

chen. Es liegt übrigens auch in der Literatur wenigstens ein direkter Beweis für Transport auf einem Schiff (oder jedenfalls Aufsuchen eines Schiffes) vor: nach LÖNNBERG (l. c.) wurde die erste Schleiereule in Schweden auf einem Schiff im Hafen von Ystad erlegt. Es sei auch darauf hingewiesen, dass nach der obigen Karte 7 von den nördlichen 9 *Tyto*-Funden ausserhalb des Wohngebietes dieser Art an der Küste oder in Küstennähe gemacht sind. Dies ist allerdings auch sonst in einigen Fällen recht natürlich, wenn nämlich das fremde Land nur durch Überqueren eines Meeresabschnittes zu erreichen ist. Aber wenn man beachtet, dass die Fundorte in Estland, Finnland und Sollefteå, wenigstens 600 bis über 700 km vom nächsten Wohngebiet gelegen sind und dass die Fundzeiten in den Herbst oder den Winter fallen, sowie ferner die Natur des Vogels als ausgeprägter Stand- oder Strichvogel berücksichtigt, so ist die Möglichkeit eines unfreiwilligen Transports in diesen Fällen vielleicht nicht ausgeschlossen. Andererseits hat die Beringung schon gezeigt, dass *Tyto alba guttata* längere Wanderungen ausführen kann, als man früher angenommen hat. So führen SCHÜZ und WEIGOLD „(Atlas des Vogelzuges“, 1931) eine Wanderung von etwa 300 km an und neuerdings wird von DUPOND (Oeuvre du Baguage des Oiseaux en Belgique, „Gerfaut“ 1935) über eine westliche Wanderung von 620 km Länge eines Leipziger Vogels nach Belgien berichtet.

Die jetzige Verbreitung der Schleiereule zeigt, dass sie empfindlich für strenge Winter ist, sei es direkt wegen der Kälte oder wegen Nahrungsmangel — ihre Nahrung besteht ja ganz überwiegend aus kleinen Säugetieren, deren Fang in genügender Anzahl, wenn der Boden monatelang schneebedeckt ist, unmöglich sein mag. Das Auskommen der Art in Finnland, falls die Schleiereule nicht ein wirklicher Zugvogel wird, scheint somit ausgeschlossen.

Some Diving Notes on Young Tufted Ducks, Young Velvet Scoters and Young Eider Ducks.

By PEKKA GRENQUIST.

In the summer 1935 some notes on the diving of young Tufted Ducks (*Nyroca fuligula*), young Velvet Scoters (*Oidemia fusca*) and young Eider Ducks (*Somateria mollis-*

sima) were made along with other investigations. Owing to this fact the material collected is scarce and partly heterogeneous. In spite of its scarceness the material is published, since investigations of the diving and of the feeding problems associated with the question of diving-ability of sea-shore birds are quite rare in Finnish literature.

The observations were made on the 6th of July and between the 5th and 14th of August from the seaward skerries of Klåvskär in the parish of Föglö. The skerries of Klåvskär belong to the large archipelago of Åland and form a tongue of small islands running north and south towards the open water of the Baltic Sea. The islands are small, naked, forestless rocks with an area of hardly more than 10000 square metres. The vegetation of gramineous and herbaceous plants is partly rich, owing to the manuring of the birds.

The islands belong to the part of the old tertiary table-land of Finland, which arose out of the Baltic Sea very late after the quaternary ice age. The skerries generally rise to a height of four to ten metres, but many of the rocks have a height of only one to four metres. In consequence the sea-floor is very irregular with areas of shallow water and countless shoals and subaquatic rocks near the surface of the water. These shallow areas are separated from each other through areas of deep water indicating dislocations in the ancient table-land.

The mean salinity of the water at the surface is 6.0 to 6.5 ‰ and at the bottom 6.5 to 7.0 ‰. The transparency of the water in early summer is from 10 to 12 metres. The difference between high and low water is from 1.50 to 1.75 metres. The tides are only a few centimetres in this part of the Baltic Sea (Atlas of Finland 1925).

The following species of birds breed in the territory (the typical ones in spaced-out type): *Corvus corone cornix*, *Anthus spinoletta littoralis*, *Motacilla a. alba*, *Sylvia c. communis*, *Oenanthe oe. oenanthe*, *Anser anser*, *Anas p. platyrhyncha*, *Spatula clypeata*, *Nyroca fuligula*, *Somateria m. mollissima*, *Oidemia f. fusca*, *Mergus m. merganser*, *Mergus serrator*, *Haematopus o. ostralegus*, *Arenaria i. interpres*, *Tringa t. totanus*, *Larus c. canus*, *Larus a. argentatus*, *Larus f. fuscus*, *Larus marinus*, *Sterna h. hirundo*, *Sterna macrura*, *Hydro-*

progneta tschegrava, *Stercorarius parasiticus*, *Alcatorda* and *Uria g. grylle*.

The areas, where the observations were made, belong to a territory of protection of sea-birds founded by the late Mr. Karl Fazer. Owing to the perfect protection the birds are less shy, and most of the observations were made through the windows of a cabin on a skerry named Råböckskär. This skerry is situated at a distance of about one kilometre from the open sea to the south, and it is surrounded by a great number of small rocky skerries and shoals, which moderate the wave-action, and further the development of a rich *Fucus*-growth.

