DANISH REVIEW OF GAME BIOLOGY Vol. 6. no. 4

Edited by Anders Holm Joensen

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by
JØRGEN FOG

(Med et dansk resumé: Dødelighed og
jagtlig udnyttelse af gråænder *(Anas platyrhynchos)*
udsat som skydefugle.)

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Смертность и охотничье использование
кряквы *(Anas platyrhynchos)*,
выпущенной с целью охоты.

COMMUNICATION NO. 83 FROM VILDTBIOLOGISK STATION
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Introduction

On many of the larger Danish estates, pheasants *(Phasianus colchicus)* are reared and released to improve the season's shooting. Similarly, mallards *(Anas platyrhynchos)* are sometimes reared and released, as for instance on the estates of Meilgaard and Brattingsborg (Fig. 1). Here, a large number of the ducks reared during 1963–68 were marked with rings from the Game Biology Station, and the recoveries obtained before 1. January 1970 illustrate dispersal, and the shooting success achieved. The open season for mallard in Denmark is from 16. August –31. December. A preliminary report has been given by Fog (1969) in Danish hunting magazines.

Meilgaard

Rearing and release techniques

The egg-laying birds originally came from stock of the Kongsdal estate, described by Fog (1965). They live all the year round in a moat, and most of the eggs are laid in duck houses and breeding baskets. As many as possible of the reared males are shot each year, so that in general the females mate with wild drakes. The eggs required for artificial hatching are collected, and using a forced-draught cabinet incubator which he has altered himself, the gamekeeper has obtained very good hatching results. Only data for 1969 are available: of 746 eggs 546 hatched (73 %).

During the first five to eight weeks, the ducklings are kept in a hut with an enclosed pen with access to water. For the first fourteen days they are fed on a proprietary initial food mixture for domestic ducklings, and then, over a period of six days, they are gradually accustomed to a diet of coarse-ground barley. After release, this is replaced with the waste from a grain-drier, consisting of small grain and weed seeds. After the ducklings have been ringed, they are moved from the rearing area to an artificial pond of about 1.5 hectares. Altogether 916 ducklings were ringed, and of these 589 were released in June, 321 in July, and 6 in August. Upon release, 441 ducklings were 5 weeks old, 420 were 7 weeks old, and 55 were 8 weeks old.

Shooting methods and shooting yield

Of the 631 birds recovered (Table 1), 626 were shot, 3 were found dead, and 2 were taken by dogs. For the total results, the recovery percentage is 69 % and it is noteworthy that 65 % of the individuals released were recovered within the boundaries of the estate, while only 3 % were recovered from other parts of Denmark and 1 % from abroad. In this connection, it should be pointed out that all rings from individuals shot or found dead at Meilgaard have been returned, whereas this is not the case for birds which died in other areas.

As is seen in Table 1, 597 birds were recovered from the estate itself, which comprises 2,500 hectares. Of these, 593 were shot, 451 on rising from the large artificial pond, and 142 on the moat and other small ponds, where shooting took place mostly during the evening feeding flight. The 593 birds shot were distributed over the shooting season as follows: August 155, September 316, October 53, November 42, and December 27.

Year of release *Udsætningsår*	Nos. juv. released *Antal ællinger udsat*	The recoveries *Genmeldingerne*							
		From Meilgaard *Fra Meilgaard*		From other parts of Denmark *Fra det øvrige Danmark*		From abroad *Fra udlandet*		Total *I alt*	
		Nos. *antal*	%	Nos. *antal*	%	Nos. *antal*	%	Nos. *antal*	%
1965	181	108	60	16	9	9	5	133	74
1966	401	248	62	2	1/2			250	63
1967	99	64	65	1	1			65	66
1968	235	177	75	6	2			183	77
Total – *i alt*	916	597	65	25	3	9	1	631	69

Table 1. Hand-reared Mallards ringed at the estate of Meilgaard 1965–68 and the recoveries obtained before 1. January 1970.

Tabel 1. Antallet af opdrættede gråænder, som er ringmærket på Meilgaard 1965–68, og de deraf genmeldte inden 1. januar 1970.

