BREEDING SUCCESS OF COMMON GULLS *LARUS CANUS* IN WEST SCOTLAND II. COMPARISONS BETWEEN COLONIES

BROEDSUCCES VAN STORMMEEUWEN IN WEST-SCHOTLAND II. VERGELIJKINGEN TUSSEN KOLONIES

J.C.A. CRAIK

Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, P.O. Box 3, Oban, Argyll PA34 4AD, Scotland, U.K.

In a study of Common Gull Larus canus *breeding success in west Scotland from 1991-1997, the number of colonies of five or more pairs monitored each year varied between 13 in 1991 and 27 in 1995. Observed mean clutch size varied greatly between colonies, from zero at colonies severely affected by predation by American Mink* Mustela vison, *to 3.0 at a colony where no predation was detected. Excluding mink-affected colonies, mean clutch for all colonies combined varied between 2.47 in 1993 (n = 663 clutches at 12 colonies) and 2.69 in 1995 (n = 843 at 14 colonies). Productivity (young fledged/pair nesting) varied significantly between colonies. In 98 observations of colonies during 1994-1997, there were 41 records of colonies producing no young, and mink predation of eggs or chicks occurred at most of these (between 25 and 38, 61%-93%). The highest productivity of a colony was 1.6 at a site where predation was not detected. Productivity for all colonies combined varied significantly between years, from 0.1 in 1993 to 0.4-0.6 in 1996 and 1997 when mink were removed from some of the colonies. For the years 1994-1997 combined, colonies apparently unaffected by predation fledged a mean of 0.7-0.9 young/pair (n = 23); colonies affected by raptors, usually or always Peregrine Falcons* Falco peregrinus, *fledged 0.4 (n = 11); colonies close to colonies of the larger gulls fledged 0.4 (n = 7); one colony affected by otter* Lutra lutra *predation fledged 0.76; and colonies affected by mink fledged 0.04-0.06 (n = 36). Predation by native species was rarely associated with whole-colony breeding failure (2 out of 19 colony observations), whereas predation by mink was commonly associated with whole-colony breeding failure (25 out of 36 colony observations). Between 1989 and 1997, at 32 colonies in 15 sealochs and sounds, total numbers of breeding pairs of Common Gulls decreased by 41% from 1248 to 734. Breeding Common Gulls disappeared from six of these 15 areas and decreased at six; at two sealochs where they increased, mink had been removed each spring to protect breeding seabirds; and, at one sealoch, breeding Common Gulls persisted only by nesting on a factory roof. These declines and disappearances are ascribed to the widespread annual breeding failures of Common Gulls caused by mink predation: too few young are reared each year to replace adults that die from all causes.*

Craik J.C.A. 2000. Breeding success of Common Gulls *Larus canus* in west Scotland. II Comparisons between colonies. Atlantic Seabirds 2(1): 1-12.

INTRODUCTION

Most of the Common Gulls *Larus canus* in western Scotland breed in colonies of 10-100 pairs on small marine islands close to the mainland, almost always in sealochs, sounds and firths. Study of one such colony showed low productivity in 1988-1990 associated with predation by Peregrine *Falco peregrinus* and Herring Gull *L. argentatus*, followed by zero productivity in 1991-1992 after American Mink *Mustela vison* ('mink') took up residence on the island. The colony site was then abandoned by Common Gulls in 1993-1997 (Craik 1999).

A high density of easily available prey stimulates surplus killing behaviour by many carnivore species (Kruuk 1972). In the relatively small but high-density seabird colonies of the sealochs and sounds of western Scotland, such behaviour by mink can lead to widespread whole-colony breeding failures.

Predation by mink at seabird colonies in this area was first observed in 1983 and became widespread from 1989 onwards, seriously affecting the breeding success and breeding distribution of island-nesting colonial seabirds. The seabird species most affected by mink are those with smaller eggs and chicks, particularly terns *Sterna* spp., small gulls such as Common Gull and Black-headed Gull *L. ridibundus,* and Black Guillemot *Cepphus grylle* (Craik 1995, 1997 and unpublished results 1989-1997).

