

a large increase in the incorporation of labeled acetate in the sterols, especially in larvae (fig. 2). We confirmed by means of preparative GLC-analysis that labeled acetate is in fact incorporated in the cholesterol. With animals treated with tetracycline, cholesterol synthesis disappears but only with a high concentration of antibiotics (1%). This could mean that symbiotic microorganisms are involved in this synthesis.

For *Thaumetopoea pityocampa* caterpillars, the cholesterol originates therefore mainly from pine needle β -sitosterol but also from biosynthesis from small molecules (acetic acid) either through symbiotic micro-organisms or by the animal itself. Furthermore, biosynthesis is greatly stimulated by Dimilin. Its other effects in addition to the specific action on the cuticle of insects⁵ include (a) a rise in the respiratory quotient⁶, (b) stimulation of the pentose cycle⁶, (c) accumulation of hemolymphatic glucose⁷, and (d) the disappearance of the polysaccharides in oenocytes⁸. Stimulation of cholesterol synthesis by Dimilin could help

to explain why ecdysteroids accumulate in some treated insects⁹ and why the effects of this insecticide are far more varied than is generally supposed.

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Genetic basis of moult, wing length, and body weight in a migratory bird species, *Sylvia atricapilla*

P. Berthold und U. Querner

Max-Planck-Institute for Behavioral Physiology, Vogelwarte Radolfzell, D-7760 Radolfzell-16 (Federal Republic of Germany), 3 December 1981

Summary. In hand-raised groups of 4 populations of Blackcaps, different patterns of juvenile moult as well as differences in wing length and body weight, adaptive to the various degrees of migratory performance, could be demonstrated. 33 F_1 -hybrids which were produced experimentally with 2 of these groups (1 African \times 1 European) showed an intermediate expression of these adaptations relevant to migration, indicating that these physiological and morphological features are under strong direct genetic control.

Patterns of juvenile and postnuptial (pre migratory) moult, as well as morphological features such as wing length and body weight, are known to be adaptive to migratory performance in birds. As a rule, long-distance migrant birds are characterized by early, short and intensive moult whereas less marked, shorter-distance migrants moult later, over a longer time and with a lower intensity. Strongly migratory birds also often have longer and more pointed wings and greater pre migratory body weight than shorter-distance migrants. Such differences have been demonstrated in different species as well as in different populations of the same species^{1,2}. The interactions of genetic and environmental influences upon these migratory adaptations are largely unclear¹⁻³. It is, however, likely – on the basis of studies in other animals – that these morphological patterns are strongly determined genetically, and there is also some empirical evidence of this among birds^{1,3-5}. On the other hand it is to be expected that environmental conditions (e.g. differences in photoperiod, temperature, or food supply under which individuals grow up) can essentially influence the expression of these migratory adaptations^{1,6,7}. The ‘genetic hypothesis’ would be supported if F_1 -hybrids of birds from 2 populations that migrate over different distances and are characterized by different physiological and morphological adaptations, showed intermediate characteristics relevant to migration^{8,9}.

The blackcap, *Sylvia atricapilla*, which has a wide distribution from about 15°–65° N. Lat. (from the Cape Verde Islands and Africa to northern Europe) is a suitable species for such a cross-breeding experiment. First, we hand-raised nestlings from each of 3 European populations and 1 African population in the spring of 1976 and 1977 in identical light conditions in Germany, and their juvenile

moult, wing length and body weight were measured. Birds of these different populations differ extremely in their migratory performance¹⁰, in the time course of their juvenile moult (fig. 1A) and in their morphology (fig. 2). In accordance with the decreasing distances of north-to-south travel in the free-living populations, and in agreement with the decreasing magnitude of migratory activity and a progressively later onset of the first migratory period^{10,11} there was also a progressively later onset of the juvenile moult from Finnish through German and French to Afri-

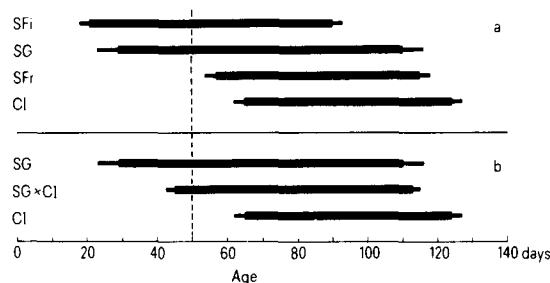


Figure 1. Time course of juvenile moult of blackcaps (with SE for the duration of the moult). A Data from birds of different populations, SFi, southern Finnish birds (n=26), 60° N. Lat.; SG, southern German (n=25), 47° N. Lat.; SFr, southern French (n=25), 43° N. Lat.; CI, birds from the Canary Islands, Tenerife, Africa (n=26), 28° N. Lat. B Data from hybrids (SG \times CI, n=33) and their parental birds (SG, CI, as above). Vertical broken line: transfer to a constant light/dark ratio of 12.5/11.5 h, in order to be able to measure the migratory performance¹⁰ in all groups in identical conditions.