Year of release *Udsætningsår*	Nos. juv. released *Antal ællinger udsat*	The recoveries *Genmeldingerne*							
		From Brattingsborg *Fra Brattingsborg*		From other parts of Denmark *Fra det øvrige Danmark*		From abroad *Fra udlandet*		Total *I alt*	
		Nos. *antal*	%	Nos. *antal*	%	Nos. *antal*	%	Nos. *antal*	%
1963	124	22	18	16	13			38	31
1964	124	63	51	21	17			84	68
1965	122	91	75	6	5			97	80
1966	103	77	75	8	8	1	1	86	84
1967	150	90	60	17	11			107	71
Total – *i alt*	623	343	55	68	11	1	1/6	412	67

Table 2. Hand-reared Mallards ringed at the estate of Brattingsborg 1963–67, and the recoveries obtained before the end of December 1969.

Tabel 2. Antallet af opdrættede gråænder, som er ringmærket på Brattingsborg 1963–67, og de deraf genmeldte inden udgangen af december 1969.

Brattingsborg

Rearing and release techniques

The first ducks were hatched from eggs from an abandoned domesticated mallard nest, which was found at Brattingsborg. The duck stock is the progeny of the above mentioned ducks, and is kept on a pond on the estate.

From here the eggs are collected, and since 1964 they have been incubated in a stillair incubator. When enough eggs have been collected for the apparatus, the ducks are allowed to hatch a clutch themselves. The artificially reared ducklings are kept in a hut, until they can live without artificial heating. Then they are moved to the pond, where the breeding stock is kept. Both artificially and naturally reared ducklings have been ringed during the years 1963–1967, altogether a total of 623 birds, of which 232 were released at an age of 8–9 weeks and 391 at an age of 9–10 weeks. 365 were released in July and 258 in August. In 1963 all ducklings were released in one pond on the estate, but since then they have been released in several small marlpits, located in barley and wheat fields. The ducklings are fed only for a few days after release, and are then left to find their own food in the fields.

Shooting methods and shooting yield

Most ducks are shot on rising from the water, but when this type of shooting is practised once or twice at the same pond, the birds do not return. After this, some birds are shot during the evening feeding flight, at various parts of the estate.

Distance in km *Afstand i km*	0–5	5–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100	>100	Total *I alt*
Recovered in year of ringing *Genmeldt i mærkningsåret*	18	5	11	3	12	11	1	2	1	3	0	6	73
Recovered later *Genmeldt senere*	4	0	2	2	1	4	0	2	1	1	1	2	20
Total *I alt*	22	5	13	5	13	15	1	4	2	4	1	8	93
% of 93 *% af 93*	24	5	14	5	14	16	1	4	2	4	1	9	99

Table 3. Distances between points of release and recovery for 93 Mallards ringed as juv. at Meilgaard and Brattingsborg.

Tabel 3. Afstand mellem udsætnings- og genmeldingssted for 93 gråænder, der er mærket på Meilgaard og Brattingsborg som ællinger.

Year of release *Udsætningsår*	Nos. juv. released *Antal ællinger udsat*	The recoveries *Genmeldingerne*							
		Distribution in age-classes (1.1.–31.12.) *Fordeling på aldersgrupper (1.1.–31.12.)*							Total *I alt*
		1.	2.	3.	4.	5.	6.	7.	
1963	124	29	1	2	1	1	0	0	34
1964	124	73	4	2	1	0	1		81
1965	303	203	16	6	3	0			228
1966	504	297	22	14	1		5		334
1967	249	167	1	1		2			169
1968	235	177	6	5	3				183
Total – *i alt*	1539	946	50	25	6	1	1	0	1029
Total, corrected *Ialt, korrigeret*		946	50	30	9	3	6	0	1044
‰ af 1044		906	48	29	9	3	6	0	1001

Table 4. Number of ringed, hand-reared Mallards released as juv. and the recoveries obtained as shot before 1. January 1970. Below serrated line: Corrections for missing recoveries. PALUDAN's method is used (PALUDAN 1951).