Owing to the observations having been made in August, notes on the diving of young birds were made mainly from species which breed late, as the Tufted Duck and the Velvet Scoter. In August most of the breeding birds mentioned above, leave their breeding territories, which fact is likely to diminish the possibilities of observation, regarding quantity of individuals and number of species. On the other hand the possibilities of observing and distinguishing the particular broods increase, and thus the same brood can be kept under daily observation.

The Tufted Duck (*Nyroca fuligula* L.).

The dives recorded were partly made in a fresh water pond (Fig. 1), at a distance of about 15 metres from the cabin, partly in a

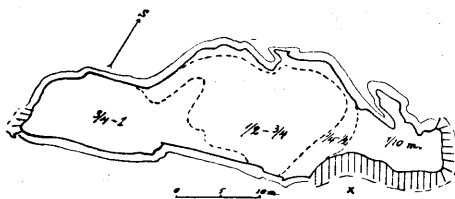


Fig. 1. *Fresh Water Pond*. The double contourline indicates naked rock-shores, the ruled areas shores with herbaceous and gramineous vegetation. The broken line gives approximative bathymetric areas, the cross the most used observing station. — The bottom is rock- and mud-bottom without any weed except *Potamogeton pusillus*.

salt water creek in the immediate neighbourhood of the cabin (Fig. 2) and partly near to a submarine rock with rich *Fucus*-growth, at a distance of 40 to 50 metres from the cabin.

A sketch was made of the fresh water pond as well as of the creek (Fig. 1 and 2 respectively), and the depths of water were sounded. The difference between high and low water in salt water from Au-

gust 5th to August 12th did not exceed 10 centimetres. In the pond the difference was only 5 centimetres. The position of the bird was fixed through a single bearing on landmarks, since the distance between the bird and the observing station never exceeded 20 metres, neither in the pond nor in the creek. The dives

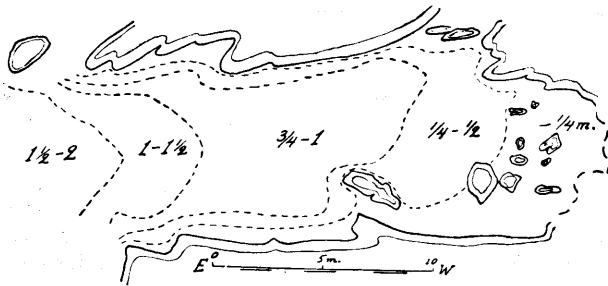


Fig. 2. Salt Water Creek. The scale also gives length and position of the cabin, and the lines underneath indicate the windows from which the observations were made. — The bottom is rock- and stone-bottom with a sparse vegetation of *Potamogeton pectinatus*.

made near the „*Fucus*-rock“ were observed from a distance of 40 to 50 metres, and thus an exact fixing of the birds' position was not possible. Consequently no sketch of the area was made. Soundings were made around the „*Fucus*-rock“, and the depth of water was found to be between 1.50 and 2.00 metres.

The dives were timed with an ordinary watch in seconds, and recorded as series only when made by the same individual mainly at the same spot without long pauses. Since the chicks in an early stage usually dive in groups, and these dives are short and difficult to record, dives were recorded only when some particular chick dived apart from the others. Some of the series are very short, since the dives made separately were often followed by group-dives, and the recording was thus interrupted.

The pauses between the different dives were not timed, since the timing of the chick-dives required great attention. — Regarding methods of observation I refer to the excellent work by J. M. DEWAR: „The Bird as a Diver“, in which the problem of diving is treated in its entirety.

The particular diving series are given below. The different series are separated from each other by the semicolon.

Chick-Dives in Fresh Water.

The dives were recorded from the freshwater pond (Fig. 1). The age of the broods when observed for the first time is given as x or y . The duration of the dives is given in seconds and the depth of water in metres.

July 6 at x days, adult female + 5 chicks ($x = \text{about 7 days}$): 9.15 a. m., 0.10 m.: 3 secs.; 0.25—0.50 m.: 5, 7 secs; 0.50—0.75 m.: 7, 8 secs; 8, 7, 8, 10, 8, 10 secs; 8, 8 secs; 4.00 p. m., 0.75—1.00 m.: 10, 9, 10, 9, 8 secs; 10, 11, 11, 11, 9, 10, 10 secs; 12, 12, 10, 13 secs; 8, 11, 10, 12, 11, 10, 10, 12 secs; 10, 10, 10, 9, 11, 12, 12 secs; 11, 10 secs; 12, 12, 12 secs; 12, 10, 11, 12, 11 secs; 5 p. m., 0.25—0.50 m.: 6, 6, 6, 5, 7 secs; 0.50—0.75 m.: 7, 8, 9 secs; 0.75—1.00 m.: 12, 12 secs; 10, 11 secs.

All dives mentioned above were recorded in half an hour. The chicks almost uninterruptedly made group-dives at one spot. Only a few chicks made separate dives and these dives are recorded above. The female conducted the young to new feeding grounds and saw that no intrusion of other females was made upon her domain. After and between the series of diving the chicks „dipped“ and „tilted“ mainly near the shore.

