

# Breeding distribution and habitat selection of Red-breasted Mergansers in freshwater in western Norway

OLAV RÅD

## Introduction

The Red-breasted Merganser *Mergus serrator* has a holarctic, boreal distribution (Bauer & Glutz 1969). In its main breeding range it is common both in coastal and freshwater habitats. In freshwater it is usually found in the lower parts of the river systems (e.g. Mills 1962a). The nesting habitat requirements in general and nest-site selection in particular have been described by various authors (e.g. Curth 1954; Hildén 1964; Kortegaard 1968; Bengtson 1970). Though some studies include descriptions of brood-rearing habitats in freshwaters (White 1957; Bengtson 1971a), these aspects of habitat selection are less documented.

This paper describes freshwater habitat utilization and distribution of breeding Red-breasted Mergansers in western Norway and discusses factors presumably involved habitat selection of broods.

## Study area

The study was carried out in lower parts of selected water systems in the counties Hordaland and Sogn og Fjordane in the central parts of western Norway.

## General topography

The land is principally a hilly highland in which deep valleys have been formed by glacial action. The valleys are characterized by their U-shape with steep hillsides and flat narrow bottoms. The valleys end in steep, narrow fiords. Lowlands are usually only found along the fiords and along the coasts, and constitute relatively small areas. In some places, e.g. the Bergen peninsula, lowlands may have a wider distribution.

## Freshwaters in the area

Both mountain areas and lowland areas contain many river systems and waterbodies. The lakes are mostly deep, with

steep shores, and have little or no emergent aquatic vegetation. Some lakes or parts of lakes are shallow with gentle shore-slopes and rather dense vegetation; mostly *Equisetum fluviatile* and *Carex* spp. Nearly all lakes are oligotrophic, except for some smaller ones situated in cultivated areas. The rivers are usually fast running and with few and restricted calm stretches.

Land has risen since the end of the last glaciation period. This means that many basins have changed from being parts of the sea to become freshwaters. The fauna of these basins retain some elements of marine origin.

## Material and methods

To establish the breeding distribution of the Red-breasted Merganser a defined area of country was surveyed during the breeding seasons of 1976 and 1977. The whole shoreline was investigated or until mergansers were observed. Most water systems were surveyed only once. Pairs, lone females and broods were noted as indications of breeding. Of these categories, pairs are the least certain indication of breeding in the locality observed. However, my own unpublished evidence from more intensive studies areas suggests that mergansers only occasionally occur outside their breeding areas. Thus, this bias can be regarded as negligible for the interpretation of the results. As it was early recognized that the presence of Three-spined Stickleback *Gasterosteus aculeatus* might be an important factor concerning the distribution of the Red-breasted Merganser, shallow water near the shore was examined for presence of sticklebacks by wading or by observation from the shore. This species, usually abundant whenever present and staying close to the shore, is easy to find. In some cases adverse weather made it difficult to discover sticklebacks, but in most cases it seems justifiable to regard the species as absent when not found. In addition to searching for mergansers and sticklebacks the characteristics of lakes and river stretches were roughly described.

In some areas population studies and

investigations on brood ecology of the Red-breasted Merganser were made. The breeding status for the species is therefore well known for 1975–1977.

Additional breeding data were also collected from the literature and from local ornithologists, and further information on stickleback distribution was received from the State Fish Biologists of Western Norway, and by interviewing residents.

## Results

The Red-breasted Merganser was found breeding in various kinds of lakes, but not in those smaller than 15 hectares, unless the lake was part of a water system with rivers connecting it with other lakes. In rivers, it was only found breeding in stretches with calm and slow-running water. Though very little selective with regard to the topography of a lake, mergansers were only found in the lower parts of a river system. With two exceptions they were not found breeding in lakes above 150 m a.s.l. This distribution seems to be closely related to the distribution of sticklebacks (Table 1).

