Camphuysen, C.J., Ensor, K., Furness, R.W., Garthe, S., Hüppop, O., Leaper, G., Offringa, H. & Tasker, M.L. 1993. Seabirds feeding on discards in winter in the North Sea. EC DG XIV research contract 92/3505. *NIOZ rapport* 1993-8. Netherlands Institute for Sea Research, Texel.
Cramp, S. & Simmons, K.E.L., eds., 1977. Handbook of the birds of Europe, the Middle East and North Africa. The birds of the Western Palaearctic. Oxford.
Furness, R.W. 1992. Implications of changes in net mesh size, fishing effort and minimum landing size regulations in the North Sea for seabird populations. *JNCC report* 133.
Garthe, S. 1993. Quantifizierung von Abfall und Beifang der Fischerei in der südöstlichen Nordsee und deren Nutzung durch Seevögel. *Hamburger avifaun. Beitr.* 25: 125-237.
Garthe, S. & Hüppop, O. in press. Distribution of ship-following seabirds and their utilization of discards in the North Sea in summer. *Mar. Ecol. Prog. Ser.*
Glutz von Blotzheim, U. N. & Bauer, K. M. 1982. Handbuch der Vögel Mitteleuropas. Band 8/1. Charadriiformes (3. Teil). Akademische Verlagsgesellschaft, Wiesbaden.
Gorke, M. 1990. Die Lachmöwe (*Larus ridibundus*) in Wattenmeer und Binnenland. Ein verhaltens-ökologischer Vergleich. *Seevögel* 11, Sonderheft 3: 1-48.
Hudson, A. V. & Furness, R. W. 1988. Utilization of discarded fish by scavenging seabirds behind white fish trawlers in Shetland. *J. Zool., London* 215: 151-166.

Sammanfattning

Måsar och stormfåglar som följer fartyg och lever på fiskeavfall nattetid

Avfall från kommersiellt fiske har uppenbart bidragit till beståndsökningar hos arter som stormfågel, sula, trutar, och tretåmås i Nordsjön. Detta fiske pågår både dag och natt och producerar väldiga mängder avfall som utnyttjas av fåglar som följer båtarna. Även om de flesta måsar och stormfågeln är kända för att söka föda nattetid kan man ännu bara gissa vilken betydelse som nattligt avfallsfiske har.

En fördel med nattfiske kan vara att konkurrensen både inom och mellan arter kan reduceras genom att olika delar av dygnet utnyttjas. Man har således observerat att "svagare" arter som stormfågel fiskade effektivare när "starkare" arter som sula och storlabb var frånvarande. Fåglarna kan kanske fly från båtljuset in i mörkret med sin fångst utan att bli jagade av andra.

Föreliggande experiment utfördes från forskningsfartyget Heincke i sydöstra Skagerak och norra Kattegat 23-25 mars 1993. Fyra trålningar vardera utfördes under dag och natt. De fåglar som följde både räknades. Vid sex av trålningarna kastades fiskar överbord från aktern en efter en. Fiskarnas art och längd samt den fågelart som tog fiskarna registrerades. Totalt kastades 157 fiskar.

Antalet trutar av fem arter skiljde sig inte mellan dag och natt medan tretåmås och sula bara fanns dagtid (Tabell 1). Stormfåglar fanns däremot bara nattetid. Andelen fiskar som togs var påtagligt hög under natten (Tabell 2). Det lilla stickprovet från dagtid i denna studie förhindrar jämförelse, men vi använder resultat från andra undersökningar från Nordsjön i Tabell 2.

Endast 3 av 131 fiskar stals av en annan fågel i mörker, vilket pekar på låg frekvens kelptoparasitism nattetid i jämförelse med dagtid (10 % enligt egna observationer).

Eftersom alla arter som följde båten nattetid tog fisk framgångsrikt, är det uppenbart att nattligt födosök spelar en större roll än man tidigare trott. Följaktligen kan man räkna med att åtminstone vissa havsfåglar täcker en avsevärd del av sitt energibehov genom att följa fiskebåtar nattetid.