Tabel 4. Antal mærkede gråænder udsat som ællinger og de deraf skudte indtil 31. december 1969. Under trappen er korrigeret for forventede, yderligere genmeldinger efter den metode, der er angivet af PALUDAN *(1951).*

As is seen in Table 2, 412 ducks were recovered before 1. January 1970, i.e. 67 % of the released birds. 403 were shot, 4 found dead, 2 taken by predators, 2 caught by man, and one flew into high-voltage wires. It is seen from Table 2 that 55 % of the individuals released were shot or found on Brattingsborg estate itself, (area 1,500 hectares), 11 % in the rest of Denmark and 1/6 % abroad. Of the 343 recoveries from Brattingsborg, 342 were shot and one found dead. The distribution of kills over the shooting season is: August 142, September 101, October 31, November 27, and December 41. As is seen from Table 2 in 1963 the shooting success on the estate itself was rather small, only 18 % of the released birds. This is due to the shooting pressure being lower in that year than in later ones. If the results for 1963 are excluded, the estate's shooting success of ducks released during 1964–1967 is 64%, almost the same as at Meilgaard.

Recoveries from outside the two estates

Altogether, 93 mallards were recovered in Denmark from outside the two estates. The distances of the recoveries from the locality of ringing are given in Table 3. It is seen that 73 birds were recovered in the year of ringing, and 20 in later years.

In both these categories about half of the birds were recovered within a distance of 0–30 km. from the point of release.

Only 10 (1 %) of the 1043 recoveries were from abroad (Fig. 1), and of these, 9 were birds released at Meilgaard in 1965. Relatively many birds released that year were recovered in Denmark outside Meilgaard estate (Table 1). The material does not include data which can be used to explain why, in that year, a greater percentage of ducks left the estate than in other years.

The sex of the two birds recovered in Sweden is unknown. Both were ringed in 1965, and shot in August and October 1967 respectively. It is possible that these were cases of abmigration. Recoveries from countries to the south-west of Denmark are distributed over the year as follows: August 2, October 2, November 1, December 1, and January 2.

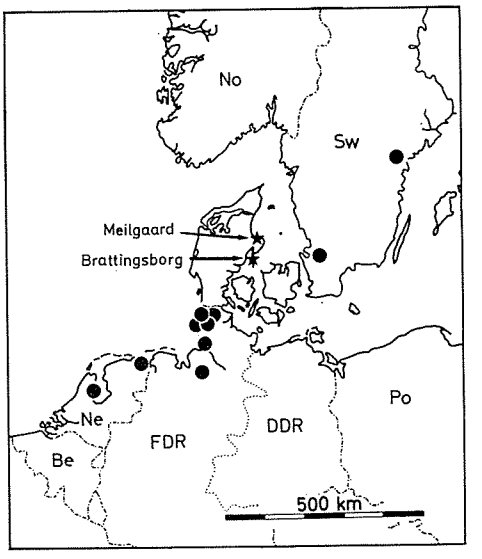

Fig. 1. Mallards ringed at Meilgaard and Brattingsborg and recovered outside Denmark.

Fig. 1. Gråænder ringmærket på Meilgaard og Brattingsborg og genmeldt i udlandet.

Mortality

In Table 4, all ringed mallards from the two estates are included, together with the recoveries obtained by shooting. When a correction is made for missing recoveries, the average mortality of first-year birds is 90.6 %. As is seen in Table 5, the mean adult mortality is 54.7 ± 2.4 %.

Based on data from HICKEY (1952), BALHAM and MIERS (1959) arrive at an equation which enables the calculation of the production of fledged young required to compensate for mortality, in any population with given first-year and adult mortality. The equation applies only to species which reproduce at an age of one year:

$$X = \frac{Mw}{50\ (1-M)}, \text{ where}$$

X = the number of young per pair at the time of ringing.
Mw = the annual loss per 100 adults (mean mortality rate per cent).
M = first-year mortality rate.
50 indicates 50 breeding pairs.

On substituting the mortality rates from the two estates a value of X = 11.6, is obtained.

The ducklings were ringed between 5–10 weeks of age (p. 3 and p. 5). According to the equation, if the population is considered to be a natural one, each female must contribute an average of 11.6 fledged ducklings in order to balance production and mortality. FOG (1965) reports that on the basis of Danish records of mallard nests, the average clutch size was 9.6. Thus it is not possible for the required production to be attained, but this is not necessary in this situation, where the ducks are released for shooting.

