Hunting as a key environmental parameter for the Western Palearctic duck populations

ALAIN TAMISIER

A comprehensive study of a species or of a community must consider all the important environmental factors which have any effect on it. For game species, this elementary statement would include hunting, since it is capable of modifying their behaviour, their ecology, their distribution, and their population dynamics. Yet among the enormous number of papers on waterfowl, very few deal with hunting as an environmental parameter. This topic, recently reviewed in a stimulating paper of Scott (1982) can be analysed somewhat further using two sets of data: the winter waterfowl censuses, and the hunting variables. Since the one international inquiry on waterfowl hunting kill was carried out in 1975–6, the central discussion relates to that period.

1. Numbers and distribution of the Western Palearctic populations of wintering ducks

These data come from the International Waterfowl Research Bureau's (I.W.R.B.) International Censuses which have run for nearly two decades, extend over three Continents, and provide us with one of the most famous long term monitoring studies of vertebrate populations (Atkinson-Willes 1976; A. Rüger, pers. com.). The majority of most species of ducks usually breed in the U.S.S.R. at latitudes where habitats can be used only during the few warm months. Soon after breeding, these ducks and the juveniles they have reared leave for the ice-free wetlands of western and southern Europe, south-western Asia and north and west Africa, which constitute their winter range. Within this range, the geographical distribution of ducks is not random. They generally gather in restricted areas (the winter quarters) and they also vary in number according to country (Fig. 1). These national variations are not directly related to the size of the country, the area of wetlands, nor the number of waterfowl hunters.

The total size of the populations in January in western Europe, around the Black Sea and the Mediterranean Sea, and in west tropical Africa is about 15 million ducks (Atkinson-Willes 1976; Scott 1982). Sea-ducks, which are not usually hunted (except in Denmark), are not included in this total. After an obvious increase in the 1970's, a period of stability was followed by a gradual decrease in total numbers for many species (A. Rüger, pers. com.). Over the last two decades on an inter-continental scale, the duck population has been rather slowly declining, but with large variations according to species.

2. Hunting variables

Several variables can be considered:

a) Length of the hunting season.

The annual length of the hunting season varies greatly between countries (Lampio 1983) along a west and southwards gradient, averaging 3.7 months in Eastern Europe, 4.3 months in Northern Europe, 5.9 months in Western Europe, and 6.6 months in Southern Europe. The maximum values are reached in France and Greece (7.5 months) and Malta (8.8 months) (Table 1). Compared to the European data, the North American hunting seasons are fairly short, with 3.3 months in U.S.A., 4.0 months in Canada, 4.3 months in Mexico. The value given for the U.S.A. (3.3), because of split seasons, is higher than the actual period open for shooting (Lampio 1983).

Hunting activity in Europe spreads over 10.5 months out of the annual cycle (Fig. 2), starting very early in the season (mid-July in France, Belgium and the Netherlands) and ending on the last days of May (some parts of Finland and Aland, and Malta). In terms of numbers of countries involved, 77% of hunting activity occurs between September and January.

b) Hunting kill

The hunting kill is known through an international inquiry of the I.W.R.B. for the 1975–6 season with French data for the