Stefan Garthe and Ommo Hüppop, Institut für Vogelforschung "Vogelwarte Helgoland", P.O. Box 1220, D-27494 Helgoland, Germany.

https://doi.org/10.34080/os.v3.23041

Excessive migratory fattening in a captive Bluethroat *Luscinia s. svecica*

ANDERS KVIST, ÅKE LINDSTRÖM & INGRID TULP

Migratory birds mainly use body stores of fat as energy source for their long demanding flights (see e.g. Odum 1960a, 1960b, Alerstam 1982). In the extreme cases, individuals of some species probably more than double their body mass due to fat deposition (see e.g. Lindström 1986, Hedenström & Alerstam 1992). This conclusion is normally drawn from weight data on live birds, where individual birds have twice as high body mass as the estimated average fat-free mass of the population. However, these very fat individuals may have higher than average fat-free mass, leading to an overestimate of their fat loads. We have found only a few studies where fat loads of more than 100% of the fat-free mass have been confirmed, when fat was extracted from dead birds. The few examples include Scarlet Tanager *Piranga olivacea* 104 % (Odum 1960a), Sanderling *Calidris alba* 102 % (Summers & Waltner 1979), and Bobolink *Dolichonyx oryzivorus* 100 % (Odum 1960b). Another way of examining changes in body mass of an individual is to retrap birds, or to follow the body mass development of caged birds.

The Bluethroats *Luscinia s. svecica* breeding in northwestern Scandinavia mainly migrate southeast in autumn, towards unknown wintering areas in SW Asia (Ellegren & Staav 1990). The first known stopover sites where fat deposition takes place are situated mainly along the east coast of central and northern Sweden. Before crossing the Baltic Sea, the Bluethroats put on only small to moderate fat loads, about 10-20 % of the fat-free body mass (Stolt & Mascher 1962, Lindström et al. 1985, Ekholm 1988, Ellegren 1989, 1991, Lindström & Alerstam 1992). Departure body masses are normally below 20 g.

Within a research program concerning the energetics of fat deposition in migrating passerines, we have kept a number of birds in captivity for shorter periods, among them Bluethroats. The bird that we report of here, a juvenile male, was caught at Norrtälje in East Sweden (59°46'N, 18°45'E) on 25 August 1993. It was brought by car to Stensoffa Ecological Station outside Lund, South Sweden (55°42'N, 13°25'E) on 27 August. The bird was kept singly throughout the study in a cage measuring 40 cm • 40 cm • 40 cm. The temperature in the room was +22 °C ± 2° and the light schedule (artificial light) simulated the local light regime of Lund (including the periods of civil twilight). The bird was fed exclusively on mealworms and was given fresh water with added vitamins. Body mass and fat score (see Pettersson & Hasselquist 1985) was checked daily around 18.00 h local time. In order to reduce the fat load down to almost fat-free mass, the bird got only small amounts of food the first two days. After that the Bluethroat was fed mealworms *ad libitum* throughout the study.

At capture, the birds weighed 19.7 g and had fat score 5. During the first days in captivity the bird lost mass down to 15.3 g (Fig.1). At this stage, the bird still had some visible fat reserves (fat score 2). From the next day (day 3) and onwards body mass increased over a period of 25 days. The highest mass recorded was 32.6 g. Thick layers of fat covered the abdomen and throat. Also the breast muscles were partly covered with fat, leaving only a small fat-free square (1.5 cm • 1.5 cm) in the centre. During the 25 days of fat deposition the Bluethroat increased its mass with

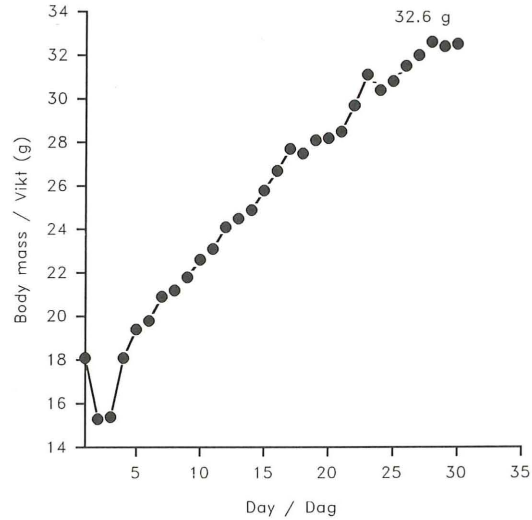

Figure 1. The change in body mass of a captive juvenile male Bluethroat. Day 1 is 27 August. Body mass was recorded in early evening.