The purpose of the work described here was to record the numbers and productivity of Common Gulls at many colonies over several years, with particular reference to the effects of predators.

METHODS

The study area lay along the mainland of west Scotland between Fort William (56°50' N) and West Loch Tarbert (55°50' N). Most of the coasts of the large islands of Mull and Gigha were excluded since they were not regularly accessible. Clutch sizes and productivity were measured at Common Gull colonies on small islands during the years 1991-1997. The number of colonies visited each year varied between 13 (in 1991) and 27 (in 1995). In 1994-1997, almost all known Common Gull colonies in the area were visited. Colonies with fewer than five pairs are excluded from the analysis below. These, many with only single pairs, held a small minority of the total breeding population; for example, in 1997 they represented 1.5% of all known pairs but seven of 30 colonies.

During 20-30 May, a single visit was made to each colony to count clutches. Pilot work had shown this to be the optimum period (unpublished results 1988-1990). Eggs were marked to prevent double-counting. The number of clutches and well-formed empty nests defined the number of pairs breeding. A second visit was made in mid to late June when the number of large chicks was

counted or estimated. At smaller colonies (<100 pairs) the whole colony could be counted and most chicks were found; at larger colonies (100-300 pairs) chicks were ringed and estimates of the total present were obtained by mark-recapture or by proportion of area covered (Walsh *et al.* 1995). Estimates were sometimes expressed as ranges and, at densely vegetated colonies, figures were rounded up to the nearest ten in order to account for concealed chicks. Productivity at each colony was calculated as the number of large young on the second visit/number of pairs (defined above) on the first visit. In 1989 clutches were counted at some of these colonies, but productivity was not measured.

In 1991-93 it was clear that many Common Gull colonies were failing to fledge any young because of mink predation of eggs and chicks. In 1994-1997 respectively, one, two five and eight of the study colonies were included in a mink control programme; mink were trapped within 1 km of these colonies (and humanely killed) in Feb-Apr, before any eggs had been laid.

During 1994-1997, predator species were inferred from prey remains (Craik 1995, 1999). Predation of small young by gulls was rarely detectable, since such prey is eaten or carried off whole. Common Gull colonies within 100 m of larger colonies of large gulls (Herring Gull, Great Black-backed Gull *L. marinus* and/or Lesser Black-backed Gull *L. fuscus*) have been classified under 'Large gulls'.

Chi-square tests, using Yates' correction where appropriate, were applied to the data (Fowler & Cohen 1986).

RESULTS

Clutch size The highest mean clutch recorded for any colony was 3.0 (all 22 nests held three eggs each). Corresponding figures for lowest mean clutch have little meaning because of egg predation. Egg collection by humans is known to occur in some areas. Egg removal by mink was severe at some colonies, leading to mean clutch sizes that were abnormally low or zero. For example, at one mink-affected colony there were no nests with more than one egg, four nests with a single egg each, and 19 empty nests; at another there were no eggs and 37 empty nests.

In order to minimise the difficulty in assessing true clutch size only colonies where 20 or more clutches were found were considered. Ignoring empty nests, mean clutch size over all such colonies for each of the years 1990-1997 varied from 2.47 (n = 663 clutches at 12 colonies in 1993) to 2.69 (n = 843 at 14 colonies in 1995). This between-year variation was significant $\chi^2_{14} = 69.4$, $P < 0.001$; analysis performed on numbers of nests with 1, 2, 3+ eggs). It is not possible to say how much of this variation may have been caused by low levels of predation. Data from these colonies were combined for 1990-1997 (Table 1). Clutches with more than three eggs were found occasionally in seven of the eight years; this may have resulted from two females laying in one nest.