Wildfowl 36 (1985): 95–103

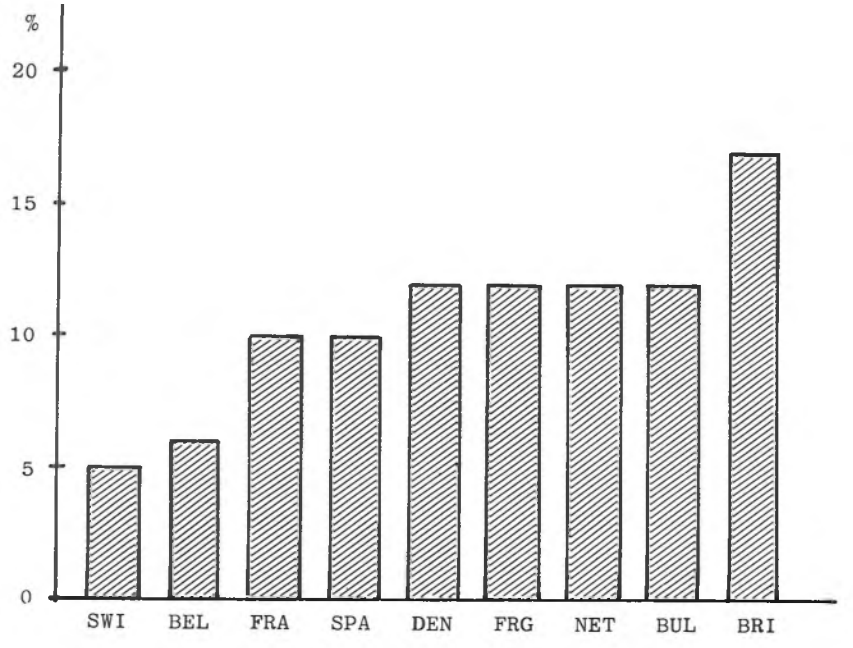

Figure 1. Relative distribution of ducks in winter (January counts) in western Europe (after Atkinson-Willes 1976).

Table 1. Some relevant data on duck hunting in Europe, and a comparison with the North American situation (after Scott 1982: Lampio 1983). Malta, with an 8.8 month hunting season produces, because of its small size, unrealistic figures for density (33,333) and disturbance (293,330).

COUNTRIES	Density of hunters per 1000km²	Length of hunting season (month)	Hunting disturb.	Duck hunting kill (x 1000)	Kill/ total kill (%)	Kill per km²	Surface of country / total surface of Europe %
German Dem. Rep.	185	4.0	740	36	0.4	0.33	1.0
Belgium	66	6.3	416	46	0.5	1.48	0.3
Rumania	–	7.0	–	80	0.8	0.34	2.2
Norway	62	4.0	248	115	1.2	0.35	3.0
Britain	164	5.7	935	153	1.6	0.63	2.3
Sweden	334	4.4	1470	168	1.7	0.37	4.2
Spain	129	5.8	748	229	2.4	0.45	4.7
Netherlands	718	6.3	4525	365	3.7	10.14	0.3
German Fed. Rep.	403	4.0	1612	370	3.8	1.49	2.3
Finland	527	5.0	2635	482	5.0	1.42	3.1
Denmark	1856	6.5	12064	817	8.4	19.00	0.4
Rep. of Ukraine	726	3.7	2686	983	10.1	1.63	5.6
France	360	7.5	2628	2242	23.0	4.03	5.1
Rep. of Russia	466	2.7	1258	2310	23.7	1.07	20.0
Europe	300	5.1	1500	9736		1.0	
USA/Canada	150	ca.3.0	450	16700		0.9	

Editors' Note. The British kill data for 1975–6 are radically different from those in the 1980's compiled by Harradine (1985): see this volume pp. 81–94.

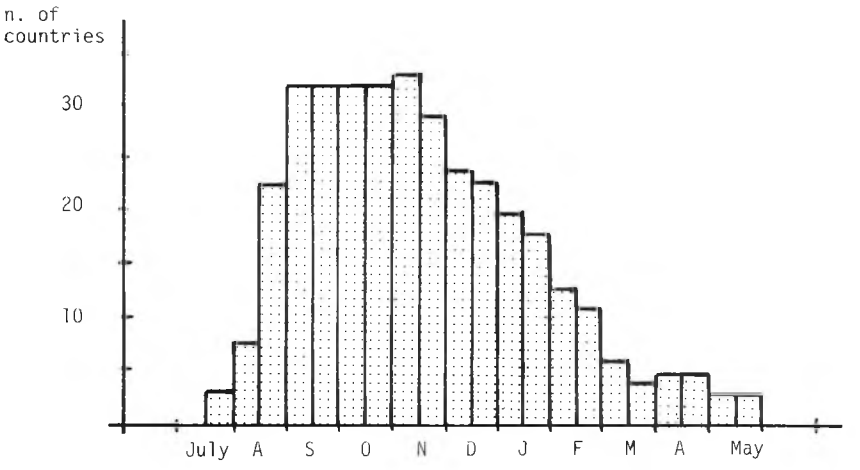

Figure 2. Monthly distribution of the number of European countries where the duck hunting season is open (after Lampio 1983). According to the countries where they happen to be, ducks could be hunted from mid-July to the end of May (10.5 months a year).

