Breeding success of raft-nesting divers in Scotland
T. D. H. Merrie

ABSTRACT A study in 1972-78 showed that Red-throated *Gavia stellata* and Black-throated Divers *G. arctica* nesting in an area of south Argyll, Scotland, where there was a shortage of island nest sites, suffered very low breeding success compared with other parts of Scotland. During 1976-80, eight artificial floating nest rafts were installed on lochs, and by 1993 breeding success had improved markedly, the productivity of Red-throated Divers being raised above the long-term average for Scotland. Nest rafts in sheltered locations were more successful and lasted longer.

During 1972-78, a study of the distribution and breeding success of Red-throated *Gavia stellata* and Black-throated Divers *G. arctica* in many areas of Scotland showed that the density of pairs was related to the area of suitable fishing water within a range of about 8 km of the nest site (Merrie 1978). Both species had a greater chance of success if they nested on an island (Merrie 1979), but fluctuating water levels could still cause extensive flooding of nests. A total of 114 summering pairs of Red-throated Divers produced an average of 0.33 young per pair, the average for 37 summering pairs of Black-throated Divers being 0.21.

In south Argyll, there was a shortage of island nest sites in an area with a regular population of four to six pairs of Red-throated and two of Black-throated Divers; both species suffered very low breeding success compared with other parts of Scotland. In 1976, two artificial floating nest rafts were installed at lochs in this area (Merrie 1979), although one of these disintegrated after two years. In 1979, with sponsorship from *BP Petroleum Development Ltd*, the lost raft was replaced and six more were installed, making a total of eight rafts, all on lochs where previous breeding attempts had been noted. In most cases, they were
rapidly accepted, usually within the first season, by both species. These Argyll populations have been monitored since then (see below).

Study methods

All lochs with rafts were visited, and, where time permitted, other lochs were checked for signs of divers. Maintenance of rafts, when necessary, was done outside the breeding season. For some years, complementary information was provided by the RSPB.

Pairs of divers without young by the end of the third week of July were presumed to have failed. They would have insufficient time left to rear young.

Results

During 1973-93, Red-throated Divers in the study area produced 31 young from 70 pair-years, data being obtained in 18 of the 21 years (table 1). Over this period, the population probably declined from an average of 4.4 pairs in the first half to an average of 3.9 in the second half.

Table 1. Breeding success at six territories of Red-throated Divers *Gavia stellata* and two of Black-throated Divers *G. arctica* in study area in south Argyll, Scotland, 1973-93. Figures are for all years combined (data for three years unavailable).

<table>
<thead>
<tr>
<th></th>
<th>Pairs</th>
<th>Rafts</th>
<th>Sites Used</th>
<th>Young Raised</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summering Nesting Rafts available</td>
<td>Island Shore Raft</td>
<td>Island Shore Raft</td>
<td></td>
</tr>
<tr>
<td>Red-throated</td>
<td>70</td>
<td>53</td>
<td>83</td>
<td>3</td>
</tr>
<tr>
<td>Black-throated</td>
<td>16</td>
<td>6</td>
<td>27</td>
<td>0</td>
</tr>
</tbody>
</table>

In 1976-93, a total of 48 pairs of Red-throated Divers summered at lochs with rafts: 40 nested on rafts, two on the shore, and six did not nest; these 48 pairs produced 29 young, an average of 0.60 per summering pair. The remaining 22 summering pairs, at lochs without rafts, produced only two chicks, both from an island site. Such productivity must be taken as typical of south Argyll.

Although there was a minimum of 12 pair-years for Black-throated Divers, only six nests were discovered, all on the same raft.

Thus, in the period since rafts were installed, a total of 48 nesting attempts was made at such lochs, and only twice was the raft not used. During the same period, five attempts were made on the shore or island of other lochs; there was no evidence that the presence of a raft attracted a diver from a loch without a raft. Of the 46 known raft nests, young were successfully reared to at least the half-grown stage (successful fledging is then almost certain) from 24 nests.

Of the five (or six?) different pairs of Red-throated Divers involved over the study period, one pair alone produced 18 of the 29 young from rafts in 15 recorded attempts (six broods of one, six of two, and three failures). The four other pairs using rafts produced, respectively, six young (from eight attempts), four (from eight), one (from five) and no young (from four attempts). No adults were marked, but, on the basis of grouping of years of proved occupancy and breeding success, it can be surmised that one pair was probably resident for the full 18 years since the raft was installed, and that at three other sites there was a single change of pair in the same period.
The success of an artificial raft depends greatly on its location and little on its condition. Rafts in sheltered water less than 4 m deep produced young even when almost bare of vegetation, or when damaged so that they swung widely on a single anchor, or when reduced to a mere fragment. No divers nested on rafts in exposed situations (table 2), although Common Gulls *Larus canus* nested twice on exposed rafts and once on a moderately exposed one.