Table 1. Clutch size (number of eggs per clutch) of Common Gull, 1990-97; 83 colony records.
Tabel 1. Legselgrootte (aantal eieren) bij Stormmeeuwen, 1990-97; 83 kolonie studies.

	1 egg	2 eggs	3 eggs	4 eggs	5 eggs	Total no. clutches	Mean clutch size
No. of clutches	610	1267	4023	15	2	5917	2.58
% of clutches	10.3	21.4	68.0	0.3	0.0		

Table 2. Productivity of Common Gulls (all colonies combined). In "Pairs" column, total number of pairs studied each year is followed in brackets by range of colony size in pairs. In "Fledged" column, the total number fledged is followed in brackets by the number of colonies which fledged no young:total number of pairs at those colonies.
Tabel 2. Productiviteit van Stormmeeuwen (all kolonies gecombineerd). Onder paren ('pairs') wordt de variatie in koloniegrootte tussen haakjes weergegeven. Onder de uitgevlogen jongen ('fledged') wordt tussen haakjes het aantal jongen/aantal broedparen op deze kolonies gegeven.

Year	Colonies	Pairs	Fledged	Fledged/pair
1991	13	883 (9-246)	224-356 (4:250)	0.25-0.40
1992	17	1236 (5-309)	205-254 (7:213)	0.17-0.21
1993	17	978 (8-280)	85-152 (10:423)	0.09-0.16
1994	25	1211 (6-281)	294-433 (14:380)	0.24-0.36
1995	27	1175 (6-306)	412-536 (11:251)	0.35-0.46
1996	23	913 (5-293)	399-519 (11:196)	0.44-0.57
1997	23	1107 (5-344)	540-667 (5:199)	0.49-0.60

Productivity The numbers of Common Gull colonies visited, numbers of pairs counted and numbers of young fledged each year are given in Table 2.

Every year there were colonies at which no young fledged, leading to great variation in productivity between colonies. Within each year, the null hypothesis that productivity did not vary between colonies was tested by chi-square tests. This null hypothesis was rejected for each year: for 1991-1997 respectively: $\chi^2_{12} = 259$, $\chi^2_{16} = 229$, $\chi^2_{16} = 182$, $\chi^2_{24} = 525$, $\chi^2_{26} = 463$, $\chi^2_{22} = 234$, and $\chi^2_{22} = 352$; $P < 0.001$ in all cases.

The variation between years in overall productivity (Table 2) was not analysed because (a) the number of colonies monitored varied between years; (b) productivity was affected by mink predation, often leading to whole-colony breeding failure; and (c) mink control increased over the years, allowing the gulls to rear more young. Overall productivity ranged from about 0.1-0.2 young/pair in 1992 and 1993 to about 0.4-0.6 in 1996 and 1997. Both the increase in productivity

Table 3. Effect of predators and other factors on productivity of Common Gulls.
Tabel 3. Effecten van predatoren en andere factoren op de productiviteit van Stormmeeuwen.

	No. pairs	No. colonies	No. fledged	Colonies fledging none
1994				
No predators	323	3	228-340	0
Raptors	94	2	30	0
Mink confirmed	679	15	36-57	11
Mink suspected	115	5	0-6	3
1995				
No predators	360	4	245-349	0
Raptors	101	2	73	0
Large gulls	59	2	28-30	0
Otter	66	1	50	0
Terns	13	1	0-2	0
Mink confirmed	506	10	16-31	5
Mink suspected	70	7	0-1	6
1996				
No predators	506	6	330-445	0
Raptors	123	4	33	0
Large gulls	88	2	36-41	0
High tide	7	1	0	1
Mink confirmed	151	6	0	6
Mink suspected	38	4	0	4
1997				
No predators	651	10	481-594	0
Raptors	151	3	44-55	1
Large gulls	44	3	10-12	1
Mink definite	213	5	2-3	3
Mink suspected	48	2	3	0
Total	4406	98	1645-2155	41

towards the end of this period and the decrease in the number of failed colonies in 1997 (Table 2) accompanied increased levels of mink control (Table 3 and below).