1974–5 season (Nowak 1977; Scott 1982). A few countries did not provide answers for the inquiry, among them unfortunately Italy and Greece where hunting cannot be considered as a minor activity (Cassola 1979; Woldhek 1980). African data are missing too, but in the northern and tropical African countries (except probably Algeria) waterfowl hunting is a marginal activity (few hunters and very low kill) in relation to the size of the wetlands and the numbers of wintering ducks (Woldhek 1980; Roux 1982, 1985).

The national kill data are rather rough estimates (for instance the French values are given with an error of ± 54% for Mallard *Anas platyrhynchos* and ± 63% for other ducks) and the variability in the method used prevent detailed analysis. However, the total arrived at is not insignificant, about 10 million ducks killed in the year. The differences between the extreme values are large enough to demonstrate that some countries have much less conservative hunting practices than others: two countries (the Russian S.F.S.R. and France) contributed about half of the total kill, and the first four countries (with the Ukrainian S.R. and Denmark) 65% of it (Fig. 3, Table 1).

The number of wintering ducks killed is independent of the size of the country: for instance, France has 23.0% of the total kill and only 5.1% of the total surface, Denmark has 8.4% and 0.4% respectively, Britain 1.6% and 2.3% (Table 1).

c) Hunting disturbance

The effects of hunting disturbance on waterfowl populations has been measured locally (Tamisier 1980; Tamisier & Saint Gerand 1981; Meltofte 1982; Jepsen 1983) but can hardly be quantified with accuracy, or extended on a larger geographical scale. However, some relative orders of magnitude can be obtained. In theory hunting disturbance is a function of the density of hunters and of the length of the hunting season (Table 1). On this point, corrections should be made for the countries where hunting is restricted either to a few days a week or in some parts of the country; also Malta's values are probably not relevant. Hunting disturbance can also be expressed as a ratio of the kill to the surface area of the country. This ratio reveals again a wide discrepancy according to countries.

The values of surface area are crude since they include a variable percentage of terrestrial habitats which are useless for waterfowl. For want of reliable data on the surface of wetlands per country, the number of wintering ducks is a better estimate of the carrying capacity of each country as long as the wetlands are usually ice-free in winter. The ratio of size of kill to size of wintering

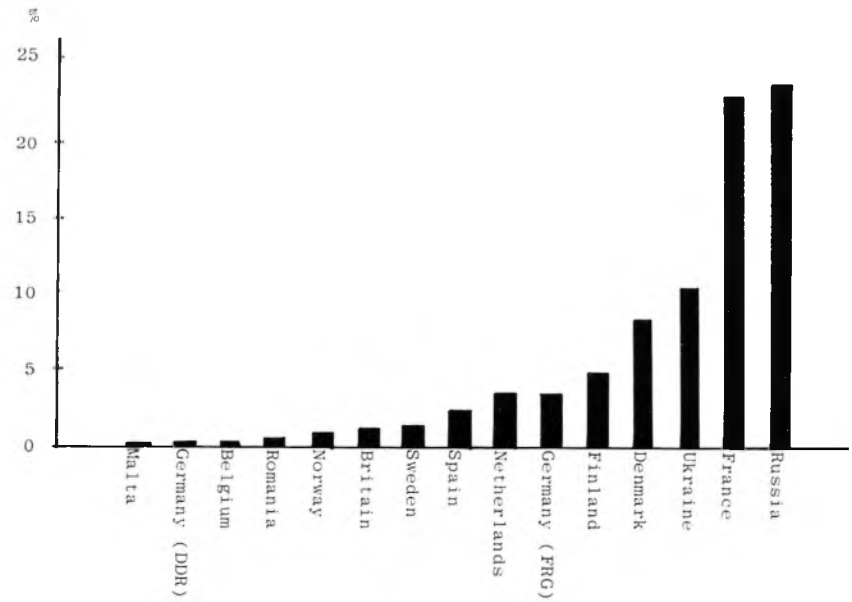

Figure 3. National hunting kill as a percentage of the total kill from the Western Palearctic duck populations, according to the International Inquiry in 1975—6 (after Scott 1982): two countries (Russian S.F.S.R. and France) take over half of the total, and four (with Ukraine S.F.S.R. and Denmark) take over 65%.