Shooting pressure, mortality, and required production

FOG (1964) has examined reports of reared, ringed mallards released throughout the whole of Denmark, and FOG (1965) has described production and mortality relationships in a semidomesticated mallard population on the Kongsdal estate, in Zealand. Data from these two investigations and the present study are compared in Table 6.

The percentage reported shot in this study and by FOG (1965) give an approximate value of the shooting pressure, as it is known that all the rings from the estates were sent in. It is necessary to presume that some of the rings from birds shot outside the estates have been lost. However, the percentage reported shot by FOG (1964) does not reflect the actual conditions, as the fact that many rings are never returned must be taken into account.

Table 6 shows that the shooting pressure at Meilgaard and Brattingsborg is much greater than at Kongsdal (66.9 % and 54.8 % respectively of the ringed individuals were reported shot). Together with this, the first-year mortality is 20 % higher at Meilgaard and Brattingsborg than at Kongsdal, 90.6 % and 70.3 % respectively. It is interesting to observe that the adult mortality lies on the same level in the two materials. This is thought to illustrate that an increase in the shooting pressure within the limits given here only has an effect on the total mortality of the young ducks.

As first-year mortality is the same for birds released throughout Denmark and for birds released at Kongsdal, it is tempting to assume that both categories of bird populations have been subjected to the same shooting pressure, and that less than half of the rings from shot birds of the first category have been returned to

X	d_x	Xd_x
1	50	50
2	30	60
3	9	27
4	3	12
5	6	30
6	0	0
Total *I alt*	98 = N	179

Table 5.
X: 1–6 represents age groups 2.–7. in Table 4. Column d_x : Recoveries from each group. The annual survival factor $\hat{s}$ is calculated according to Lack:

$$\hat{s} = 1 - \frac{N}{\sum Xd_x} = 0.4525$$

$$\text{S.D.: } \pi = 2x\,0.5475 \sqrt{\frac{0.4525}{98}} = 0.0236$$

The annual percentage survival for ducklings alive on their 1. January is 45.3 ± 2.4 % and the annual mortality consequently 54.7 ± 2.4 %.

Tabel 5.
X: 1–6 svarer til 2.–7. aldersgruppe i tabel 4. I kolonnen d_x er anbragt de genmeldte ænder for hver aldersgruppe incl. de forventede yderligere tilbagemeldinger. Den årlige overlevelsesfaktor $\hat{s}$ beregnes med Lack's formel således:

$$\hat{s} = 1 - \frac{N}{\sum Xd_x} = 0.4525$$

Den dobbelte standardafvigelse:

$$\pi = 2x\,0.5475 \sqrt{\frac{0.4525}{98}} = 0.0236$$

Efter de udsatte gråænder har overlevet det første årsskifte, er den årlige overlevelsesprocent 45.3 ± 2.4 %, og den årlige dødelighed følgelig 54.7 ± 2.4 %.

Material *Materiale*	Percentage reported shot % *Genmeldt som skudt %*	First-year mortality % *Førsteårs-dødelighed %*	Adult mortality % *Voksendødelighed %*	Production of fledged young required *Krav til produktion af flyvedygtige ællinger*
Fog (1964) Tables 9 & 10	(20.7)	73.4	58.8	4.4
Fog (1965) Tables 3, 4, 9 & 10	54.8	70.3	60.0	4.1
This study Tables 3 & 4 *Denne under-søgelse*	66.9	90.6	54.7	11.6

Table 6. Percentage reported shot, first-year mortality, adult mortality and required production in three materials of Mallards ringed as juv.

Tabel 6. Procenten af fugle rapporteret skudt, førsteårsdødeligheden, voksendødeligheden og produktionskravet i tre materialer af gråænder, der er ringmærket som ællinger.

First-year mortality *Førsteårs-dødelighed* %	Adult mortality *Voksen-dødelighed* %	Production required *Produktions-krav*
70	60	4
76	60	5
80	60	6
83	60	7
85	60	8

Table 7.
The production required to balance 60 % adult mortality and first-year mortality from 70–85 % in a Mallard population.