Factors affecting productivity In 1994-1997, there was a total of 98 records from colonies (a colony that was observed in two, three or four years gave two, three or four records). These records were classified according to various influences, such as types of predator, as shown in Table 3. There were 36 records of confirmed mink predation at colonies (15, 10, 6 and 5 for 1994-97 respectively) and a further 18 (5, 7, 4 and 2) records of suspected mink predation at colonies. In addition, mink

were removed from colonies on 16 occasions (1, 2, 5 and 8) and of these, mink predation did not occur at 14 (1, 2, 5 and 6 from 1994-97 respectively). Thus mink were present at 50-68 of 98 colony records (51%-69%).

Whole-colony breeding failure was recorded in 41 of the 98 colony observations. Of these, mink were confirmed as predators at 25 (11, 5, 6 and 3 from 1994-97 respectively) and suspected at a further 13 (3, 6, 4 and 0). Thus a high proportion of whole-colony failures were associated with predation of eggs and chicks by mink (25-38 of 41, or 61%-93%). The yearly increase in mink control accounts for the decrease in number of mink-affected colonies in 1997. For a comparison of productivity between colonies which were and which were not protected in this way, see Craik (1998).

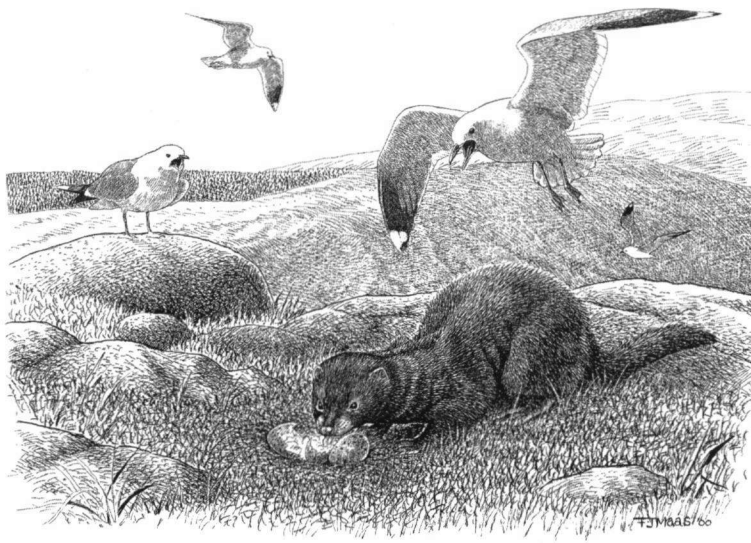
Other factors which affected breeding success were Peregrine Falcons, European Otters *Lutra lutra*, nearby colonies of large gulls, tern colonies on the same small island (where persistent aggression by adult terns deterred adult Common Gulls from approaching their own eggs or young), and high tides washing out clutches.

The effects of these various influences are summarised in Table 4; productivity of colonies where predation was not detected was 0.7-0.9; where predation by raptors was evident, it was about 0.4; near colonies of large gulls, it was about 0.4; and where there was chick predation by otters, it was 0.75 (although this figure is based on only one colony and is therefore provisional). Colonies affected by mink had very low mean productivity (0.04-0.06). Aggression by terns, recorded in one instance only, was also associated with low productivity of Common Gulls.

Predation by native predators was rarely associated with whole-colony breeding failure (a total of 2 out of 11, 7 and 1 instances involving raptors, gulls or otters respectively; Table 4), whereas predation by mink commonly led to whole-colony breeding failure (25 out of 36 instances when mink predation was definitely recorded; Table 4). This difference is highly significant ($\chi^2_1 = 15.0$, $P < 0.001$).