**Table 2. Success rate of raft-nesting Red-throated *Gavia stellata* and Black-throated Divers *G. arctica* in relation to exposure, south Argyll, Scotland, 1976-93.** Exposure of raft to wind and waves is rated on an arbitrary scale of 1 to 4: 1 = sheltered, 2 = moderately sheltered, 3 = moderately exposed, 4 = exposed.

<table>
<thead>
<tr>
<th>Exposure rating</th>
<th>No. rafts</th>
<th>NEST ATTEMPTS</th>
<th>YOUNG PRODUCED</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>Red-throated</td>
<td>Black-throated</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>16</td>
<td>6</td>
</tr>
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</tr>
<tr>
<td>4</td>
<td>2</td>
<td>0</td>
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</table>

**Discussion**

Divers seem to be attracted to traditional nesting lochs (e.g. Okill & Wanless 1990; Gomersall 1986), and the presence of artificial nest sites at other waters is unlikely to lure them away. In south Argyll, the breeding population was not increased simply by the provision of a greater number of nest sites, as has occurred with many other species. It would have been interesting, however, had greater resources and effort been available, to have tested the response to a superfluity of nest rafts.

If raft-nesting produced a surplus of young, and if the productivity of divers in the surrounding country remained at the 1973-78 level (there were no reasons to expect an increase), then this surplus would merely have helped to redress the poor productivity at nearby lochs. Okill & Wanless (1990) found that young Red-throated Divers often returned to the vicinity of their natal lochs.

Black-throated Divers have shown a particularly low productivity. Provision of rafts did not improve on the figure of 0.21 young per summering pair, with only two young from 15 pairs (0.13), but for most of the study period only one pair was involved. A later and much more extensive RSPB project, however, showed that Black-throated Divers breeding on rafts produced about 50% more young than those on natural sites (*Black-throated Diver Raft Project Newsletters* 1993, 1994). The RSPB figures do not include summering pairs which do not breed, and it is most likely that the presence of rafts has induced more such pairs to breed; if this is so, the actual increase in productivity will be greater than 50%.

How do the results from the south Argyll project compare with natural productivity of stable populations, and would further nest-raft provision help to reverse a declining population trend? Cramp & Simmons (1977) quote figures which equate to 0.36 young per nesting pair in Shetland and 0.40 young per nesting pair in Finland. An extensive review of data on Red-throated Divers in Shetland from 1918 to 1982 (Gomersall 1986) showed an average productivity of 0.45 young per breeding pair, with little significant variation or trend. Since this is from a sample of over 1,100 pairs, and since Shetland holds the majority
of Scotland's breeding Red-throated Divers (Okill & Wanless 1990), 0.45 young per breeding pair must be regarded as sufficient to maintain a stable population if mortality levels and causes remain similar to those of the past 70 years.

For Red-throated Diver, it may be interesting to compare the above results with data supplied by the RSPB from surveys undertaken in 1988 in south Argyll (excluding the present study area) and in 1989 on Coll, in both cases at lochs without rafts, and with the results for 1980-92 from a single raft installed in a loch in Bute. Of 30 pairs breeding in south Argyll, eight were successful and produced eight young (= 0.27 per breeding pair); on Coll, 14 pairs summered, eight bred, and five of these were successful, producing six young (= 0.42 per summering pair, 0.75 per breeding pair). The raft on Bute produced a total of 13 summering pairs; 11 bred, and nine of these produced 11 young (= 0.85 per summering pair, 1.0 per breeding pair)(I. Hopkins in litt.).

The Argyll raft project has resulted in increases for Red-throated Divers: from 0.45 young per breeding pair, or about 0.35 per summering pair, to 0.75 and 0.63 respectively. This is consistent with the 50% or more increase noted for Black-throated Divers by the RSPB. In the study area, however, only two young Red-throated Divers resulted from 13 breeding attempts in natural sites, both islands.

The project has raised the productivity of a small population of Red-throated Divers from a level insufficient to maintain stability to one which may even provide a small surplus for recruitment elsewhere. There appears, however, to have been a decrease in number of breeding pairs. The project is probably not sufficiently extensive to affect the general picture of the mainland Argyll population, where natural sites are similar to those in the study area. Using Gomersall's (1986) productivity of 0.45 young per breeding pair, and assuming that 75% of summering pairs breed, it can be calculated that about 45% of all summering pairs in such a large regional population would need to be provided with nest rafts to bring total productivity up to the long-term Shetland norm.

Acknowledgments

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References