Figure 4. Relative impact of hunting on ducks in the western and central European countries where wintering occurs (annual kill/number of wintering ducks in January). Unfortunately the Italian data are missing: this country would probably be located close to France on this Figure. See explanations in the text.

population – which has no biological meaning for these migratory populations – provides a relative estimate of the amount of general disturbance of hunting on ducks according to countries (Fig. 4). It leads to three remarks:

Firstly, the total kill is cumulative throughout the hunting season, whilst the wintering numbers are an instantaneous value of the size of the population in January, at a time when it is probably close to a minimum. As a result, the ratio can be greater than 1, as in France and Denmark.

Secondly, the wetlands of the western European countries are used as winter quarters for some ducks, and also as staging

areas for others wintering further along the migration routes. The hunting kill is mostly made during the migration time, on transient populations whose size is very hard to measure: we cannot quantify the through-put of ducks at a given place on the flyway.

Lastly, however, this through-put is at a maximum close to the breeding grounds and a minimum at the terminal winter quarters where indeed its value is the same as the wintering numbers. So the number of transient ducks is much higher in the north-eastern European countries than it is for instance in France or Spain.

The given values of the ratio are not corrected according to these biases, but if they were, the ratio would be still higher for countries like France where it is already fairly high, and even lower in all the northern and continental countries.

Discussion

Ducks cross over many countries twice a year and encounter quite distinct hunting situations from place to place. Investigating the precise impact of hunting on these populations is difficult for several reasons:

- the size of the populations is known with a good accuracy only from January counts and the size of these populations at the starting of the hunting season is but a crude estimate (Scott 1982),
- the size of the through-put at points along the migration routes is unknown,
- the size of the hunting kill comes from a single inquiry with some important gaps,
- we have no precise data on the total surface of the wetlands for each country in relation to their potential use by the ducks.

These limitations prevent absolute conclusions. Yet they are counterbalanced by earlier, indirect evidence where a wide discrepancy is regularly shown between a few countries and the rest. In effect, whatever the criteria we use, the same few countries come "first" either in terms of length of the hunting season (Malta, France, Greece), density of hunters and hunting disturbance (Denmark, Netherlands, Ukraine), hunting kill (Russia, France, Ukraine), kill per surface area (Denmark, Netherlands, France) or kill per wintering total (France, Denmark, W. Germany). A comparison between the European and the North American situation clearly demonstrates the much more conservative situation in North America for all these criteria (Table 1). So four questions must be answered:

1) What is the impact of this high hunting pressure on the waterfowl populations?

Hunting seems to have two distinct effects on them:

a) Geographical distribution. Over a given threshold of disturbance and kill, ducks cannot stay any longer. This point is demonstratively reached at places where night shooting occurs as in France (Tamisier & Saint Gerand 1981): these places become almost completely deserted and the ratio of kill to wintering ducks is 19 times higher there than at the adjacent localities without night shooting. The density of wintering ducks is also usually inversely correlated to the intensity of the hunting pressure. The distribution maps of wintering and transient ducks, wherever they are drawn, are a good illustration of the distribution of quiet vs. hunted areas (see Fig. 1, and Tamisier 1980; Meltofte 1982; Raffin & Lefeuvre 1982; Jepsen 1983; Yesou 1983).

b) Size of the populations. Since the lower density of ducks in hunted areas is not balanced by over-crowded areas elsewhere (the January counts provide proof on this point) we can suspect that hunting lowers the total size of the populations. As a matter of fact, we know that the Western Palearctic populations per surface area are half the North American ones (Scott 1982), a difference that is obvious to anybody who has regular experience on both sides of the Atlantic. Similarly the rapid increase in numbers of species recently protected from hunting in many countries (Shelduck *Tadorna tadorna*, Brent Geese *Branta bernicla*, Greylag Geese *Anser anser* for instance) demonstrates conclusively that hunting was their limiting factor. The same conclusion can be made at a smaller scale, for the protection of a favourable wetland from hunting is immediately followed by an increase in the number of birds (Tamisier 1980; Schifferli 1983) which is usually not compensated for by a decrease elsewhere.

2) How can the Western Palearctic populations of ducks stand this heavy hunting pressure?