Productivity in the absence of predation At colonies where there was no evidence of predation, mean productivity for 1994-1997 combined was about 0.7-0.9 (Table 4). It was remarkably constant from year to year (0.71-1.1, 0.68-0.97, 0.65-0.88, and 0.74-0.91 in each of the years 1994-1997; Table 3). This range probably represents the maximum that this population, comprising a number of colonies, is capable of achieving when free of predation. The highest productivity recorded at a single colony was 1.57 young/pair.

In 1991-1996, colony productivity exceeded 1.0 only four times and never at more than one site each year. In 1997, it exceeded 1.0 at five sites; mink were killed locally at four of these, a higher proportion than in earlier years, which suggests that mink control contributed to this enhanced breeding success.



Mink plundering Common Gulls nest *Amerikaanse Nerts plundert Stormmeeuwnest* (F.J. Maas)

Effects of repeated breeding failure: local extinctions Three distinct effects of annually recurring, mink-related whole-colony breeding failures of seabirds have been described in this area (Craik 1995, 1997): (1) terns and small gulls abandon breeding sites and nest elsewhere; (2) overall breeding numbers decline; and (3) discrete areas of the habitat, such as sealochs, sounds and archipelagos, lose all or most of their breeding seabirds. In these circumstances, Common Gulls are often the last species to move their breeding site and they tend to move as short a distance as possible, frequently to the nearest island or the nearest mainland.

Counts of Common Gulls at 32 colonies in both 1989 and 1997 indicated a 41% decrease in total numbers breeding in 15 areas, i.e. sealochs and sounds (Table 5). Mink predation of adults, eggs or young was recorded at Common Gull colonies in all 15 areas at some time during 1989-1997. Breeding Common Gulls

Table 4. Mean estimated productivity of Common Gulls in colonies subject to various influences, 1994-97. Data are those in Table 3, excluding the "mink suspected" data. A colony studied each year may be represented four times here.

Tabel 4. Gemiddelde jongenproductie van Stormmeeuwen in kolonies die blootstaan aan een verscheidenheid aan verstoringen, 1994-97. De basisgegevens zijn in Tabel 3 samengevat (uitgezonderd de 'vermoedelijk' door Amerikaanse Nertsen verstoorde nesten). Een kolonie die jaarlijks werd onderzocht kan 4x in deze tabel voorkomen.

	Pairs	Colonies	Fledged	Colonies fledging no young	Fledged /pair
No predators	1840	23	1284-1728	0	0.70-0.94
Raptors	469	11	180-191	1	0.38-0.41
Gulls	191	7	74-83	1	0.39-0.43
Mink	1549	36	54-91	25	0.04-0.06
Otter	66	1	50	0	0.76
Terns	13	1	0-2		0.0-0.15
High tide	7	1	0	1	0

Table 5. Changes in numbers of pairs of Common Gulls 1989-97. The number of colonies is given in brackets. These figures represent an overall decrease of 41%.

Tabel 5. Veranderingen in aantallen broedparen Stormmeeuwen, 1989-97. Het aantal kolonies is tussen haakjes aangegeven. Deze gegevens representeren een totale afname van 41%.

Sealoch or Sound	1989	1997
L Teacuis/Sunart (2)	30	0
L Linnhe (5)	77	41
Coruanan (1991-1997)(1)	138	31
L Leven (3)	94	24
L Creran (2)	15	*c.* 20*
L Etive (4)	471	492
L Feochan (1)	36	23
L Melfort (3)	123	13
L Craignish (2)	63	84
L Crinan (1)	50	0
Sound of Luing (2)	26	0
L Sween: Danna (1)	50	0
L Fyne: Whitehouse Bay (1)	35	0
L Caolisport (1987) (2)	10	6
L Sween (2)	30	0
Total (32 colonies)	1248	734

* No ground- or island-nesters remained in Loch Creran in 1997 and these 20 pairs bred on an inaccessible roof (see text); this count is based on adults since clutches could not be counted.

were extirpated from six of the areas and decreased in another six; they increased in three sealochs - Lochs Etive, Craignish and Creran. Most of the mink control (see above) in 1994-1997 took place in Loch Etive, Loch Craignish and Loch Feochan. At Loch Creran all island-nesting Common Gulls left after well-recorded mink predation of eggs and young in successive years from 1989. By 1995-97 the only breeding Common Gulls were in a new colony on the roof of a shoreside factory, where they were presumably inaccessible to mink and where they fledged young in each of those three years.