can birds (fig. 1A). We then used the African and German birds of the above experiment for a cross-breeding experiment in aviaries in 1978 and 1979. We successfully handraised 33 hybrids and investigated them for juvenile moult, wing length, and body weight in exactly the same way as their parents. The F_1 -hybrids showed an intermediate time course of juvenile moult (fig. 1B) which differed significantly from that of the parental African population in onset, duration and termination ($p < 0.001$, $p < 0.02$, and $p < 0.01$ respectively, Mann-Whitney U-test) and from the

parental German population in onset and duration ($p < 0.001$, and $p < 0.01$). Statistically significant intermediate features in the hybrids were also found in wing length and body weight (fig. 2; all comparisons $p < 0.001$). In conclusion, the F_1 -hybrids showed consistent intermediate expression of physiological and morphological features associated with migration, all of which have now been shown to be under strong direct genetic control. Consequently individual populations of blackcaps and probably also a series of other migratory bird species with similar migratory adaptations are equipped with innate, genetically fixed time-programs for juvenile moult and genetically fixed morphological prerequisites for migration.

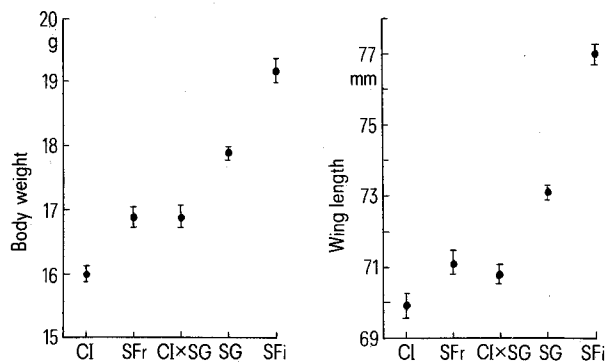


Figure 2. Premigratory body weight and wing length (mean values with SE) of 4 populations of blackcaps and of F_1 -hybrids (CI x SG) (abbreviations as in fig. 1).

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Serotonin-containing cells in the ascidian endostyle

D. A. Sakharov and Natalia Salimova¹

Koltzov Institute of Developmental Biology of the USSR Academy of Sciences, 117334 Moscow (USSR), 1 June 1981

Summary. In the ascidian endostyle, all fluorescence due to serotonin is localized in the peripheral, iodine-binding area of the endostylar epithelium, which is homologous to the vertebrate thyroid. The amine appears to be stored in granule-containing cells which may correspond to the vertebrate calcitocytes.

In a survey of the relative amounts of serotonin (5-hydroxytryptamine, 5-HT) in different tissues of an ascidian, the highest concentration was found in the endostyle or subpharyngeal ciliary groove². An explanation for this finding was suggested by Gorbunova who investigated the ascidian endostyle by electron microscopy. Gorbunova described a previously-unknown cell type in the peripheral iodine-binding region of the endostylar epithelium and suggested that it corresponds to the parafollicular cells of the thyroid tissues³. The parafollicular cells (C-cells, calcitocytes) are known to be able to synthesize 5-HT⁴. Gorbunova speculated, therefore, that calcitocyte-like granule-containing cells of the endostyle might be responsible for the high content of 5-HT in the organ³.

The hypothesis that calcitocytes of protochordates occur within the pharyngeal, i.e. endodermal, epithelium is obviously in disagreement with the assumption that the vertebrate calcitocytes are of neuroectodermal origin. This view, however, has received some support from recent findings of calcitonin-like immunoreactivity in ascidian endodermal epithelia^{5,6}. In the present study we investigated the localization of 5-HT in the endostyle in order to test another prediction of the hypothesis.

Material and methods. 14 ascidians of 3 species, *Styela rustica*, *S. clava* and *Molgula retortiformis*, were used in this study. Animals were obtained from the Sea of Japan and the White Sea⁷ and kept in aquaria before use. Cryostat sections or stretch preparations of the pharyngeal tissue were prepared for examination by fluorescence microscopy, using the formaldehyde⁷ and glyoxylic acid⁹ techniques for the localization of biogenic amines. The specificity of the fluorescence was checked using controls and microspectrofluorimetry, as described previously¹⁰.

Results and discussion. In all 3 species investigated, specific fluorescence due to biogenic monoamines was obtained in stretch preparations of the pharynx treated with formaldehyde or glyoxylic acid. This is illustrated by figure 1 in which a row of brightly fluorescent cells can be seen against a dull background of autofluorescent structures. There were 2 such rows of fluorescent cells, 1 on each side of endostyle. The colour of the cells was yellow in both formaldehyde and glyoxylic acid preparations. The cells were typically smooth, ovoid or flask-like in shape. Within a row the cells were usually arranged in small clusters distributed at irregular intervals. Investigation of transverse sections of the endostyle confirmed that all specific fluores-