Table 7.
Produktionskravet, hvis en voksendødelighed på 60 % og førsteårsdødelighed på 70–85 % skal opvejes i en gråandebestand.

the Game Biology Station. On the basis of these data, however, it is not possible to see whether there is a linear correlation between hunting pressure and first-year mortality.

The required production of fledged ducklings is calculated by Fog (1964, 1965) to be 4.4 and 4.1 per female per year respectively, and on the basis of foreign and Danish reports, it is estimated that a required production of this order can be attained. As previously mentioned, however, a natural population cannot attain the production of 11.6 fledged birds necessary if the first-year and adult mortality are 90.6 % and 54.7 % respectively. It must be concluded that under Danish conditions, a mallard population can apparently tolerate that throughout the lifespan, about 55 % of the individuals in it fall prey to hunters, whilst a shooting pressure of 67 % would cause a decrease in the population.

Given the conditions of a first-year mortality varying from 70 % to 85 % and an adult mortality of 60 % per year, the required production was calculated (Table 7). PIRKOLA (1968) reports that the average brood success of the mallard is less than eight flying juveniles per pair in Finland. From the Netherlands, EYGENRAAM (1957) reports about 5 fledged ducklings per female, and from Denmark FOG (1964, 1965) mentions 5.0-7.5 young.

It is realistic to assume that under Danish conditions, a balance can be reached between production and mortality in a mallard population, as long as first-year mortality does not exceed about 75 %. As is evident in Table 7, such a first-year mortality rate and an adult mortality rate of 60 % can be balanced by a production of 5 fledged ducklings per adult female.

On the other hand, it is assumed that the population's reproductive capacity is exceeded, if the shooting pressure causes the first-year mortality to exceed 75 %.

Conclusion

With the rearing and shooting techniques used on the estates of Meilgaard (2,500 hectares) and Brattingsborg (1,500 hectares), it was possible to shoot about two-thirds of the mallards released. If the number of ducks released in each year is considered separately, it is noticed that in two cases at Brattingsborg and one at Meilgaard three-quarters of the released birds were shot within the boundaries of the estate itself. In agreement with the high shooting success on the estates, only few ducks were recovered from other Danich areas (3 % and 11 % respectively of the released individuals), and only 1 % and $^1/_6$ % respectively were reported from abroad. The results from the two estates are extremely satisfying. Such high shooting yields are exceptional for released pheasants, for instance, and many other larger estates could advantageously begin similar rearing and release methods, either with regard to the proprietor's own shooting, or to renting the shooting rights as a commercial proposition.

In previously published material on the mallard population at Kongsdal, 55 % of the ringed individuals were later shot, as against about 67 % in the present material. The intensive shooting at Meilgaard and Brattingsborg has caused the first-year mortality rate to be 20 % higher there than in the population at Kongsdal. However, the adult mortality rate of birds from both sources is at the same level. Assuming that the adult mortality is always more or less constant, when the shooting pressure fluctuates within the limits given in the comparison between Kongsdal and the other two estates, it is reasonable to assume that reproduction can balance mortality in a population, as long as the first-year mortality does not exceed about 75 %. This is calculated here with a production of 5 fledged ducklings per adult female in the population. It must be added that there is very little material available to shed light on the reproductive capacity of mallards in Denmark. If a natural population is subjected to the same shooting pressure as the ducks at Meilgaard and Brattingsborg were, the balance between production and mortality could not be maintained, as the required production in this instance would be 11.6 ducklings per adult female per year.

Summary

1) On the estates of Meilgaard and Brattingsborg, a total of 1539 ringed juveniles were hand-reared and released for shooting, from 1963–1968.

2) The eggs were artificially incubated, and the ducklings obtained released at an age of 5–10 weeks.

3) 1043 recoveries have been reported, comprising 68 % of the released birds. 940 of the recoveries were from the two estates, which have thus themselves recovered 61 % of the released birds. Only 93 birds were reported from the rest of Denmark, and 10 from abroad.

4) The first-year mortality rate is 90.6 %, and the adult mortality rate is 54.7 ± 2.4 %. A production rate of 11.6 fledged ducklings per adult female is required to balance this mortality. Such production cannot be attained.