Viktutvecklingen hos en juvenil blåhakehane i fångenskap. Dag 1 motsvarar 27 augusti. Fågeln vägdes på tidiga kvällen.

17.2 g (from 15.4 g to 32.6 g). The average rate of body mass increase was 0.69 g per day.

In four other bluethroats, treated the same way, body masses culminated around 24 g. In an additional 10 bluethroats, that still were increasing in body mass when released, the two fattest birds weighed 26.4 g and 28.1 g. Thus, it is not unlikely that some of these latter birds would have attained similarly high masses if they had been allowed to continue feeding.

When the Bluethroat weighed 31.1 g. (day 23) we let it fly freely in the room. It had no apparent problems to fly or manoeuvre when landing, even though it had lost the outermost 5 mm of the outer four primaries, which may have hampered its flight performance (cf. Pennycuick 1989).

Ellegren (1989) estimated that each score of the Pettersson & Hasselquist (1985) fat scale represented 0.6 g fat in Bluethroats in autumn. On day 2 our focal bird weighed 15.3 g and had fat score 2. According to Ellegren (1989) the fat-free mass should be 14.1 g. However, data from catches in Norrtälje indicate that the body mass is on average the same in fat score 0 and 1 (own unpubl. data). This is probably explained by the fact that these two fat classes are particularly difficult to separate between. Therefore, we estimate that the fat-free mass of our bird was 14.7 g. On the evening of day 2, our bird probably had no food in the stomach, which it certainly had when it weighed 32.6 g. To make the data compatible, we therefore subtract 1 g from 32.6 g, to simulate an empty stomach (1 g roughly equals the contents of a full stomach, own observations). If our estimates are correct, the peak mass of the Bluethroat was 16.9 g over the fat-free mass, representing an extra load of 115 %. According to Pennycuick (1989, Program 1) this bird had the amazing capacity of flying 2980 km in still air, if all of the mass increase was due to fat deposition. This is equivalent to a straight flight between Norrtälje and the western shores of Lake Aral in Kazakhstan.

The departure fat loads of Bluethroats leaving from stopover sites in eastern Sweden during autumn are low. Out of more than 100 Bluethroats caught in the evenings (when birds are heaviest) at Norrtälje in 1988 and 1989 (see Lindström & Hasselquist 1989), the heaviest bird weighed 22.6 g. At another autumn stopover site in Gävle (60°42'N, 17°11'E), the heaviest bluethroat, a juvenile female, weighed 24.5 g (H. Ellegren, *in litt.*).

At Norrtälje, some birds were also offered mealworms *ad libitum* in the field (Lindström & Hasselquist 1989, Lindström et al. 1990, Lindström & Alerstam 1992). Several birds used this extraordinary feeding site, and the heaviest bird weighed 25.2 g when it departed. In a previous study of captive Bluethroats, one adult male attained a mass of 27.5 g during autumn migratory fattening (Lindström et al. *in press*). There is a shortage of data from the migration route outside Sweden. We have only found one study, where several hundred Bluethroats have been caught and weighed in Middle Asia and Kazakhstan both during autumn and spring migration (Dolnik 1985). Also there the vast majority of birds had a body mass below 20 g. The only weights above 20 g reported were from the southeastern Karakum desert (east of the Caspian Sea) where two birds weighed 20.5 and 22.3 g, respectively (Dolnik 1985). Ullrich (1972) reports evening body masses of 22.0 and 23.0 g for Bluethroats of the subspecies *cyanecula* on spring migration in Germany. Thus, our Bluethroat weighing 32.6 g seems to be the heaviest Bluethroat ever recorded. It also had, as far as we know, a bigger fat load than what has been recorded in the wild for any bird species.