DISCUSSION

Whether or not American Mink have affected the native fauna of the countries to which they have been introduced has been the subject of much debate. In particular, Birks (1986) and Dunstone (1993) have argued that the impact of mink has been slight or undetectable. This may be true for non-colonially breeding aquatic bird species, although strictly comparable "before-and-after" comparisons of such species appear not to have been made. It is certainly not true for ground-nesting seabird species that breed in dense colonies on islands. The work described here shows that the effect of mink on Common Gulls in west Scotland has been severe. Mink were present at a surprisingly high proportion of Common Gull colonies and responsible for most of the whole-colony breeding failures. This led to local declines in breeding numbers and to the abandonment by Common Gulls of many traditional breeding sites (Table 5 and Craik 1997, 1998).

This work attempts to quantify the extent to which breeding by Common Gulls is affected by and adapted to different predators. The figures in Table 4, although intended only as an approximate estimate of predator impact, show that Common Gulls are able to fledge reasonable numbers of young in the presence of native predator species, but that they are unable to do so in the presence of an introduced predator. This suggests that a fine adaptive balance exists between predator and prey species that have co-evolved and co-adapted to a habitat, and shows how easily this equilibrium can be disrupted by an introduced species.

Possible reasons for the severity of this disruption of seabird breeding patterns by introduced mink include: (1) their swimming ability allows them to reach islands up to 2 or 3 km offshore that were formerly safe from most mammalian predators; (2) both seabirds and mink utilise the shoreline habitat so that predator easily encounters prey; (3) mink readily travel to exploit a newly encountered source of abundant prey and so take up permanent residence in the colony (otters appear not to do this); and (4) mink often kill more than they eat. Much remains unknown of the details of the subsequent whole-colony breeding failures; it may be that the disruption of the colony by the permanent presence of a newly arrived mink is so extreme that other predators are able to exploit the unprotected eggs and chicks.

Adverse effects of American Mink and Herring Gulls on the breeding success of Common Gull colonies in the Baltic have been reported (Bergman 1986; Kilpi 1995). American Mink have also been considered responsible for the decline and disappearance of the water vole *Arvicola terrestris* from parts of Britain (Woodroffe & Lawton 1990; Lawton & Woodroffe 1991; Strachan 1997; Lambin 1998). There are many reports (some anecdotal) from Scandinavia and Iceland on the decline and disappearance of Black Guillemots, Razorbills *Alca torda* and other bird species following the arrival of American Mink (Andersson 1992; Asbirk 1978; Errington 1961; Folkestad 1982; Gerell 1968; Johansen 1978; Niemimaa & Pokki 1990; Olsson 1974; Bergman 1971 and *pers. comm.* 1990). However, there are comparatively few quantitative data that relate the primary effects of introduced mink on seabirds (widespread whole-colony breeding failures) to their consequent secondary effects (population decline).

In the absence of an adequate population model, it is difficult to say whether the higher values of overall productivity, 0.4-0.6, seen in 1996-1997 when mink were controlled at five to eight of the colonies (Table 2), will be high enough to reverse the present decline in population numbers. It seems likely, however, that lower mean productivity, such as the 0.1-0.2 recorded in 1992-1993 when there was little or no selective control of mink, are unsustainable. It is difficult to avoid the conclusion that Common Gulls in west Scotland are now unable to maintain their numbers, and that they will continue to decrease in numbers unless mink are controlled at selected colonies every year.