Assuming that the duck populations are

more or less stabilised in numbers (which we have seen is an optimistic hypothesis), this drastic question necessitates the building of a population dynamic model. However, we lack reliable data for every parameter involved (particularly those concerning reproduction) so this model is still to be constructed. Several answers, not necessarily controversial, can nevertheless be proposed:

– The worst effects of the hunting pressure are localised in a few countries so they must be partly compensated for by the conservative measures taken in others: this means that the former countries are parasitic on the rest.

– The level of the population is high enough (whilst lower than it could be), and its structure (age- and sex-classes) sufficiently well balanced to keep the total numbers more or less constant. This means that hunting reduces the size of the populations without disturbing their functioning. The same, at a much lower intensity of hunting, has been demonstrated in North America (Trauger & Stoudt 1978).

– The Western Palearctic populations are partly fed by the Eastern Palearctic ones which are exposed to a much lower hunting pressure. This implies that the boundaries between the two bioclimatic zones are more permeable than usually considered; this has been already proved by recoveries of Garganey *Anas querquedula* ringed in Mali and recovered in Eastern Siberia (Jarry & Lamarche 1980).

– The reproductive rate is higher than usual and compensates for the higher loss from hunting. This speculative point must be considered only as an hypothesis.

3) Is the described situation still up to date?

The kill data are 10 years old. Over the last decade, there have been some changes. Many new reserves were created and there were several improvements in hunting legislation (Lampio 1972, 1983), as in Malta (hunting season reduced from 12 to 8.8 months) or in France (8.5 to 7.5 months) – but in the latter country a decline in the numbers of sedentary gamebirds led to a switch by hunters to migratory species such as waterfowl, which are still numerous. In addition, night shooting is still (illegally) practised. However, all over the range of the Western Palearctic populations, the loss of wetlands continued (Scott 1980; Mustin 1982; Roux 1985) in spite of constant recommendations for their protection (for example, see Scott & Smart 1982) and the welfare of the waterfowl populations cannot be said to be better now than before. The balance sheet of positive and negative changes suggests a gradual deterioration of the situation over the last 10 years.

4) What of the future?

The restoration of the duck populations despite the loss of wetland habitats and the reduction of their potential use because of hunting disturbance is a common goal of scientists, conservationists, and wildfowl managers (Scott 1982). Lowering the hunting pressure is strongly suggested all over Europe (Reichholf 1973; Moller 1978; Tamisier & Saint Gerand 1981; Meltofte 1982; Raffin & Lefeuvre 1982; Scott 1982). Priority must be given to the places where hunting has the most deleterious effects on the duck populations. We do not need to know precisely whether killing two million ducks a year from mid-July to February is worse than night shooting (as in France) since all are dangerous for the populations. We must formulate an International Hunting Legislation for the Western Palearctic populations and follow the existing international recommendations (in particular the E.E.C. Directive on Bird Conservation), putting the fundamental specific requirements of the birds first rather than the needs of the hunters (Man no longer relies on hunting for food).

Consequently the arguments of "tradition" in favour of some hunting activities cannot carry weight in new hunting legislation, only their biological impact on the waterfowl populations. Night shooting as well as spring hunting should definitely be stopped. More generally, elementary biological rules can be used as guidelines to lower hunting pressure, first of all by shortening the hunting season at both ends. Biologically, hunting should not be open before the fledging of all juveniles. The timing of egg laying and the length of the incubation period and of the rearing of the young vary according to species and place. The mean values for Europe (Cramp & Simmons 1977) show that the fledging period can spread over 5 months for the Mallard (and Coot *Fulica atra)*, usually much less for the other species; it is completely ended as late as the middle of

October, the latest species being Mallard, Tufted Duck *Aythya fuligula* (and Coot) (Fig. 5). Hunting is open in three countries (France, Belgium, Netherlands) as early as mid-July, and in 22 countries from 15 August. This is all the more surprising as those three countries which open first are those where the late fledging of ducks is very common. Taking into account the temporal cline in the breeding chronology from north-east to south-west (Cramp & Simmons 1977), a suggestion for the opening of the hunting season in September for the north-eastern countries and in October for the others would have actual biological meaning.

