wildfowl numbers recorded in Dombes wetland, in France (Fouque *et al.* 2009), and for the NW European populations (Wetlands International 2006). [1]Further information on the variable trends recorded for Northern Shoveler and for Coot is given in Table 3.

Species	Trends at 91 fishponds in Dombes 1981/82–2005/06	Trends at 88 wetlands in France 1987/88–2007/08	NW European population trends
Mute Swan	Strong increase	Strong increase	Increase
Greylag Goose	Strong increase	Strong increase	Increase
Eurasian Wigeon	Moderate increase	Moderate increase	Stable
Gadwall	Moderate increase	Moderate increase	Increase
Common Teal	Moderate increase	Moderate increase	Increase
Mallard	Moderate increase	Moderate increase	Decrease/Stable
Northern Pintail	Moderate increase	Moderate increase	Stable
Northern Shoveler[1]	Stable (Uncertain/Strong decrease)	Moderate increase	Stable
Red-crested Pochard	Moderate increase	Moderate increase	Increase
Common Pochard	Moderate increase	Moderate increase	Decrease
Tufted Duck	Moderate decrease	Moderate decrease	Stable
Coot[1]	Stable (Mod. increase/Strong decrease)	Moderate increase	Stable

Table 5. Results of the GLM (Poisson distribution) models developed to explain the number of wintering birds in relation to year (Y), class of sites (C) and the interaction of these two variables (d.f. = 207). Overdispersion was taken into account by fixing scaled Pearson χ^2 to 1. Such models are significant when the scaled deviance approaches the value of 1. In the present case, the model for Red-crested Pochard and Eurasian Wigeon are considered as not fitting the data. The last column indicates those factors that had a significant effect within the model (Wald statistics, $P \leq 0.05$).

Species	Deviance	Pearson χ^2	Scaled deviance	Significant parameters
Mute Swan	8.90	9.81	0.91	C Y C*Y
Eurasian Wigeon	21.38	70.57	0.30	–
Gadwall	22.69	24.57	0.92	C C*Y
Common Teal	46.76	59.14	0.79	C
Mallard	208.68	199.03	1.05	C Y
Northern Pintail	29.11	31.76	0.92	Y
Northern Shoveler	36.17	46.46	0.78	C
Red-crested Pochard	6.37	15.34	0.41	–
Common Pochard	379.45	437.61	0.87	C C*Y
Tufted Duck	23.66	24.34	0.97	C Y
Coot	188.66	201.86	0.93	C

responsible for accommodating the increasing wintering numbers, notably for Common Pochard and Gadwall. Almost three-quarters of the winter numbers of dabbling ducks could be found on these ponds (Bernard & Lebreton 2007). Conversely diving ducks, most notably Tufted Duck, seemed to be more sensitive to the ecology of the fishponds and to the food supply at these sites rather than to their hunting status. Mute Swan used hunting sites with low densities of other wildfowl.

Non-hunting sites and the largest fishponds were located in the southern part of the Dombes, which is probably why this area is currently more important for wildfowl and Coot than the northern region (Bernard & Lebreton 2007). One priority for the future should be to increase the numbers of non-hunting sites in the north, which could double the area of non-hunted wetlands at the Dombes. If it is deemed worthwhile from a local management perspective, additional conservation action is also needed for some species. Three species declined in numbers in Dombes, yet