ACKNOWLEDGEMENTS

I am most grateful to R., A. and N. Lightfoot for help with fieldwork, and to M.P. Harris, K.R. Thompson, M. Tasker and an anonymous referee for valued comments on earlier drafts.

SAMENVATTING

In deel twee van het onderzoek naar broedsucces van Stormmeeuwen in de buurt van Oban (West Schotland) worden de verschillen tussen kolonies beschreven op basis van onderzoek in de periode 1991-97. Het aantal onderzochte kolonies varieerde van 13 in 1991 tot maximaal 27 in 1995. De legselgrootte varieerde van 0 in kolonies waar Amerikaanse Nertsen hadden huisgehouden tot 3.0 op een plaats waar geen sporen van predatie konden worden aangetoond. In gebieden waar de effecten van predatie door Amerikaanse Nertsen te verwaarlozen waren, varieerde de legselgrootte van 2.47 in 1993 (n= 663 legsels in 12 kolonies) tot 2.69 in 1995 (n= 843 legsels in 14 kolonies). Ook het uitvliegsucces (uitgevlogen jongen per broedpaar) verschilde sterk tussen de onderzochte kolonies. In 41 gevallen (n= 98 onderzochte kolonies) vloog geen enkel jong uit en in veel gevallen werden sporen van Amerikaanse Nertsen aangetroffen die eieren of jongen hadden gepredeerd (25-38 gevallen; 61-93% van de niet producerende kolonies). De hoogst gemeten productie bedroeg 1.6 jongen per paar in een kolonie waar geen Amerikaanse Nertsen voorkwamen.

De productiviteit voor alle kolonies tezamen varieerde van 0.1 in 1993 tot 0.4-0.6 in 1996 en 1997, toen Amerikaanse Nertsen succesvol waren bestreden in een deel van de broedgebieden. In de periode 1994-97, vlogen 0.7-0.9 jongen per paar uit in 23 kolonies die blijkbaar weinig last hadden van predatie; 11 kolonies die last hadden van predatie door roofvogels (meestal Slechtvalken Falco peregrinus*) kenden een productie van 0.4 jongen per paar; 7 kolonies in de onmiddellijke omgeving van*

broedkolonies van grote meeuwen hadden eveneens een uitvliegsucces van 0.4 jongen per paar; één kolonie waar sporen van predatie door Otters Lutra lutra *werden aangetroffen kende een uitvliegsucces van 0.76 jongen per paar; de resterende 36 kolonies, alle met vraatsporen van Amerikaanse Nertsen, brachten 0.04-0.06 jongen per paar groot. Uit dit materiaal blijkt, dat in kolonies waar inheemse predatoren eieren of jongen pakten zelden of nooit een totaal verlies van jongenproductie werd waargenomen (2 van de 19 kolonies). In schril contrast daarmee staat het effect van de (geïntroduceerde/ ontsnapte) Amerikaanse Nerts: 25 van 36 koloniewaarnemingen met een totaal mislukt broedseizoen.*

Tussen 1989 en 1997 nam de populatie Stormmeeuwen in 32 kolonies in 15 zee-armen en -engtes met 41% af van 1248 naar 734 broedparen. Broedende Stormmeeuwen verdwenen uit zes van de 15 kustgebieden, namen af in zes andere en in twee gebieden waar een toename kon worden geconstateerd waren Amerikaanse Nertsen elk voorjaar intensief bestreden. In het 15e kustgebied, tenslotte, konden broedende Stormmeeuwen zich slechts handhaven door op het dak van een fabriek te nestelen. De geconstateerde afname in het broedsucces en het broedvoorkomen van Stormmeeuwen in dit deel van Schotland wordt geheel toegeschreven aan de predatie van eieren en jongen door Amerikaanse Nertsen: de kolonies produceren eenvoudig te weinig jongen om de populatie in stand te houden.