**Table 1. Presence (+) or absence (–) of Stickleback and Red-breasted Merganser in 63 lakes in western Norway.**

		Stickleback	
		+	–
Red-breasted	+	21	2
Merganser	–	2	38

Chi square = 46.9     $P < 0.001$

Sticklebacks occur in lakes and slow-running river stretches below the marine border, which varies between 40 m a.s.l. in outer coastal areas and 100 m a.s.l. in the inner fiord areas (O. Rye, pers. com.). Because of the steep landscape and poor dispersal properties of the sticklebacks, the species has not spread much above the marine border. In some lakes sticklebacks have been introduced by man. These lakes, which were found 100–150 m a.s.l., also contained breeding mergansers.

Thus Table 1 shows that merganser distribution in the study area is associated with the presence of sticklebacks, which is usually sufficient to initiate selection of the lake for breeding, provided the lake is not too small. Table 1 also shows that the

Red-breasted Merganser may breed in lakes devoid of sticklebacks. The two known cases found in my study, Jølstravatnet and Oppheimsvatnet are, however, somewhat unusual. In Jølstravatnet, the Brown Trout *Salmo trutta* spawns in the lake and the fry occur in schools in shallow waters, in contrast to the common spawning pattern of trout in rivers. Both lakes have a high production of salmonids. Thus the lakes seem to contain enough food for merganser broods. Oppheimsvatnet, however, only had 1 pair in 1977, whereas other lakes of the same size in that water system, which contained both sticklebacks and salmonids, had a breeding population of 4–5 pairs in each year, 1975–1977.

## Discussion

Among the important factors regarding the habitat selection of the merganser are food, nest site, loafing site and structural and functional adaptations to these factors (e.g. feeding behaviour, anti-predation behaviour). The main ultimate factors involved in habitat selection of breeding habitats are those associated with the survival of eggs and ducklings. This implies that ducklings are more demanding than are adults with regard to food, shelter, escape from predators, etc. Consequently adults may survive well in habitats not suitable for the young, but avoid selecting such areas for breeding.

The strong correlation demonstrated between mergansers and sticklebacks suggests the importance of sticklebacks as food for merganser broods in western Norway. Two stomachs of half-grown ducklings taken from Vangsvatnet contained together 43 sticklebacks and 1 trout. I have also been able to identify sticklebacks brought to the surface by diving ducklings. Food studies from northern Norway (Aass 1956) and Iceland (Bengtson 1971b), areas which contain the same fish species as western Norway, confirm the role of sticklebacks as a staple diet of merganser ducklings. In Scotland, Berry (1936) stresses the importance of sticklebacks and small Eels *Anguilla anguilla* as food, though Mills (1962b) found sticklebacks to be of minor importance. Mills did not, however, give the age of the birds he examined.

The food of the merganser ducklings the first days after hatching seems, at least partly, to consist of larvae of water insects,

but very soon fish constitutes the main part of the food (Bengtson 1971b). Thus, a suitable breeding habitat should contain fish species that fulfil the needs of the merganser ducklings living in shallow waters, small and plentiful, and easily available.

Freshwater communities of western Norway consist of very few fish species: Three-spined Stickleback, Brown Trout, Salmon *Salmo salar*, Char *Salvelinus alpinus* and Eel. The char fry stay on rather deep waters in lakes and are thus less accessible to the mergansers. Salmon and trout fry usually live in running waters and often hide under stones and in crevices. They may be more agile and escape attacks better than the sticklebacks. Consequently they may be more costly to catch for small ducklings and thus a less suitable prey. But, as in Jølstravatnet, merganser ducklings may survive on trout under certain circumstances.

In one of the lakes in my study, Lønavatnet, holding 4–5 breeding pairs, the adjoining river contains a large population of trout fry, but no sticklebacks. I have never seen foraging broods there until the ducklings were nearly full-grown. In lakes where the Red-breasted Merganser broods normally forage the trout are mostly more than 10 cm in length. At least half-grown young may occasionally take prey of that size or even greater, and large ducklings may survive on trout. The crucial point in habitat selection of merganser broods, however, is the requirements of the small ducklings, especially in the period when their food-seeking activity is becoming more and more adjusted to fish. Then their capacity to catch larger fish than stickleback is limited and presumably not sufficient for survival and growth. In other parts of their breeding range (e.g. Britain and eastern Scandinavia), other fish species such as Perch *Perca fluviatilis* (Atkinson & Hewitt 1978) and various Cyprinids, e.g. Minnow *Phoxinus phoxinus* may play the same role as staple food as stickleback in western Norway.