August 5, adult female + 5 chicks at $x + 30$ days: 2 p. m., 0.75—1.00 m.: 17, 15, 20, 20 secs. The dives were not made at the same spot. The young reappeared on the surface 3 to 4 metres from the spot where they dived in.

August 6, adult female + 5 chicks at $x + 31$ days: 10 a. m., 0.50—0.75 m.: 10, 15, 15 secs.

August 12, adult female + 5 chicks at $x + 37$ days: 11 a. m., 0.75—1.00 m.: 12, 18, 17, 18 secs. The chicks ascended 2 to 3 metres from the place of descending. After the dives the young „dipped“ near the shore.

Chick-Dives in Salt Water.

Dives made by chicks belonging to the same broods (x and y), which were kept under daily observation in the pond, were recorded from the salt water creek (Fig. 2). The periods of dives made by chick and female simultaneously in the same depths of water are printed in italics, those recorded from females in parentheses.

August 7, adult female + 5 chicks at $x + 32$ days: 8.00—8.15 p. m., 0.75—1.00 m.: 10, 12, 12, 15, 12, 15, 10, 15, 15, (*adult female: 15, 15, 15*) secs; 15, 15, 14, 14 secs. (The adult female made dives 10 metres apart from the brood in a depth of 1.50—2.00 m.: 19, 18, 19, 18, 20, 15, 18, 19 secs).

August 8, adult female + 5 chicks at $x + 33$ days: 8.30—8.40 p. m., 0.25—0.50 m.: 15, 10 secs; 10, 10, 10 secs (*adult female: 10, 10, 10*) secs).

August 9, adult female + 5 chicks at $x + 34$ days: 8.45—9.00 p. m., 1.00—1.50 m.: 17, 15, 15, 18 (*adult female: 17, 15, 15, 18*) secs.

August 10, adult female + 5 chicks at $x + 35$ days: 8.30—9.00 p. m., 0.25—0.50 m.: 15 secs; 0.75—1.00 m.: 12, 12, 15, 15, 13 (*adult female: 13*) secs; 1.00—1.50 m.: 16, 18, 18, 15, 18, 16 secs.

August 11, adult female + 3 chicks at $y + 5$ days ($y = 10$ to 15 days): 7.00—7.30 p. m., 0.25—0.50 m.: 5 (*ad. female: 15*) secs; 0.75—1.00 m.: 8, 8, (*ad.*

female: 14, 12), 8 secs; 7, 7, (*ad. female: 13*), 9, 7 secs; 1.00—1.50 m.: 10, 10, 10 secs; 8, 9, 11, 9, 9, 11 secs; 8, (*ad. female: 17*), 10, 10, 9, (*ad. female: 15, 11*), 8, 10, 9 secs; 8, 9, 8, 10, (*ad. female: 16, 17*) secs. (An adult dive in 1.50—2.00 m. of water lasted 17 seconds).

Dives made by Adult Females in Salt Water.

Besides the dives made by adult females together with the young in the same depths of water, printed above in italics in parentheses, dives made by four adult females without broods were recorded. These dives were made in a depth of 1.50—2.00 m. near the „Fucus-rock“. At the periods of adult feeding spells the young were resting in the pond without the mother-birds.

August 11. Of four adult females one made the following series at 5.00—5.18 p. m. in a depth of 1.5 to 2.0 m.: 17, 16, 18, 16, 16, 16, 18, 19, 19, 19 secs. The series was interrupted by a pause of two minutes duration; 17, 12, 16, 16 secs etc., by a pause of one minute; 18, 13, 18, 17, 15, 17, 17, 18, 16 secs; by a pause of three minutes; 19, 17, 19, 18, 15, 21, 17, 16 secs. The diving of the female lasted in all 18 minutes and the bird travelled only about 20 metres on the surface. — 5 a. m. 4 ad. females, 1.50—2.00 m.: 18, 15, 20, 20, 15, 15, 15 secs; 25, 20, 17, 17 secs etc. — 5.30 a. m. the adult female observed flew to the pond.

In all 216 dives were recorded from the Tufted Duck, of which 142 from young birds and 74 from adult females. Of the dives made by young birds 66 were from chicks at x days (= about 7 days), 28 from those at $y + 5$ days (= 15 to 20 days) and 48 from young at $x + 30$ to 37 days (= 5 to 6 weeks).

Opportunities to note dives from different broods often arose but the dives were not recorded, since it was impossible to estimate the age of the young. The series from the brood at $y + 5$ days were noted because of the simultaneous dives made by the female and the young in the same depths of water.

All dives recorded from the brood x (in all 114 dives of which 66 at x days and 48 at $x + 30$ to 37 days) and from adult females (74 dives) were put in a table (see p. 12). — The mean times given in the table of the periods spent under water in different depths are not exact, since the material collected is scarce and no errors were calculated. Also, the soundings of the depth of water did not give exact values, as it was difficult to obtain the exact position of the diving bird, and because the bottom in salt water was rocky and irregular. The depths were therefore put together in groups with an amplitude from 0.25 to 0.50 metres. The percentage-frequencies of dives made by individuals belonging to the

same age-group, in different depths were not calculated, since the distribution of dives in different depths depends, to some extent at least, on the system of observation.