REFERENCES

Andersson A. 1992. Sjöfågelbeståndets utveckling i Bullerö skärgård efter invandring av mink. Ornis Svecica 2: 107-118.

Asbirk S. 1978. Tejsten *Cepphus grylle* som ynglefugl i Danmark. Dansk orn. Foren. Tidsskr. 72: 161-178.

Bergman G. 1971. Grylleteisten *Cepphus grylle* in einem Randgebiet: Nahrung, Brutresultat, Tagesrhythmus und Ansiedlung. Comment. Biol. 42: 1-26.

Bergman G. 1986. Feeding habits, accommodation to man, breeding success and aspects of coloniality in the Common Gull *Larus canus*. Ornis Fenn. 63: 65-78.

Birks J. 1986. Mink. Anthony Nelson Ltd, Oswestry.

Craik J.C.A. 1995. Effects of North American Mink on the breeding success of terns and smaller gulls in west Scotland. Seabird 17: 3-11.

Craik J.C.A. 1997. Long-term effects of North American Mink on seabirds in western Scotland. Bird Study 44: 303-309.

Craik J.C.A. 1998. Recent mink-related declines of gulls and terns in west Scotland and the beneficial effects of mink control. Argyll Bird Report 14: 98-110.

Craik J.C.A. 1999. Breeding success of Common Gulls *Larus canus* in west Scotland I. Observations at a single colony. Atlantic Seabirds 1(4): 169-181.

Dunstone N. 1993. The Mink. Poyser, London.

Errington P.L. 1961. An American visitor's impressions of Scandinavian waterfowl problems. J. Wildlife Management 25: 109-130.

Folkestad A.O. 1982. The effect of mink predation on some seabird species. Viltrapport 21: 42-49.

Fowler J. & Cohen L. 1986. Statistics for ornithologists. B.T.O. Guide No. 22, British Trust for Ornithology, Tring.

Gerell R. 1968. Food habits of the Mink *Mustela vison* in Sweden. Viltrevy 5: 119-174.

Johansen O. 1978. Reproduction problems of some Laridae species in western Norway. Ibis 120: 114-115.

Kilpi M. 1995. Breeding success, predation and local dynamics of colonial Common Gulls. Ann. Zool. Fenn. 32: 175-182.

Kruuk H. 1972. Surplus killing by carnivores. J. Zool., Lond. 166: 233-244.

Lambin X. 1998. Book review of Water Voles by R. Strachan (1997). Mammal News 113: 15.

Lawton J.H. & Woodroffe G.L. 1991. Habitat and the distribution of Water Voles: why are there gaps in a species' range? J. Anim. Ecol. 60: 79-91.

Niemimaa J. & Pokki J. 1990. Minkin ravinnosta Suomenlahden ulkosaaristossa. Suomen Riista 36: 18-30.

Olsson V. 1974. Förändringar inom en population av tordmule *Alca torda* och tobisgrissla *Cepphus grylle* i Östergötlands skärgård 1954-1973. Vår Fågelvärld 33: 3-14.

Strachan R. 1997. Water Voles. Whittet Books.

Walsh P.M., Halley D.J., Harris M.P., del Nevo A., Sim I.M.W. & Tasker M. L. 1995. Seabird monitoring handbook for Britain and Ireland. Joint Nature Conservation Committee, Peterborough.

Woodroffe G.L. & Lawton J.H. 1990. The impact of feral Mink on Water Voles in the North Yorkshire Moors National Park. Biol. Conserv. 51: 49-62.

ERRATUM

In: Breeding success of Common Gulls I: *Atlantic Seabirds* 1(4) page 176. the second sentence of the Legend to Figure 4 should begin: "Solid circles, open circles, open squares and solid squares are..."

Common Gulls *Stormmeeuwen* (C.J. Camphuysen)