Hunting should be suspended after mid-winter (Recommendation XI of the Second Technical Meeting on Western Palearctic Migratory Waterfowl Management, Paris 1979: in Scott & Smart 1982), if any hunting and natural mortality factors are not to be additive. Moreover most ducks are then already paired, and killing them at this time comes close to killing their potential brood. Lastly, many recent North American studies reveal a strong correlation between the quality/quantity of the nutrient reserves stored by the ducks in late winter and their reproductive rate on the northern breeding grounds (Krapu 1981; Ankney 1982; Reinecke 1985). Consequently the ending

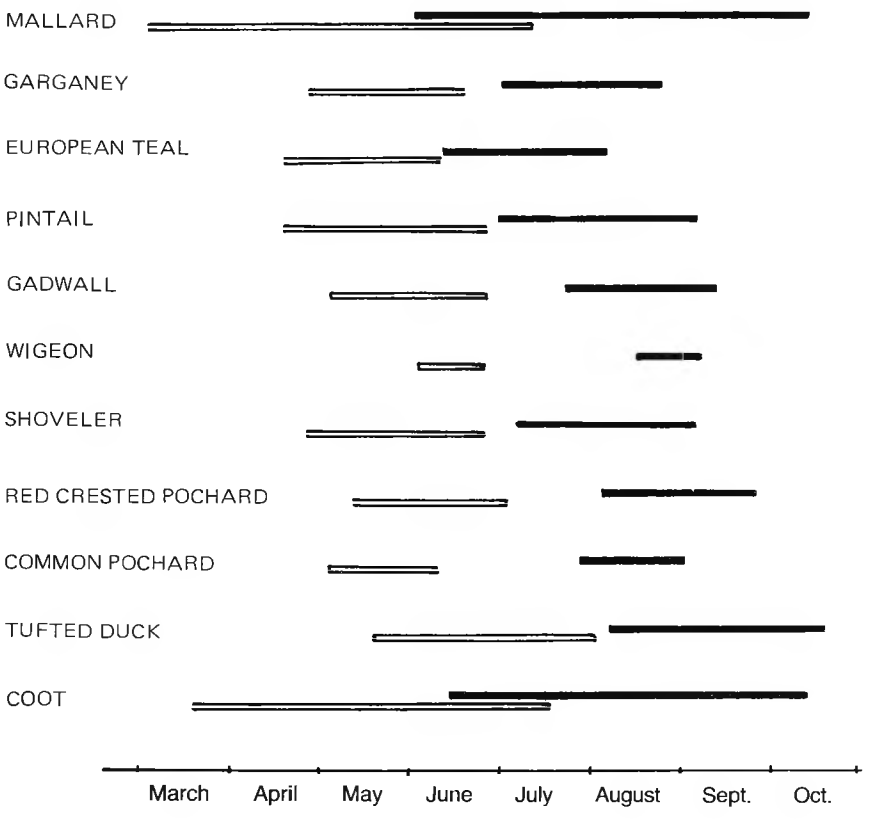

Figure 5. Mean European values of the chronology of the egg laying (open lines) and fledging period (solid lines) of ducks and coots (after Cramp & Simmons 1977). The hunting season at present opens in three countries (France, Belgium, Netherlands) as early as in mid-July when most young are still unfledged, and in 22 countries in mid-August.

of the hunting season, already closed at the latest on 31 January for half a century in all the American States, has been progressively advanced there to the middle of January, and eventually to the end of December without any compensation in the opening time. In Europe, the season is still open on the last days of February in 11 countries and until May in three countries (Fig. 2). A proposal to close it on 15 December (Reichholf 1973) may not be practicable, but to take the end of January as the end of the hunting season in all the countries frequented by the Western Palearctic populations could be relatively easily accepted, quickly applied, and quite efficient.

As a general result, the hunting season would not last anywhere more than 4 to 5 months, which would be a considerable improvement as compared to the present situation. It could still be improved towards the North American situation which is not yet considered restrictive enough because of the loss of wetlands and increased hunting pressure (Boyd 1981; Ward 1983).