Number and Mean Times of Dives according to Depth in Salt and Fresh water.

Depth in metres	Dives in Fresh Water				Dives in Salt Water			
	Chick at x Days		Chick at $x + 30$ to 37 Days		Chick at $x + 32$ to 35 Days		Adult Female	
	Number	Mean Time in secs	Number	Mean Time in secs	Number	Mean Time in secs	Number	Mean Time in secs
0.10—0.25	1	3.0	—	—	—	—	—	—
0.25—0.50	7	6.0	—	—	6	11.7	4	11.3
0.50—0.75	13	8.2	3	13.1	—	—	—	—
0.75—1.00	45	10.7	8	17.1	14	13.1	7	13.9
1.00—1.50	—	—	—	—	17	15.9	12	15.7
1.50—2.00	—	—	—	—	—	—	51	17.4

To avoid a false estimation of the mean times obtained, the particular dives were put in a diagram with the depths on the absciss and the times of the dives in seconds on the ordinate. (Fig. 3). The diagram illustrates the separate dives in relation to the material as a whole, and gives a better survey of the value of the material than a calculating of errors could possibly do.

According to the diagram and the table the dives made by young at x days (= about 7 days) differ in depths from 0.10 to 1.00 metres out of possible 1.0 metre. Most dives took place in a depth of 0.75 to 1.00 metre and the dives lasted from 8 to 12 seconds. The „maximum-frequency“ in a depth of 0.75 to 1.00 metre partly depends on the fact, that dives were easy to record in these depths without disturbing the birds.

It has earlier been shown in the Tufted Duck (BROCK 1912 as quoted by DEWAR 1924 p. 19), that the downy young make at first dives lasting 5 to 8 seconds. At 10 days the dives have lengthened to 10 or 15 seconds. The values obtained in the summer 1935 seem to agree with those mentioned by BROCK, at least regarding the duration of chick-dives at x days.

At an age of $x + 30$ to 37 days the dives fall in depths between 0.25 and 1.50 metres out of possible 2.0 metres. Most of the

dives were made in depths from 0.75 to 1.50 metres, and the dives lasted usually 12 to 18 seconds.

The dives recorded from adult females were made in salt water in depths from 0.25 to 2.00 metres out of possible 2.0 metres, with a „maximum-frequency“ in 1.50 to 2.00 metres. In these depths the dives usually lasted 15 to 20 seconds. The greatest depth recorded was 2.0 metres and the longest dive lasted 25 seconds. However, it must be remembered that no dives were recorded outside the areas of observation mentioned above, since it was impossible to fix the position of the diving bird. Diving females were observed outside these areas, and it is therefore possible that the adult females made dives in deeper water than 2.0 metres. But the adult dives were not made in deeper water than 4.0 metres, since the depth of water did not exceed 4.0 metres in any areas, where the adult females made dives. From the young dives were not observed outside the observing areas, except in shallow water near to shore.

DEWAR (1924 p. 102 and 103) recorded the following values from adult males and females in fresh water: The greatest depth was 16 feet and the longest dive had a period of 40 seconds. The male had a greatest percentage-frequency in 5 feet of water (23.9 per cent) and the female in 3 feet of water (25.0 per cent). Most dives by both sexes took place in 2 to 6 feet (80.6 per cent) and this appears to be the normal vertical range of the Tufted Duck according to DEWAR.

The values in the table and the diagram show, *that dives*

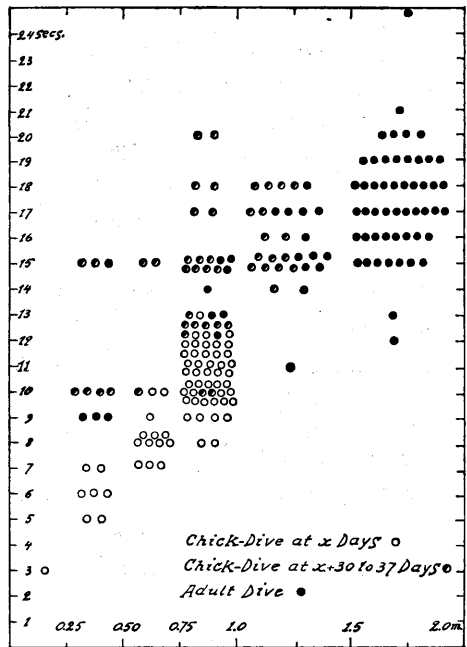


Fig. 3. Dives recorded from the Tufted Duck in Fresh and Salt Water in the Summer 1935. (x days = about 7 days, $x + 30$ to 37 days = 5 to 6 weeks).

made by individuals belonging to the same age-group usually last longer in deep water than do the dives in shallow water.

Earlier has been found, that dives, which are made near to the shore are short, and that dives made in more open water are comparatively prolonged in time. (DEWAR 1924 p. 5). According to DEWAR (1924 p. 37) the most important factor which controls the duration of the dive is the depth:

„It is shown that, within the limits of the vital capacity of the organism, depth of water is the principal factor which controls the average period of the dive“.

According to DEWAR the „time-depth relation“ of the diving birds is expressed approximately by the rule of twenty seconds for the first fathom and ten additional seconds for each succeeding fathom; the rule was tolerably correct in all depths of water from three feet to three fathoms and no specific differences were obtained.