5) Shooting pressure, first-year mortality, adult mortality, and required production concerning material from three sources in Denmark are compared. When the percentage of birds reported shot rises from 54.8 % to 66.9 %, the first-year mortality rises from 70.3 % to 90.6 %, whereas the adult mortality rate is not increased. A cautious estimate indicates that in Danish mallard populations, a balance can be maintained between mortality and production, as long as the first-year mortality does not exceed about 75 %.

Dansk resumé

Dødelighed og jagtlig udnyttelse af gråænder (Anas platyrhynchos) udsat som skydefugle.

1. På godserne Meilgaard og Brattingsborg (se fig. 1) blev der i 1963–68 udsat 1539 ringmærkede gråænder (ællinger). Man udsatte dem med henblik på jagtlig udnyttelse i den efterfølgende jagtsæson.
2. Æggene blev udruget på maskine og ællingerne udsat i 5–10 ugers alderen.
3. Der er indløbet 1043 genmeldinger (68 % af de udsatte fugle). 940 af genmeldingerne er kommet fra de to godser, der således selv har genmeldt 61 % af de opdrættede ænder. Kun 93 individer er rapporteret fra det øvrige Danmark og 10 fra udlandet (tabellerne 1, 2, 3 samt fig. 1.).
4. Førsteårsdødeligheden er 90.6 %, og den gennemsnitlige årlige dødelighed blandt voksne fugle 54,7 ± 2,4 % (tabellerne 4 og 5). Hvis der var tale om en naturlig bestand, ville der med de beregnede dødelighedsprocenter ikke kunne opretholdes balance mellem ællingeproduktion og mortalitet, idet produktionskravet er beregnet til 11,6 flyvedygtige ællinger pr. tilstedeværende hun pr. år (det gennemsnitlige ægantal er 9,6).
5. Jagttryk, førsteårsdødelighed, voksendødelighed og produktionskrav i tre danske materialer er sammenlignet i tabel 6. Når den del af genmeldingsprocenten, som forårsages af beskydning, stiger fra 54,8 til 66,9, vokser førsteårsdødeligheden fra 70,3 % til 90,6 %, medens den adulte dødelighed ikke øges. Et forsigtigt skøn synes at vise, at der i en dansk gråandebestand kan opretholdes balance mellem dødelighed og produktion, så længe førsteårsdødeligheden ikke overskrider ca. 75 % (tabel 7).

Резюме на русском языке:

Смертность и охотничье использование
кряквы *(Anas platyrhynchos)*, выпущенной с целью охоты.

1. На землях имений Мейлгорд и Братингсборг (см. фиг. 1) в течение 1963-68 г. было выпущено 1539 окольцованных утят *Anas platyrhynchos* с целью охоты в последующем сезоне.

2. Яйца выводились в инкубаторе, и утята выпускались на свободу в 5-10 недельном возрасте.

3. Получено 1043 сведений о встречах (68 % всех выпущенных птиц). Из этих сообщенний, 940 получены с вышеуказанных двух имений. Таким образом, они сами сообщили о 61 % разведенных ими уток. Только о 93 особях сведения получены из других мест Дании, а 10 встреч из других стран (табл. 1, 2, 3 и фиг. 1).

4. Смертность за первый год составляет 90,6 %, а средняя смертность взрослых птиц 54,7 $\pm$ 2,4 % (табл. 4 и 5). Если бы шла речь о естественном составе, то при полученных процентах смертности нельзя было поддерживать баланс между продукцией утят и смертностью, так как потребовалась бы годовая продукция 11,6 лётных утят на каждую самку (среднее число яиц составляет 9,6).

5. Интенсивность охоты, смертность за первый год, смертность взрослых особей и требуемая продукция на основании трех датских материалов сравнены в табл. 6. Если та часть процента встреч, которая получается вследствие отстрела, возрастает с 54,8 на 66,9 %, смертность за первый год повышается с 70,3 на 90,6 %, между тем как смертность взрослых особей не повышается. Осторожный подсчет к. б. указывает, что в местной популяции *Anas platyrhynchos* баланс между смертностью и продукцией может поддерживаться при условии, что смертность за первый год не превышает около 75 % (табл. 7).

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