Other proposals might be made to lower the hunting pressure and ideally to equate it as far as possible with the resources (space and food) with which the ducks are provided. For instance a national bag-limit whose value would be determined according to the amount of these resources, to the total size of the autumn populations, and to the numbers of the hunters would be good in theory. However, the North American experience over five decades shows that this is inefficient in regulating the populations (Anderson & Burnham 1976; Boyd 1978; Rogers *et al.* 1979). In Europe, the institution of bag-limits would not reduce the hunting disturbance which is more related to the length of the hunting season. Furthermore, it would be difficult to arrive at such limits in terms of biological capabilities of the populations and habitats and we can only speculate about the application and control of limits in those countries where hunting has at present the worst effects. Finally, once accepted, it would constitute a political and psychological brake on any further improvement of the hunting legislation. As a result bag limits would have a very hypothetical efficiency, if any. We would do better to save our energy and propose realistic and useful changes such as stopping night shooting and shortening the hunting seasons.

It is fruitless to invest in the protection of wetland habitats if at the same time the problems of hunting are not solved by drastic changes of unquestionable efficiencies.

Summary

Western Palearctic duck populations have to stand a very high hunting pressure in seasons running from mid-July to the end of May, having an annual kill of ca. 10 million ducks which leaves January population of about 15 million. Moreover, a wide discrepancy appears between the very few countries which are responsible for these high mean figures (because of night shooting, long hunting seasons and heavy kill) and the others: the former are parasitic on the latter as far as duck populations are concerned. Consequently the winter distribution of ducks is biased in favour of the lightly hunted countries and the overall level of the populations is lowered. A comparison with the North American situation strengthens these points.

As a result, lowering the hunting pressure must be achieved through an International Hunting Legislation for the restoration of the Western Palearctic duck populations. Taking into account the fundamental requirements of the ducks as determined by the most recent results of theoretical and applied research, a suggestion for stopping night shooting and shortening the hunting season to run from September (in the northern and eastern countries) and October (in the western and southern countries) to the end of January would lead to a considerable improvement. The protection of wetlands is fruitless as long as such changes in the hunting situation are not applied.

References

Anderson, D. R. & Burnham, K. P. 1976. *Population ecology of the Mallard. V. The effect of exploitation on survival.* US Fish and Wildl. Serv. Resource Publ. 128.

Ankney, C. D. 1982. Report of the bioenergetics Discussion Group. *in* Proc. Workshop on the ecology of wintering waterfowl, Puxico, Missouri. April 1982 (Delta Waterfowl Res. Station, Ed.).

Atkinson-Willes, G. L. 1976. The numerical distribution of ducks, swans and coots as a guide in assessing the importance of wetlands in mid-winter pp. 199–254 in: Smart, M. (Ed.). *Proc. Int. Conf. Cons. Wetlands and Waterfowl, Heiligenhafen 1974.* I.W.R.B. Slimbridge.

Boyd, H. 1978. The role of harvest surveys in managing the exploitation of waterfowl in Canada. *Can. Wildl. Serv. Rept. Series* 43: 122–3.

Boyd, H. 1981. Prairie dabbling ducks 1941–1990. *Progress Notes, Can. Wildl. Serv:* 9 pp.

Boyd, H. 1983. Intensive regulation of duck hunting in North America: its purpose and achievements. *Can. Wildl. Serv. Occasional Paper* 50: 24 pp.

Cassola, F. 1979. Shooting in Italy: the present situation and future perspectives. *Biol. Conserv.* 16: 85–106.

Cramp, S. & Simmons, K. E. L. (Eds.) 1977. *The Birds of the Western Palearctic*. Vol. 1. and 1980 Vol. 2. Oxford University Press.

Jarry, G. & Lamarche, B. 1980. Recherches sur les Anatidés hivernant dans le delta interieur du Niger (Mali) (Jan–Fev. 1980). *Rapport de Convention CRBPO/ONC*. Paris.

Jepsen, P. U. 1983. (Game reserves as a part of nature management in Denmark). *Proc. Third Nordic Congr. Ornith.* 1981: 133–43.

Krapu, G. L. 1981. The role of nutrient reserves in Mallard reproduction. *Auk* 98: 29–38.

Lampio, T. 1972. Hunting seasons and methods in Europe 1969–70. *Proc. Int. Conf. on Conserv. Wetlands and Waterfowl, Ramsar 1971:* 157–69.

Lampio, T. 1983. *Waterfowl Hunting in Europe, North America and some African and Asian countries.* I.W.R.B. Spec. Pub. no. 3.