Of the dives recorded in the summer 1935, those from adult females in depths from 1.50 to 2.00 metres seem to follow the twenty-seconds rule. But there is no evidence of the rule in the dives recorded from chicks in different depths.

The diagram shows *that adult females and young at $x + 30$ to 37 days dive in deeper water and remain longer under water than do the young at x days. The adult females dived partly in greater depths than did the young at $x + 30$ to 37 days.* — It is to be supposed that with growing age the young little by little enter new stages in ability of diving, expressed by an increase of the middle depth and of the mean time of the dive.

An examination of the particular series recorded from adult females and young at $x + 30$ to 37 days in shallow water, seems to bear evidence of the fact, that the adult females and the young at $x + 30$ to 37 days spend a longer time under water in search of food than do the chicks at x days in the same depths.

On the 6th of July 45 dives were recorded from chicks at x days in a depth of 0.75 to 1.00 metre in the pond. The mean time of the dive was 10.7 seconds. From August 5 to August 12 in the same pond one series was recorded from young at $x + 30$ to 37 days in a depth of 0.50 to 0.75 metres: 10, 15, 15, mean time 13.1 seconds; and two series in 0.75 to 1.00 metre of water: 17, 15, 20, 20 and 12, 18, 17, 18, mean time 17.1 seconds. This value is al-

most synchronous with the mean-time obtained from the same individuals when diving in salt water in 1.00 to 1.50 metres (15.9 secs) and that obtained from adult females in 1.50 to 2.00 metres of water (17.4 secs).

It is to be observed that on July 6 in half an hour 66 dives were recorded without difficulty in the pond, whereas from the 5th to the 12th of August only 11 dives were recorded. This fact indicates that at $x + 30$ to 37 days the pond only to a very small extent was used as a feeding area. The young remained in the pond all day long between the real feeding spells in salt water, since the pond was a good refuge for diving birds. Adults and broods of Tufted Ducks, Mallards and Shovellers were often observed in the pond.

The dives mentioned above are prolonged in time, since the young at $x + 30$ to 37 days, obviously owing to lack of food with regard to quantity or quality, spent a longer time under water than did the chicks at x days. This is confirmed by the behaviour of the young when diving. The dives were not made at the same spot like at x days. The distance between the spot, where the young ascended and that of descending was from 3 to 4 metres.

In the dives recorded from adult females and young at $x + 32$ to 35 days in depths from 0.25 to 1.00 metre in salt water a prolonged period was also obtained compared with the dives recorded from the chicks at x days in the same depths in fresh water. In 0.25 to 0.50 metres of water the mean times of the dives were: 11.3 seconds from females, 11.7 secs from young at $x + 32$ to 35 days and 6.0 secs from chicks at x days. In 0.75 to 1.00 metre of water the mean times were 13.9, 13.1 and 10.7 seconds respectively. — The values obtained from adult females and young at $x + 32$ to 35 days were about the same, obviously because most of the dives recorded from adult females in 0.25 to 1.00 metre of water were group dives; the female and the young dived together almost simultaneously. In 0.25 to 0.50 metre the following series were recorded: chick 10, 10, 10 secs, ad. female 10, 10, 10, secs; in 0.75 to 1.00 metre: chick 10, 15, 15 secs, ad. female 15, 15, 15 secs; chick 13 and ad. female 13 secs. On the other hand on August 11 an obvious difference was observed in the dives recorded from adult females and young at $y + 5$ days (= 15 to 20 days). (The chick-dives recorded from brood y do not appear in the table.) The female

remained longer under water than did the young in the same depths: 0.25 to 0.50 metres: chick 5 ad. female 15 secs; 0.75 to 1.00 m.: chick 8, 8, 7, ad. female 14, 12, 13 secs; 1.00 to 1.50 m.: chick 8, 10, 9, 8, 10, ad. female 17, 15, 11, 16, 17 secs.

All series and mean times earlier mentioned in the text, show *that dives recorded from adult females and young at 5 to 6 weeks ($x + 30$ to 37 days) last longer than those from chicks at about 1 week (x days) in the same depths of water. Adult females also remain longer under water than do the young at about 3 weeks ($= y + 5$ days) in the same depths. The mean times and the series of dives from adult females and young at 5 to 6 weeks ($x + 32$ to 35 days) in the same depths in salt water are nearly the same.*

The prolonged dives in the same depths of water earlier mentioned, seem to indicate that with growing age the time used for search of food is relatively prolonged compared with the time of the dive as a whole. In the pond absence of food was supposed to cause the prolonged dives.

DEWAR (1924 p. 91) obtained in the Little Grebe values of the chick-dives, which were about fifty per cent of the period of the adult dive in the same depth of water, and he found that the percentage-equivalent then rose until the date of fledging. After complete fledging the chick-dives were almost synchronous with those of the adult female.