There are some possible reasons to why Bluethroats do not usually carry large fat loads in nature. First, Bluethroats may not pass large ecological barriers like deserts or mountain ridges on their migration. Thus, there is no need for excessive fat loads. However, since we do not know the wintering grounds of Bluethroats (Ellegren & Staav 1990), the question about potential ecological barriers has to be left unanswered. Second, the speed of migration increases along the route (Ellegren 1990), suggesting that fat deposition rates change accordingly. If so, and if Bluethroats try to migrate as fast as possible (Lindström & Alerstam 1992), they should not be expected to put up large fat loads during autumn migration, according to theories of optimal migration (Alerstam & Lindström 1990). In captivity, though, a Bluethroat has no possibilities to consume its fat by flying. However, it has good possibilities to feed extensively, and probably a strong urge to do so, throughout the autumn. The combined effect of locomotory inactivity and intensive feeding may be sufficient to explain the excessive fat loads found in the Bluethroat of this study.

In numerous other studies of captive migratory birds, high body masses have been reported (e.g. Berthold et al. 1972, Gwinner et al. 1992), often indicating fat loads of around 100 %. Thus, there are no reasons to believe that the excessive fattening in captivity of our focal bird is unique for bluethroats.

We are most grateful to Bill Douhan and K-A Rosling with family who assisted in various ways with the catching at Norrtälje, to Sune Jönsson and Arne Nilsson for building the keeping cages, and to Hans Ellegren for comments on the manuscript and for letting us use unpublished data. This study was supported by grants from the Swedish Natural Science Research Council. IT acknowledges the receipt of an ERASMUS grant from The Netherlands.

References

Alerstam, T. 1982. *Fågelflyttning.* Signum, Lund.

Alerstam, T. & Lindström, Å. 1990. Optimal bird migration: the relative importance of time, energy and safety. Pp. 331-351 in *Bird Migration: The Physiology and Ecophysiology* (Gwinner, E. ed). Springer, Berlin.

Berthold, P., Gwinner, E. & Klein, H. 1972. Circannuale Periodik bei Grasmücken. I. Periodik des Körpergewichtes, der Mauser und der Nachtunruhe bei *Sylvia atricapilla* und *S. borin* unter verschiedenen konstanten Bedingungen. *J. Orn.* 113:170-190.

Dolnik, V. R. 1985 (ed). Energy resources of the birds migrating across arid and mountain regions of Middle Asia and Kazakhstan. *Proc. of the Zoological Institute, Leningrad.* Vol. 137.

Ekholm, A. 1988. Viktutveckling hos rastande blåhakar. *Fåglar i X-län* 19:14-26.

Ellegren, H. 1989. Hur kan vikt och vinglängd användas för att uppskatta mängden lagrat fett hos flyttande fåglar? - En metodstudie hos höstflyttande blåhakar *Luscinia s. svecica*. *Vår Fågelvärld* 48:75-85.

Ellegren, H. 1990. Autumn migration speed in Scandinavian Bluethroats *Luscinia s. svecica*. *Ring. & Migr.* 11:121-131.

Ellegren, H. 1991. Stopover ecology of autumn migrating Bluethroats *Luscinia s. svecica* in relation to age and sex. *Ornis Scand.* 22:340-348.

Ellegren, H. & Staav, R. 1990. Blåhakens *Luscinia s. svecica* flyttning - en återfyndsanalys av fåglar märkta i Sverige och Finland. *Vår Fågelvärld* 49:323-336.

Gwinner, E., Schwabl, H. & Schawbl-Benzinger, I. 1992. The migratory time program of the Garden Warbler: is there compensation for interruptions ? *Ornis Scand.* 23:264-270.

Hedenström, A. & Alerstam, T. 1992. Climbing performance of migrating birds as a basis for estimating limits for fuel-carrying capacity and muscle work. *J. exp. Biol.* 164:19-38.

