

Size of fish carried by flying Red-throated Divers *Gavia stellata* (Pont.) to nearly fledged young in nesting tarn

R. ÅKE NORBERG and ULLA M. NORBERG

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The choice of food of divers (*Gavia*) is not easily studied in the field, since the birds usually feed far out on open water. However, *G. stellata* nests in small lakes and tarns, where it can be observed at relatively close range. Photographs taken of divers landing on a nesting tarn, carrying fish that had been caught in a large fishing lake, provided information on prey size selection. The length of 11 fishes brought to nearly fledged young ranged from 9 to 20 cm and averaged 15.6 cm. The estimated weight of the fish ranged from 7 to 99 g, averaging about 50 g.

Introduction

Information on the choice of food of the Red-throated Diver is not readily obtainable, since the birds usually fish far out on open water. Most of the data available come from analyses of the stomach contents of birds collected during October-February in their marine, wintering areas (MADSEN 1957). Accordingly, we wish to report some observations on the size of fish fed to nearly fledged young.

Methods

In a study of the flight of *G. stellata*, we took photographs and cine-films of divers taking-off from and landing on nesting tarns in SW Sweden (NORBERG

& NORBERG 1971). Pictures of divers landing with fish for their young provided information on their diet. A small, rather narrow nesting tarn (ca. 45 m wide) offered unusual opportunities to watch the divers at close range (tarn L in Fig. 7 in NORBERG & NORBERG 1971). From this tarn we produced photographs of sufficient resolution to permit estimation of the sizes of fish brought from a fishing lake 2.1 km away.

Since the fish were hanging in the bill, their full lengths were not seen in the photographs (Fig. 1) and had to be estimated. When the same prey appeared in more than one photograph, the mean of the estimates was calculated.¹ The reference length used was the distance from the eye to the tip of the bill of the diver, which was measured

¹) Independent estimates from two photographs of each of three fishes yielded the following lengths: 17.0 and 16.3 cm; 15.4 and 15.3 cm; 9.1 and 8.4 cm.

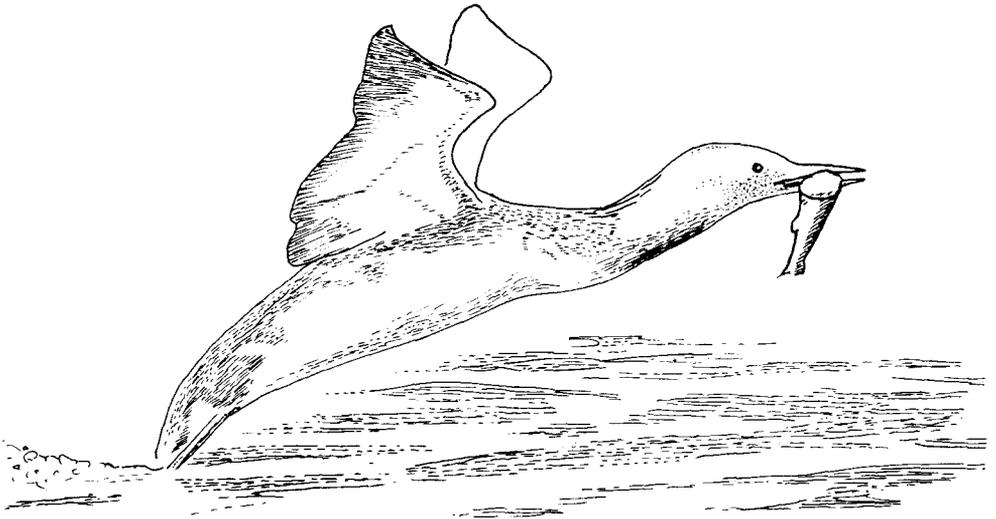


FIG. 1. *Gavia stellata* landing with a fish whose estimated length is 14 cm and weight ca. 30 g. Drawn from photo.

on eight study skins at the Museum of Natural History, Gothenburg, and found to average 81 mm (range 75—85 mm, S.D. 4.2).

Food

On July 31, the two young divers in the brood studied were still in the nesting tarn. They could already fly and when one of the adults took off, the young were usually stimulated to do the same (NORBERG & NORBERG 1971, Fig. 5). However, they landed again near the end of the tarn, after a straight flight at a height of a few metres, and did not follow the adult bird as it climbed to tree-top height while flying once or twice round the tarn. On August 2 only one young diver remained in the tarn, the other having apparently learnt to climb to tree-top height. The data below are for food brought to nearly

fledged young (July 16 — August 2, 1969).