TOWNSEND (1905), quoted by BENT (1919) as quoted by DEWAR (1924 p. 9) says that in the Horned Grebe the duration of the dive depends upon two factors, the depth of water and the local abundance of food. Earlier has been mentioned the „time-depth relation“ and the „twenty-seconds' rule“ as stated by DEWAR (1924). Of factors causing true exceptions from the „twenty-seconds' rule“ DEWAR (1924 p. 72) mentions alarm, sexual activities, locomotory habits in relation to the nest, brood-care, absence of hunger, difficulty or ease in procuring food, „reversion to a primitive time-depth relation“ and illumination under water. According to DEWAR (1924 p. 73) the food factor affects only a small number of dives in any series, and it operates chiefly to shorten the period of the dive and does not prolong the dive by more than a few seconds beyond the average duration of the corresponding series of dives. — Before I go further into the question about the cause of the

prolonged dives, the progress towards maturity in the Tufted Duck may be given as observed in the summer 1935 completed by numerous observations made in the years 1932, 1933 and 1934 from the same areas of observation.

At an age of only a few days the chicks make dives both in salt and fresh water. These dives are mostly short, lasting only a few seconds. Dives observed were mainly made near to shore in shallow water or in more open water in the surface layer, in salt water particularly over *Fucus*-weed. In the material presented above only dives made at the same spot, supposed to have reached the bottom are recorded. At this age the food stuff is mainly caught by „dipping“, „tilting“ and „pelagic“ diving (see DEWAR 1924). Little by little dives made to the bottom, so called „bottom-diving“ (DEWAR 1924 p. 4) get more common. „Dipping“ and „tilting“ is observed between the series of dives. The dives are still made almost all day long, and the female is watching the brood without any longer pauses in the daytime. Broods which at the youngest stage mainly dive in fresh water ponds make feeding spells in salt water particularly over „*Fucus*-rocks“ and in small creeks with swimming *Fucus*-weed, and the food stuff is mainly caught by „dipping“, „tilting“ and short „pelagic dives“. In the summer 1934 two broods of the Tufted Duck were observed from a short distance from June 28 to July 6. All day long dives were observed in the pond (Fig. 1), but at least three to four times a day feeding spells were made to small creeks with swimming *Fucus*-weed in the neighbourhood of the cabin. The *Fucus*-weed swimming on the surface or near the surface of the water was examined by „dipping“, „tilting“ and partly by short „pelagic dives“. No real „bottom-dives“ were recorded from the feeding spells in salt water. On July 6, when the observations were interrupted, the age of the broods was about 10 days. In the summer 1935 „surface feeding“ was not observed in swimming *Fucus*-weed in the small creeks, since no storms washed *Fucus*-weed ashore. On the other hand the chicks were observed „dipping“, „tilting“ and doing „pelagic diving“ among growing *Fucus*-weed on the submarine rocks. — After about ten days the bottom-dive is little by little prolonged in time and lengthened according to depth. The dives are no more made all day long but mainly at feeding spells in salt water. The female conducts the young and makes dives together with them

(for instance at $y + 5$ days); in the earlier stage (until about ten days) the dives made by females were observed only in the twilight, when the chicks rested in the pond. At $x + 30$ to 37 days dives made in fresh water ponds are quite rare, and the females still conduct the young at the feeding spells in salt water. The young stay for long whiles alone in the fresh water ponds, since the adult females now take feeding spells in salt water at daytime. At this age the time and the depth of the young dive seem to correspond to those of the adult dive. Dives made by almost fledged young and by adult females are according to the material collected in the summer 1935 prolonged in time in deep water as well as in shallow water compared with those from chicks at x days.

The observations in the summer 1935 were finished on August 12, and the chicks at $x + 37$ days were not yet fledged.

Because of the heterogeneity and scantiness of the material collected, it is difficult to estimate if the prolonged dives recorded from adult females and almost fledged young in shallow water are of quite occasional or local character, or if in progress towards maturity these prolonged dives happen as a rule. If these dives were typical in the areas, in which the observations were made the prolonged period in shallow water could be explained in the following way. *When the chicks attain a new stage of ability of diving, expressed by a prolonged period of the dive and by a transition to new, perhaps different feeding grounds, in deeper water, which correspond to their demands of food, the old feeding grounds in shallow water are later only used exceptionally for search of food. Thus the dives in shallow water are relatively prolonged in time owing to scarceness of food with regard to quality or quantity or both together.* Lack of food is given as one possible reason for the prolonged dives, since in the Tufted Duck, the young as well as the adults show a preference for particular feeding-grounds, where dives are made daily well-nigh at the same spot. The feeding-grounds of the young are in the areas of observation usually more limited than are those of the adults, since the feeding grounds of the chicks are partly chosen with regard to security. The particular feeding-grounds of the young are according to observations made in the areas mentioned, common to different broods, which feed in the same spots on different times of the day.

If the prolonged dives in shallow water take place as a rule in the progress towards maturity independent of local conditions regarding food and security, the chick-dives of the Tufted Duck could be compared with the dives recorded by DEWAR from the adult Coot, the adult Waterhen and from young Little Grebes in an early stage. According to DEWAR (1924 p. 94) the adult Coot and Waterhen have no „bottom-time“; they go straight down to the bottom, stay there no more than a moment, and then return straight to the surface, where the food stuff is examined. According to DEWAR (1924 p. 91) the chick-dive of the Little Grebe in an early stage was synchronous with the dives obtained from adult Coots in the same depths of water. — The chick-dives observed from the Tufted Duck in the summer 1935 could be explained as a „reversion to a primitive time-depth relation“ as stated by DEWAR for the Coot and the Waterhen. (As earlier cited DEWAR mentions the „reversion to a primitive time-depth relation“ as a factor causing true exception from the twenty-seconds rule). *Thus it seems possible that in the progress towards maturity the „bottom-time“ with growing age is prolonged; the time used for search and examination of food at the bottom is short in the early stages, and with growing age it is prolonged independently of the local conditions.*

To work out the problem, more accurate and methodical investigations would be required, than those made in the summer 1935, of the dive of young and adult birds, preferably compared with investigations of the bottom-fauna on the feeding grounds and of the food-stuff swallowed by the birds.