Lindström, Å. 1986. Fat deposition in migrating birds. *Introductory Paper No. 44*, Dept. of Ecology, Lund University.

Lindström, Å. & Alerstam, T. 1992. Optimal fat loads in migrating birds: a test of the time-minimization hypothesis. *Am. Nat.* 140:477-491.

Lindström, Å., Bensch, S. & Hasselquist, D. 1985. Höstflyttningsstrategi hos unga blåhakar *Luscinia svecica*. *Vår Fågelvärld* 44:197-206.

Lindström, Å., Daan, S. & Visser, G. H. *In press*. The conflict between moult and migratory fat deposition: a photoperiodic experiment with bluethroats. *Anim. Behav.*

Lindström, Å. & Hasselquist, D. 1989. Varför mata blåhakar med mjölmask? *Roskarlen* 11:8-16.

Lindström, Å., Hasselquist, D., Bensch, S. & Grahn, M. 1990. Asymmetric contests over resources for survival and migration: a field experiment with bluethroats. *Anim. Behav.* 40:453-461.

Odum, E. P. 1960a. Premigratory hyperphagia in birds. *Am. J. Clin. Nutr.* 8:621-629.

Odum, E. P. 1960b. Lipid deposition in nocturnal migrant birds. *Proc. XII Intern. Ornithol. Congr.*: 563-576.

Pennycuick, C. J. 1989. *Bird flight performance. A practical calculation manual.* Oxford University Press, Oxford.

Pettersson, J. & Hasselquist, D. 1985. Fat deposition and migration capacity of Robins *Erithacus rubecula* and Goldcrests *Regulus regulus* at Ottenby, Sweden. *Ring. & Migr.* 6:66-76.

Stolt, B.-O. & Mascher, J. W. 1962. Untersuchungen an rastenden Blaukelchen (*Luscinia s. svecica*) in Uppland, Mittelschweden, unter besonderer Berücksichtigung der Körpermasse und Gewichtsvariationen. *Vogelwarte* 21:319-326.

Summers, R. W. & Waltner, M. 1979. Seasonal variations in the mass of waders in southern Africa, with special reference to migration. *Ostrich* 50: 21-37.

Ullrich, B. 1972. Zum Frühjahrszug des Blaukelchens (*Luscinia svecica cyanecula*) mit besonderer Berücksichtigung der Gewichtsvariation der Rastvögel. *Vogelwarte* 26:289-298.

Sammanfattning

Ovanligt kraftig fettpålagring hos en blåhake Luscinia s. svecica *i fångenskap*

I samband med studier av fettupplagring och energetik hos flyttande fåglar hölls ett antal fåglar en kortare tid i fångenskap. En av dessa, en ung blåhakehane, lade på sig mycket stora mängder fett. Fågeln hade fångats i Norrtälje 25 augusti 1993 och sedan transporterats till Stensoffa Ekologiska station utanför Lund där studien utfördes. På 25 dagar ökade blåhaken i vikt från 15,4 g till 32,6 g (Fig. 1). Den genomsnittliga ökningen i vikt var 0,69 g per dag. Den beräknades då ha ökat med 115 % av sin fettfria vikt, vilket är mer än vad som rapporterats i litteraturen för någon frilevande fågel. Enligt flygteoretiska beräkningar skulle fågeln, om hela viktökningen bestod av fett, kunnat flyga 2980 km. Detta motsvarar en non-stopflygning mellan Norrtälje och Aralsjöns västra strand. Den rapporterade vikten är betydligt högre än de högsta vikter (20-24 g) som frilevande blåhakar normalt har under flyttningen.

Anders Kvist, Department of Ecology, Animal Ecology, Lund University, Ecology Building, S-223 62 Lund, Sweden.

Åke Lindström, Department of Ecology, Animal Ecology, Lund University, Ecology Building, S-223 62 Lund, Sweden.

Ingrid Tulp, Department of Ecology, Animal Ecology, Lund University, Ecology Building, S-223 62 Lund, Sweden and Netherlands Institute for Sea Research (NIOZ), P. O. Box 59, 1790 Den Burg, Texel, The Netherlands.