Merganser ducklings usually escape predators by skittering over the water (Palmer 1976). Only when they are pressed very hard do they try to escape by diving or by crouching motionless on the shore. When slightly disturbed, i.e. when a potential predator is discovered at some distance, the female leads the ducklings away, not only from the predator, but also from the shore. This behaviour maximizes the possi-

bilities of escaping attack, by holding a predator at a secure distance and having the maximum possible escape directions. Small ponds and tarns may not allow use of this strategy; it will be easier to get into a corner and get caught.

Mergansers have a high food consumption during the brood period (Heinroth & Heinroth 1931; Atkinson & Hewitt 1978). In small tarns mergansers may reduce their prey populations below the level which makes hunting efficient for growth and survival. Some evidence for this hypothesis exists. On three occasions whole broods disappeared from small breeding tarns near the sea, to which they apparently moved. Only a few stickleback were found, an indication of lack of food. During feeding periods the brood move continuously along the shore, without feeding for long at the same sites (Hildén 1964).

The most common proximate factors involved in habitat selection of birds in general are thought to be physiognomic characteristics of the habitat. Food is recognized as a proximate factor by only a few species, living on fluctuating food resources (Hildén 1965). Though different factors associated with structural characteristics of a habitat are important in habitat selection of the Red-breasted Merganser (e.g. size of a lake, speed of a river, and perhaps transparency of the water), these factors cannot alone explain their distribution, as many lakes without breeding mergansers are not markedly different from lakes containing breeding mergansers. So the breeding female has to select her habitat from an additional basis to such structural qualities. This basis is very likely to be food, the presence of plenty of small fish on shallow waters. However, it is not necessarily the food requirements of the female alone which determine her selection of breeding habitat. Adults are often seen foraging in streams and river stretches never used by broods and seem to survive well on salmonids (Aass 1956; White 1957; Mills 1962b) which are common in nearly all water systems in western Norway. Thus it is likely to be the quality of fish populations necessary for the survival of the young which is the important proximate factor. Other studies of habitat selection in ducks have stressed the importance of islets and colonies of Larids as proximate factors, but few studies have demonstrated that food may act as a proximate factor. Pehrsson (1974) showed that Long-tailed Duck *Clangula hyemalis* select lakes con-

taining the crustacean *Polyartemia forcipata* as brood-rearing lakes, and Eriksson (1978) showed that the Goldeneye *Bucephala clangula* broods usually selected lakes with the highest abundance of food. Whether the quality and quantity of food also influences the selection of breeding habitat is not mentioned. In the case of the Long-tailed Duck, however, it is reasonable to suggest that the presence of large planktonic crustaceans may act as a proximate factor. Both Red-breasted Merganser and Long-tailed Duck may be regarded as food specialists, dependent on one species of prey, whose distribution greatly affects the distribution of their predator. In general food as a proximate factor may be more important than earlier recognized (c.f. Hildén 1965). In fact, whenever structural qualities of a habitat do not 'guarantee' the amount of food needed for raising offspring, it would be advantageous for an individual to react on the amount and quality of the food present in a habitat to enhance the survival possibilities of its offspring.

### Acknowledgements

This study was partly supported by the University of Bergen and the municipality of Voss. Local ornithologists supplied observations of breeding mergansers and J. P. Madsen supplied data on stickleback distribution. S.-A. Bengtson, I. Byrkjedal and K. Sjöberg made constructive criticism of a draft.

### Summary

The breeding distribution and habitat selection of the Red-breasted Merganser *Mergus serrator* was investigated in west Norwegian freshwaters. The distribution is closely related to the distribution of the Three-spined Stickleback *Gasterosteus aculeatus*. The ducklings require small fishes, easily accessible in shallow waters. Stickleback is the only fish species in western Norway which fulfils these requirements. A female merganser selects her breeding habitat both from the structural characteristics of lakes and from quality and quantity of the food present for the young.

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