The Velvet Scoter (*Oidemia f. fusca* L.).

The observations of the diving of the Velvet Scoter were made from the skerry Råböckskär in the shallow areas south of the skerry, where the depth of water in no place exceeded four metres. Since the females of the Velvet Scoter are more shy than the Tufted Ducks the recording of the dives was made from the cabin at a distance of twenty to forty metres. An exact fixing of the birds' position was not possible owing to the distance and to the fact that the young of the Velvet Scoter did not work for a long time at the same spot like the young Tufted Ducks. Consequently

the depths given below are very approximative. The dives were timed according to the same principles as in the Tufted Duck.

The particular observations recorded are given below.

August 3, adult female + 6 chicks at x days (about 1 week?), 12.20 a. m.: One chick was making dives apart from the brood, about ten metres from the shore; two dives were apparently made in the surface layer of the water: 8, 8 secs and two dives in a depth of about two metres were supposed to be „bottom-dives“: 15 and 20 secs.

August 10, adult female + 4 chicks at $y + 7$ days ($y =$ about 10 days), 4.30—5.30 a. m.: The chicks „dipped“ and „tilted“ almost uninterruptedly over „*Fucus*-rocks“. Only one separate dive was recorded, which lasted 18 seconds.

August 11, adult female + 4 chicks at $y + 8$ days, 5 a. m.: In a depth of about 1.50 metres of water a single adult dive lasting 15 secs and a chick-dive lasting 18 secs were recorded.

August 12, adult female + 17 chicks at $z + 9$ days ($z = 3$ to 4 days?), 7.30—8.00 p. m.: The brood was working over „*Fucus*-rocks“ and near to shore. The chicks made short dives lasting only a few seconds in the surface layer of the water, and „dipping“ and „tilting“ over the *Fucus*-weed was observed to be very common. Different individuals made separate dives, which seemed to be bottom-dives: 5, 10, 10, 10, 6, 11, 12, 9 secs; 8, 8 secs; 11 secs; the diving series made by the chicks were followed by „dipping“ and „tilting“ over „*Fucus*-rocks“ and near to shore. The adult female also made separate dives in deeper water apart from the brood in 1.50 to 2.0 metres: 14, 20, 21, 22, 19 secs and in about 2.0 metres: 25, 20, 25 secs.

August 13, adult female + 17 chicks at $z + 10$ days: The young were almost all day long moving about near to shore and from one „*Fucus*-rock“ to another. The female sometimes made dives apart from the chicks, which „dipped“, „tilted“ and made short „pelagic dives“ over *Fucus*-weed. One series was recorded from the female: 7, 9, 14, 8, 12 secs and two from a separate chick: 7, 8, 6 and 15, 13 seconds.

All together 36 dives were recorded from the Velvet Scoter of which 22 from chicks and 14 from adult females. The dives were made in a depth of less than four metres. The small number of dives recorded from chicks is explained through the assiduous „dipping“, „tilting“ and „pelagic diving“ over *Fucus*-weed. The young mainly made short „pelagic dives“ in a cluster and thus it was impossible to distinguish the particular individuals except when separate dives were made. Of the dives recorded from chicks 20 were supposed to be bottom-dives. Most of these dives lasted from 7 to 15 seconds and the longest dive was 20 seconds. The age of the chicks on August 12 was from two to two and a half week.

The dives recorded from adult females seemed to be bottom-dives made at the same spot. The period of the adult dive was from about 10 to 20 seconds and the longest dive lasted 25 seconds.

According to DEWAR (1924 p. 117) the longest dive and the greatest depth of water recorded from adult birds were 51 seconds and 24 feet respectively, and the greatest percentage-frequency for both sexes combined was in two to three fathoms of water.

According to the observations made in the summer 1935 from the areas mentioned above the chicks of the Velvet Scoter until an age of about twenty days mainly „dip“ and „tilt“ and make „pelagic dives“ long the shore and over *Fucus*-weed. Particular individuals make dives in deeper water lasting until 20 seconds apart from the brood supposed to be „bottom-dives“.

The Eider Duck (*Somateria m. mollissima* L.).

August 12, adult female + 2 young not yet fledged at about 2 months, 2 p. m.: The young dived in deep water about 25 metres from the shore. The female watched the young and did not do any diving. The young *a* made the following dives in 5 to 6 metres of water: 40, 40, 35, 35, 35 and 30 seconds. The dives made by the young *b* in more than 6 to 7 metres were: 40, 45, 47, 45 and 49 seconds. The dives were recorded in half an hour and the pauses between the dives were thus remarkably long. At 6 p. m. the same brood was observed „dipping“ and „tilting“ near to shore in shallow water.