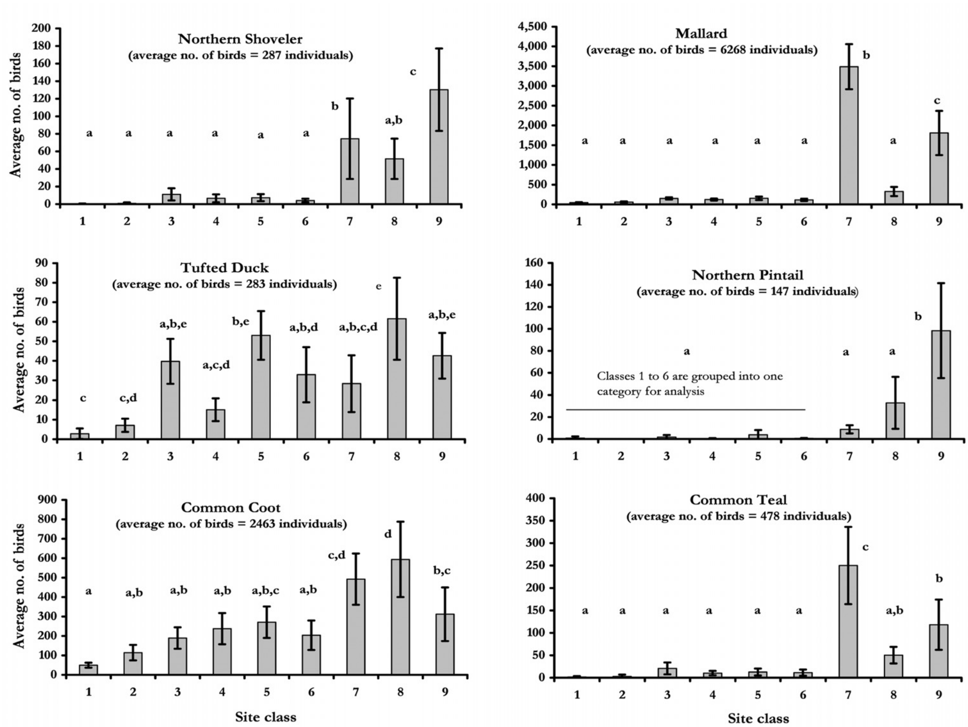

Figure 3. Average number of birds (includes imputed data) recorded for winters 1981/82–2005/06 per site class for six species with no significant year*class interactions (*i.e.* trends in numbers over the years did not vary in relation to site classification). Vertical bars show 95% confidence intervals. Classes (columns) with a same letter did not differ; those with different letters (a, b or c) differed significantly at $P = 0.01$ (Bonferroni adjusted test).

two of these (Coot and Shoveler) were increasing at a national scale. Moreover, Coot was one of the most numerous species and Shoveler was one of four species with 1% of its biogeographical population (*i.e.* met a Ramsar criterion for a site of international importance) recorded in the Dombes wetland. Local environmental factors therefore seem to be having a negative effect on these species. For these two quarry species, all of the nine site classes derived from hunting activity, location and the size of the fishpond were used by the birds, and there was no interaction between site categories and years (*i.e.* trends in numbers), so these three parameters do not seem to be responsible for the decline. Other factors therefore should be considered and one hypothesis is that inappropriate management of fishponds may be reducing the food supply for these species (J. Broyer, unpubl. data).

Development of a management plan for the whole of the Dombes should be considered to identify priority areas for

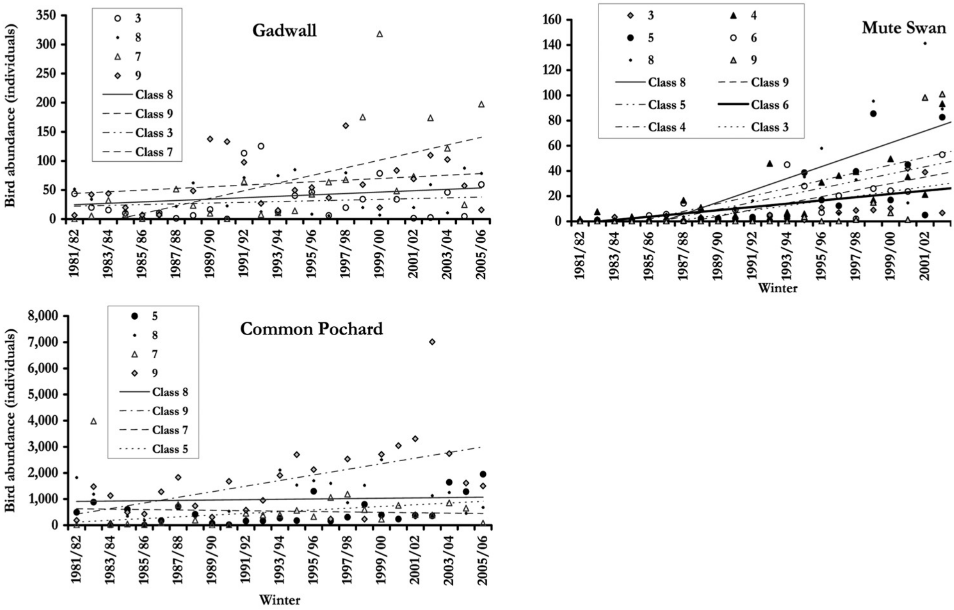

Figure 4. Average winter number (includes imputed data for the whole period 1981/82–2005/06) of individuals per class for the three species with a significant year*class interaction (*i.e.* trends in numbers over years differed between site classes).

further investigation, to advise on fishpond management for the benefit of all interested parties, and to improve the carrying capacity of the fishponds for fish and wildfowl. Natura 2000 listing would bring some useful measures, but designation of the Dombes as a Ramsar site would be appropriate recognition of the international value of the area for waterbirds, and also help to promote the development of a management plan. The involvement of local stakeholders (including hunters, fishermen and conservationists) in discussing habitat management possibilities for the region would provide a framework for drawing together the collective consciousness of what the Dombes is now and can be in the future (Mondain-Monval & Lamarque 2003; Ramsar Convention Secretariat 2006). The conservation of this wetland through a wise use of its resources requires the commitment of all involved to reconcile economic and ecological goals.

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