The adult divers were not observed to fish in the nesting tarn. Instead they undertook fishing flights to an oligotrophic lake of ca. 1.4 km², situated 2.1 km away.

In all the cases that we have observed at this and at several other nesting tarns, the diver returned to the tarn with only one fish at a time, carried crosswise in the bill.

The size was estimated for 11 fish. Their length ranged from 9 to 20 cm, averaging 15.6 cm (S.D. 3.9, Table 1).

The prey could not be indentified as to species, but the commonest fish species in the fishing lake are *Perca fluviatilis* L., *Leuciscus rutilus* (L.), *Salmo trutta* L. and *Esox lucius* L.

Graphs of the weight versus body length of *Perca fluviatilis* and *Leuciscus rutilus* appear in ALM (1922, Figs. 9 and 10). Since these graphs cover only the size range 90—160 and 70—190 mm, respectively, we fitted power functions to the graphs and obtained $w = 12.35 L^{3.00}$ for *P. fluviatilis*, and

TABLE 1. Estimated length and weight of fish brought to nearly fledged young of *Gavia stellata*. The fish were not identified as to species, but weight was estimated with equations relating weight to length in *Perca fluviatilis* and *Leuciscus rutilus*. The average length of the fish is 15.6 cm, whereas the length of a fish of the average weight is ca. 16.5 cm.

Estimated length, cm	Estimated weight for <i>P. fluviatilis</i> , g	Estimated weight for <i>L. rutilus</i> , g	Number of fish observed
9	9	7	1
10	12	10	1
14	34	28	3
15	42	35	1
17	61	52	1
19	85	74	1
20	99	87	3
M. 15.6	55 (L = 16.5)	48 (L = 16.6)	n=11
S.D. 3.9	35	31	

$w = 14.12 L^{3.16}$ for *L. rutilus*, where w is the weight in kilograms and L is the body length in metres. With the aid of these power functions, we extrapolated ALM's curves to include fish lengths of up to 200 mm, the maximum length estimated for the fish brought by the divers. This is a moderate extrapolation, which we feel is justified.

Insertion of the data on fish length in the equations above gives an average weight of 55 g (S.D. 35) and a weight range of 9–99 g for *P. fluviatilis*, and an average of 48 g (S.D. 31) and a range of 7–87 g for *L. rutilus*. The mean lengths were calculated from the estimated weights of all specimens (Table 1). Even if the divers brought fish from other species, their shape was similar to those of the species treated above, and so their weights should be similar.

Considering the long distance between the fishing lake and the nesting tarn, and the hard work the divers have to do to take off and climb (NORBERG & NORBERG 1971), it is obvious that they would save considerable time and energy by bringing big fish with a narrow size range. It is therefore noteworthy that they bothered to transport

a fish whose weight was only one-tenth of that of the biggest ones brought to the tarn.

The upper size limit of fish carried in flight may be set by aerodynamic factors (if not by the swallowing ability of the young). Their achievements during take-off and climbing flight do not suggest that the divers have wide power margins for carrying extra weight. Even without a fish load they have to skitter along the water for 15–40 m before taking off, and then climb at very shallow angles (NORBERG & NORBERG 1971). Furthermore, the location of a fish in the bill, far ahead of the centre of gravity of the diver, is likely to impose difficulties during take-off and climbing, since the average position of the centre of pressure of the wings has to be moved forwards in compensation, by changing the wing stroke.

The winter food of *G. stellata* in marine localities consists of fish measuring 1.5–25 cm (MADSEN 1957).

In an extensive field study in Finland, LEHTONEN (1970) found that the length of fish fed to the young of *Gavia arctica* (L.) could reach about 20 cm, but was mostly 6–15 cm.

Selostus: Kaakkurin melkein lentokykyisille poikasilleen tuomien kalojen koosta

Kuikkalintujen ravinnon tutkiminen tuottaa vaikeuksia etenkin siksi, että lajit enimmäkseen ruokailevat avovesillä. Kaakkurit kuitenkin pesivät niin pienissä lammissa, että niitä voidaan tarkastella melko läheltä. Valokuvia veteen laskeutuvista, kaloja poikasilleen tuovista kaakkureista voitiin käyttää ravintokalojen koon mittaamiseen. Tuotujen yhdentoista kalan pituus oli 9—20 cm., keskimäärin 15.6 cm. Kalojen arvioitu paino oli 7—99 gr., keskimäärin n. 50 gr. (Taulukko 1).

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