Meltofte, H. 1982. (Shooting disturbance on waterfowl). *Dansk Orn. Foren. Tidsskr.* 76: 21–35.

Moller, H. S. 1978. (Bird hunting in Denmark 1961–1975). *Anser* Suppl. 3: 177–83.

Mustin, M. 1983. Action concertée de recherches pluridisciplinaires sur les marais de l'Ouest de la France. *Rap. de Synthèse Museum Nat. Hist. Nat. Min Environnement.* Paris.

Nowak, E. 1977. Report of Hunting Kill Statistics Research Group. *Bull. I.W.R.B.* 43/44: 55–60.

Raffin, J. P. & Lefeuvre, J. C. 1982. Chasse et Conservation de la Faune Sauvage en France. *Biol. Conser.* 23: 217–41.

Reichholf, J. 1973. Begrundunng einer okologischen Strategie der Jagt auf Enten (Anatidae). *Anz. Orn. Ges. Bayern* 12: 237–47.

Reinecke, K. 1985. Nutrition, Condition and Ecophysiology. Report of a Workshop in *Proc. Symp. Waterfowl in Winter, Galveston, Texas,* 1985. (in press.).

Rogers, J. P., Nichols, J. D., Martin, F. W., Kimball, C. F. & Pospahala, R. S. 1979. An examination of Harvest and Survival Rates of Ducks in Relation to Hunting. *Trans. N. Amer. Wildl. and Nat. Res. Conf.* 44: 114–26.

Roux, F. 1982. Trekvogels aver Sahara en Sahel. 2. De Binnendelta van de Niger. *Panda Netherl.* 6: 83–85.

Roux, F. 1985. Problèmes rencontrés par les oiseaux d'eau migrateurs dans les zones humides de l'Afrique occidentale. pp. 22–32 in: McDonald, A. & Goriup, P. (Eds.). *Migratory Birds: problems and prospects in Africa.* Rep. XIVth.

Schifferli, L. 1983. Distribution and numbers of ducks wintering on Swiss waters, 1967–81, and possible factors affecting them. pp. 140–5 in: Boyd, H. (Ed.). *Proc. 1st Western Hemisphere Waterfowl and Waterbird Symp. Edmonton, May 1982.* C.W.S., Ottawa.

Scott, D. A. 1980. *A preliminary Inventory of Wetlands of International Importance for Waterfowl in West Europe and Northwest Africa.* I.W.R.B. Spec. Publ. no. 2.

Scott, D. A. 1982. Problems in the management of waterfowl populations. pp. 89–106 in: Scott, D. A. & Smart, M. (Eds.) *Proc. 2nd Tech. Mtg. West Palea. Migr. Bird Manage. Paris* 1979.

Scott, D. A. & Smart, M. 1982. (Eds.) *Proc. 2nd Tech. Mtg. West Palea. Mig. Bird Manage. Paris 1979.* I.W.R.B., Slimbridge.

Tamisier, A. 1980. Cumul d'activités et saturation des milieux. *Bull. Off. Nat. Chasse No. Sp. Scient. et Techn.:* 235–241.

Tamisier, A. & Saint Gérand, Th. 1981. Stationnements d'oiseaux d'eau et chasse de nuit sur les départements côtiers de France. *Alauda* 49: 81–93.

Trauger, D. L. & Stoudt, J. H. 1978. Trends in waterfowl populations and habitats on study areas in Canadian parklands. *Trans. N. Amer. Wildl. and Nat. Res. Conf.* 43: 187–205.

Ward, P. 1983. Prairie waterfowl and wetland management: a historical perspective. pp. 4–8 in: Boyd, H. (Ed.). *Proc. 1st Western Hemisphere Waterfowl and Waterbird Symp. Edmonton, May 1982.* C.W.S. Ottawa.

Woldhek, S. 1979. *Bird Killing in the Mediterranean.* Europ Committee Prevention Mass Destruction Migr. Birds. Zeist, Netherlands.

Yesou, P. 1983. Anatidés et Zones humides de France metropolitaine. *Bull. mens. Off. Nat Chasse No. Scient. et Techn.* Paris.

Dr. A. Tamisier, Centre d'Ecologie de Camargue, C.N.R.S., 13200 Arles, France, and Centre de Recherches sur la Biologie des Populations d'Oiseaux, Paris.