DEWAR (1924 p. 124) obtained from adult birds as a longest dive 47 seconds and as a greatest depth about 16 feet and most dives recorded were made in 6 to 12 feet of water.

The longest dive recorded in the summer 1935 was 49 seconds and the greatest depth at least 6 metres (> 20 feet). The dives were made in practically open water and by soundings no depths under 5 metres were obtained from the area where the dives were made.

From August 5 to 14 no dives made by Eider Ducks, neither young nor adult, were recorded from the shallow areas (0.5 to 4.0 m.), which seemed to be favourite feeding grounds of Tufted Ducks and young Velvet Scoters. On the other hand young Eider Ducks without or with adult females were observed every day in the shallow areas „dipping“ and „tilting“ in *Fucus*-weed over subaquatic rocks and in little creeks very near the shore: The age of the young observed was from one and a half to two months. Also in the sum-

mers 1932 to 1934 the „dipping“ and „tilting“ of young Eider Ducks in *Fucus*-weed was observed to be very common.

The Goosander (*Mergus m. merganser* L.).

Most of the dives recorded from adult Goosanders were made in deeper water north of the island Råbocksjär.

On August 9, at 11 a. m. an adult bird made the following dives in a depth of 4 to 5? metres: 30, 25 and 27 seconds.

On August 10 at 11 a. m. the following series in a depth of 3 to 5? metres were recorded from an adult bird: 25, 23, 35, 35 secs; 25, 35 secs; at 12.30 p. m.: 30, 21, 20, 20, 10, 20 secs; 23, 21 secs; 30, 30, 27, 5, 30, 33, 34, 26 and 35 seconds.

In all 27 dives were recorded from adult Goosanders. The longest dive lasted 35 seconds.

According to reports in literature (DEWAR 1924 and others quoted by Dewar) the Tufted Duck, the Velvet Scoter and the Eider Duck are known to be bottom-feeders, which search the food material from the bottom and swallow the food-stuff before they ascend to the surface. They have well marked feeding spells and are constant to certain feeding grounds, the Eider Duck and the Velvet Scoter mainly over rocky areas.

The material collected in the summer 1935 completed by numerous observations in the summers 1932—1934 from Klåvskär indicate that the young of these three species at least in a very young stage are bottom-feeders only to a small extent.

DEWAR (1924 p. 93) gives the evolution of the diving habit as follows:

„The behaviour of adult and of young diving birds in shallow water points to the origin of diving for food from feeding at the surface of the water. An adult diving bird seen at work in shallow water may dip, tilt and dive in search of food. Dipping may merge into tilting and after tilting in vain for a few seconds the bird may dive from the tilted position. In the young of the Coot the normal sequence in ontogeny is surface-feeding, dipping, tilting and diving. This is the course of events in the majority of young Coots.“ — „In the Coot, and also in the Mute Swan, the young progress from one stage to another, ...

The observations made in the summers 1932—35 give the same stages in progress towards maturity in the Tufted Duck, Velvet Scoter and the Eider Duck. In all three species „surface-feeding“

„dipping“ and „tilting“ is observed to be very common in an early stage, and in the Eider Duck also in a quite late stage. Possibly the young Eider Ducks without mother-birds remain longer in the stage of „dipping“ and „tilting“ than do the young conducted by adult females. The young without mother-birds „dipped“ and „tilted“ well-nigh all day long in shallow areas with *Fucus*-growth. But also young Eider Ducks at about two months, which were conducted by adult females, „dipped“ and „tilted“ assiduously in shallow water evidently between the real dives in deep water. By stormy sea this method of feeding was more usual than by calm sea.

In the areas of observation the *Fucus*-rocks are of great importance as feeding areas for the young, since the *Fucus*-weed gives shelter to a rich fauna of shell-fish. By low-water the capture of the food-material in *Fucus*-weed is possible through „surface-feeding“, „dipping“ and „tilting“, and by high-water through short „pelagic dives“.

Litterature cited: BENT, A. C., 1919, Life Histories of North American Diving Birds. Order Pygopodes. Bull. U. S. Nat. Mus., Nr 107. — BROCK, S. E., 1912, The Tufted Duck (*Fuligula cristata*) in the Nesting Season. Scot. Nat., 265—271. — DEWAR, J. M., 1924, The Bird as a Diver. London. — TOWNSEND, C. W., 1905, The Birds of Essex County, Massachusetts. Mem. Nuttall Orn. Club. Nr 3. — Atlas of Finland 1925.

Der Uhu auf Åland.

Beitrag zur Ernährungsbiologie.

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Es war meine Absicht, den Uhu, dem ich bisher an seinen Horstplätzen in Mitteldeutschland und in der Tschechoslowakei nachgegangen war, in einem ganz anderen Lebensgebiet aufzusuchen und dort meine Ernährungsstudien zu treiben, um so das Gesamtbild von der Nahrung dieser Grosseule ergänzen und vertiefen zu können. Meine Wahl fiel auf Åland, und zwar kam ich darauf durch das Lesen des ausgezeichneten Werkes PALMGREN'S „Quantitative Untersuchungen über die Vogelfauna in den Wäldern Südfinnlands, mit besonderer Berücksichtigung Ålands“ (Acta Zoologica