Table 1: Clutch sizes and the reduction in brood size at hatching

	Clutch size at the time of finding				
	2	3	4	5	eggs
Number of nests	2	11	34	1	
Nests with:					
1 infertile egg	0	0	5	0	
1 partly developed embryo	0	1	2	0	
Nests losing:					
1 egg	0	1	3	1	
3 eggs	0	0	1	0	

Two nests are represented in more than one category: one nest had one infertile egg and also lost an egg during incubation; another nest contained one infertile egg and an egg with a dead embryo.

The rate of loss (as defined above) of individual eggs from nests (as opposed to the loss or failure of entire clutches) may be estimated in the same way as the rate of nest loss. At each visit to a nest, the number of eggs was noted. An egg present for one day represents one 'egg-day'. The outcome of each nest with eggs is now unimportant and, of the original 48 nests, the data for the 37 nests of known outcome and five nests of unknown outcome can be utilised. Eight egg losses occured out of 2,403 egg-days (only eggs known to be present are included in the total eggs days), representing a loss rate of 0.0033 eggs per day, or a survival probability of 0.9967 per day. The survival probability for an individual egg is 0.918 over a 26-day incubation period (this does not take into account egg loss during the laying period).

The number of eggs in a nest at the start of incubation is a useful and exact definition of clutch size. In this study, the mean number of eggs per nest at the time of finding was 3.71 (n=48). How good is this as an estimate of initial clutch size? The mean observation time (exposure) of successful nests was 20 days per nest. Assuming an incubation period of 26 days, these nests were therefore found after a mean of 6 days incubation had elapsed. If this was true of all nests found, the egg loss over this period may be estimated and the clutch size estimate corrected accordingly. 4 eggs may have been lost over this period (from the success rate per egg-day) and the clutch size estimate corrected to 182/48 or 3.8 eggs per nest. This estimate of clutch size (noting that such estimates are poor substitutes for hard data) is identical to that of Jackson & Jackson (1975) for birds nesting in Hampshire.

The small amount of data available from this study inevitably limits the sophistication of the analysis. With larger samples, the Mayfield method can be used to look in greater detail at differences in failure rates in different populations, at different times of year and so on (Willis 1981). It would also be of interest to compare rates of individual egg loss, infertility and embryonic death between populations.

References

Cadbury,C.J. & S.Housden. 1982. Outer Hebrides - threat to breeding waders. Wader Study Group Bull. 35:5.
Furness,R.W. & B.L.Furness. 1981. A technique for estimating the hatching date of eggs of unknown laying date. Ibis 123: 98-102.
Green,G.H. 1980. Changing agricultural practice: Scotland and breeding waders. Wader Study Group Bull. 29:5.
Hensler,G.L. & J.D.Nichols. 1981. The Mayfield method of estimating nesting success: a model, estimators and simulation results. Wilson Bull. 93: 42-53.
Jackson,R. & J.Jackson. 1975. A study of breeding Lapwings in the New Forest, Hampshire 1971-1974. Ringing & Migration 1: 18-27.
Johnson,D.H. 1979. Estimating nest success: the Mayfield method and an alternative. Auk 96: 651-661.
Mayfield,H. 1961. Nesting success calculated from exposure. Wilson Bull. 73: 255-261.
Mayfield,H. 1975. Suggestions for calculating nest success. Wilson Bull. 87: 456-466.
Pienkowski,M.W. 1983. Breeding biology and population dynamics of Ringed Plovers Charadrius hiaticula in Britain and Greenland: nest predation as a possible factor limiting distribution and timing of breeding. J. Zool., Lond. 202: in press.
Redfern,C.P.F. 1983. Lapwing nest sites and chick mobility in relation to habitat. Bird Study 29: 201-208.
Willis,E.O. 1981. Precautions in calculating nest success. Ibis 123: 204-206.
Witherby,H.F., F.C.R.Jourdain, N.F.Ticehurst & B.W.Tucker. 1941. The Handbook of British Birds. H.F. & G. Witherby, London.

C.P.F.Redfern, 66 Highfield Avenue, Appleton Park, Warrington, Cheshire, WA4 5DX.

AN UNCERTAIN FUTURE FOR BREEDING WADERS IN ICELAND

by R.W. Summers and M. Nicoll

Many of the species of waders which visit Britain, either during migration or to winter on the coast, breed in Iceland. It is generally felt that those birds which breed in northern, sparsely populated, lands are relatively safe from the influences of man. Such a notion is far from the truth. Many waders which breed in Iceland do so in marshes, a threatened habitat.

Iceland has a surface area of 103,100 km^2, of which only 9,000 km^2 is, or has been, marsh-land (Sigfússon 1976). There are several different types of marsh to be found in Iceland. Peninsula marshes, which are found on lowland peninsulas, tend to be acidic, peaty and generally unfit for cultivation. Flood plain marshes occur at the mouths of large rivers which periodically flood the marshes, and the soil is composed of sand and silt. Valley marshes are found in valley bottoms. Finally, there are low mountain marshes which contain much wind blown dust in their soils (Hallgrímsson 1977).

The marsh vegetation of valley marshes is dominated by sedges (Carex spp. and Eriophorum spp.), horsetails (Equisetum spp.) and dwarf shrubs such as willows (Salix spp.) and birches (Betula spp.). The vegetation often forms spongy hummocks, about 0.5 m across and 20 cm high, sometimes surrounded by shallow water, through which emergent sedges grow. These plants provide poor nutrition for grazing livestock. However, where the marshes have been artificially drained, grasses (Graminae) can grow and provide a higher level of nutrition. The carrying capacity for grazing or haying of bogs can be increased up to twentyfold by drainage and fertilizer application (Thorsteinsson and Olafsson 1975). However, the performance of individual animals may not be much improved, for Gudmundsson and Helgadottir (1981) found that lambs grew poorly on improved bog pastures as well as on the natural lowland bog pastures.

Large scale drainage operations began in Iceland as far back as 1942, though it is only within the last 20 years that there has been an acceleration in the number of drainage schemes (Geirsson 1975). Actually, there has been a slight decrease in the number of drainage schemes in the last few years. This is because all the wetland has been drained in some regions, there has been a decline in the number of farmers, and also more attention is being paid to improving old fields (H.Hallgrímsson in litt.). The sequence of land change is, in the main, as follows. Ditches two metres wide and two metres deep are dug with an excavator across a marsh, with a distance of as little as 50 metres between ditches. The marsh may take several years to dry out, but gradually sedges are replaced by indigenous grasses. The second major change in the land is brought about by rotary cultivation which has the effect of breaking up the old marsh hummocks. Finally the ground is reseeded with introduced grass species. However, these introduced grasses are prone to frost damage and in June 1981 we saw many fields with patches of dead grass. Hides (1972) has shown that nitrogen applications reduce the percentage of water-soluble carbohydrates in ryegrass and this tends to decrease the cold tolerance. High levels of fertilizer nitrogen must be applied to these new pastures in order to maintain high levels of production and to retain the introduced species in the sward. The new pastures are managed for both grazing (sheep, horses and cattle) and cutting (hay and silage).

Iceland has a relatively small area of fertile lowlands; the total potential agriculture land is about 15,200 km^2 (Sigfússon 1976), about 15% of the surface area. Hence there is strong pressure to develop the agricultural potential of marginal land, and there was a 70% grant payable by the State on approved drainage schemes (Geirsson 1975). However, once drained, the recurrent annual costs for the maintenance of high levels of production on this new grassland are high. It is difficult to appreciate the long-term economical effects of such grassland management, for, after about 20 years it is likely that the introduced species will do little better than indigenous species which have been given the right management (Munro 1981). Of all the types of marsh, it is the area of valley marshes that has been reduced at the fastest rate. We found that the ditches through these marshes had little water in them indicating the effectiveness of the drainage. In comparison, the ditches through the flood-plain marshes were often full of slow-moving water. Undoubtedly, it is these two types of lowland marsh that have been most affected. They represent a small proportion of all the marsh-land in Iceland and already by the mid 1970s about 1,300 km^2 had been drained, a reduction of 50-80% of their areas (cf. Geirsson 1975). More will have been drained by now.

We have little idea of the ways in which wader populations have been and are being affected, whether in terms of changes in community structure, density, breeding success, or changes in the ways the waders use the marshes. Some marshes, such as flood-plain marshes, still support breeding waders after drainage, whilst valley marshes, when drained, may have few or none. Unfortunately this information is just not known. Some species, such as the Oystercatcher Haematopus ostralegus, Golden Plover Pluvialis apricaria and Redshank Tringa totanus do feed on the new pastures, and broods of Redshank forage in the large ditches. However, there can be no doubt that waders such as Dunlins Calidris alpina, Black-tailed Godwits Limosa limosa, Snipes Gallinago gallinago, and Red-necked Phalaropes Phalaropus lobatus, which are more closely associated with marshes, are losing their breeding habitat. Clearly, if we want to conserve these wader populations there is a need for research to study the ways in which drainage is affecting waders in Iceland.

Iceland became a Contracting Party to the "Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat", on 2 December 1977. However, like many contracting countries (including Britain), Iceland has listed few wetlands which it promises to safeguard. Thus we envisage that some time in the future Iceland will be in a similar situation to Britain now, where nature conservationists are desperately trying to safeguard tiny and scattered scraps of lowland marsh.

Acknowledgements

We should like to thank Dr A. Petersen, H. Hallgrímsson and J.H. MacAdam for helpful comments on this note. The Scottish Ornithologist's Club and British Trust for Ornithology provided funding for our trip to Iceland.

References

Geirsson,O. 1975. [Bog drainage for farming purposes.] Rit Landverndar 4: 143-154. (Icel. with Engl. summ.)
Gudmundsson,O. & Helgadottir,S. 1981. Mixed grazing on lowland bogs in Iceland. Pp.20-31 in Proceedings of the Workshop on Mixed Grazing (Eds. T.Nolan & J.Connolly). Agric. Inst., Ireland.
Hallgrímsson,H. 1977. [A short survey of bog conservation in Northern Iceland.] Tyli 8(1): 7-14. (Icel. with Engl. summ.)
Hides,D. 1972. Selection for improved winter hardiness in Italian ryegrass. Annual Report of the Welsh Plant Breeding Station, Aberystwyth, pp.31-34.
Munro,J.M.M. 1981. Introduction of improved plant resources. Brit. Grassland Socy. Occ. Symp. No.12: 17-33.
Sigfússon,S.H. 1976. [Land resources - land size - Food production.] Rit Landverndar 5: 74-79. (Icel. with Engl. summ.)
Thorsteinsson,I. & Olafsson,G. 1975. [The value of bogs for livestock grazing.] Rit Landverndar 4: 155-168. (Icel. with Engl. summ.)

R.W.Summers, 353 Arbroath Road, Dundee, Tayside.

M.Nicholl, Dundee Museum, Dundee, Tayside.