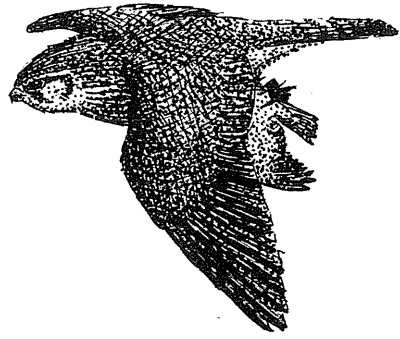


# Mindre meddelelser



## Afhentning og fortæring af gemt bytte hos Dværgfalk *Falco columbarius* uden for yngletiden

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Mange falkearter, deriblandt Dværgfalken *Falco columbarius*, vides i yngletiden at kunne skjule føde for at forhøre den samme dag eller en af de følgende dage, hvor jagtmulighederne måske er mindre gunstige (Sperber & Sperber 1963, Greaves 1968, Dickson 1979, Cade 1982, Village 1990). Det er endvidere kendt at visse falkearter, f.eks. Tårnfalk *Falco tinnunculus* (Village 1990) og Amerikansk Tårnfalk *Falco sparverius* (Cade 1982), kan deponere bytte uden for yngletiden.

Deponering af føde uden for yngletiden er mig bekendt ikke tidligere beskrevet for Dværgfalken. Nedenfor beskrives imidlertid et sådant tilfælde fra et træksted i det tidlige efterår.

Den 14. september 1990 stod jeg i det nordligste fugletårn med udsigt over Schäferiångerna på det sydlige Öland sammen med Palle Nygaard, Finn Jensen, Peter Andersen og Birger Strandqvist. Omkring kl. 14 kom en Dværgfalk hun/ungfugl flyvende langs kysten. Da den var ved at være ud for os, drejede den ind over engene og landede på en sten. Efter at have siddet et øjeblik og set sig omkring hoppede falken ned bag stenen, var ude af syne et øjeblik og fløj så op på stenen igen med en lille fugl, som den gav sig til at plukke og æde.

Dette forløb gentog sig tre gange. Ofte fløj falken fra stenen, hvor den havde hentet byttet, hen til en træstamme, hvor den fortsatte fortæringen af byttet. På et tidspunkt fløj den pludselig ned langs kysten og forsvandt ud af syne. Nogle minutter senere vendte den tilbage med endnu en småfugl i kløerne. Denne gang var byttet dog tydeligt levende. Det fløj fra falken en enkelt gang men blev hurtigt indfanget igen.

Det undrede os meget, at falken kunne "fange" bytte ved bare at hoppe ned fra en sten. Palle Nygaard og jeg selv undersøgte derfor falkens opholdssted nærmere. Dette lå op til et pigtrådshegn midt på et større strandengsområde. En håndfuld store sten og en godt frønnet træstamme dominerede området. Græsset var 10-20 cm højt, dog noget højere op ad sten og træstamme. Alt i alt

et område som selv på afstand skilte sig ud fra de omgivende flade engarealer.

Oven på stammen lå en død Gærdesmutte *Troglodytes troglodytes*. Ved siden af stammen og næsten helt inde under denne fandt vi to døde Fuglekonger *Regulus regulus*. Ud over disse tre intakte fugle fandt vi næb og fjer fra en plukket Fuglekonge ved stammen og af to andre ved nærliggende sten.

De tre intakte fugle var ret friske. Brystfjerene sad godt fast på dem alle. Gærdesmutton og den ene Fuglekonge havde indsunkne øjne, mens den anden Fuglekonges øjne endnu ikke var indsunkne. Denne var endvidere i rigor mortis. Ved at føle forsigtigt på den ene Fuglekonges hoved kunne vi konstatere, at den ene side af kraniet havde flere brud. Den anden Fuglekonge havde blod på brystfjerene. Endvidere lå den ene fugl på ryggen. Alt dette tydede på, at fuglene var døde tidligt på dagen (den ene Fuglekonge dog nok først omkring frokost eller senere – måske drejede det sig om den fugl, vi havde set falken komme med), at de havde lidt en voldelig død, og at de forsætligt var blevet anbragt, hvor vi fandt dem.

At Dværgfalken målbevidst fløj fra kysten direkte hen til en af stenene, og straks derefter samlede en øjensynlig død småfugl op dér, tyder på, at det var falken selv, som havde dræbt fuglene og gemt dem.

### Diskussion

Deponering af bytte i yngletiden er tidligere beskrevet for Dværgfalken (Sperber & Sperber 1963, Greaves 1968, Dickson 1979). Uplukket eller delvist plukket bytte blev skjult i nærheden af reden og inden for synsvidde af denne eller hunnens foretrukne udkigspost. Byttet blev som regel efterladt på træstubbe eller lignende steder, og næsten altid på steder ulig de foretrukne plukkeposter eller på steder uegnede til plukning. Byttet blev ofte gemt i lyngtøtter.

Village (1990) skriver, at bytte hos Tårnfalken normalt gemmes i græstuer, for foden af stolper eller på lignende

let genkendelige steder. Cade (1982) antyder noget tilsvarende om Vandrefalke *Falco peregrinus*. Dværgfalkens depot på Öland var ligeledes anlagt på et selv på afstand let genkendeligt sted.

I yngletiden er det oftest Dværgfalken, som gemmer bytte. Både ungfugle, og i et enkelt tilfælde en han, er dog set gøre det (Sperber & Sperber 1963, Dickson 1979).

Omfanget af byttedeponering hos falke er relateret til fødemængden (Sperber & Sperber 1963). Når jagtmulighederne er specielt gunstige, vil en falk dræbe et bytte, gemme det og vende tilbage efter flere (Cade 1982). På Öland var der mange småfugle på træk, og særlig først på dagen kunne de ses overalt i krattene – ofte i mere eller mindre udmattet tilstand efter nattens træk. Det er derfor sandsynligt, at Dværgfalken først på dagen var i stand til at fange flere småfugle, end den kunne æde. Disse er så blevet gemt til eventuelt senere brug.

**Summary: Retrieval and consumption of cached prey by Merlin *Falco columbarius* outside the breeding season**

On 14 September 1990, at a major meadow area on the south coast of Öland, Sweden, a female or juvenile Merlin *Falco columbarius* was observed retrieving three apparently cached prey items from beside some large stones. Upon retrieving an item the Merlin consumed it sitting on the nearest stone or on a nearby log. Three intact and rather fresh small birds were later found on and beside the log: one Wren *Troglodytes troglodytes* and two

Goldcrests *Regulus regulus*. The Goldcrests showed signs of having suffered a violent death. Feathers and beaks of three plucked Goldcrests were found nearby.

The Falcon is believed to have caught the birds earlier in the day when plenty of night-migrating passerines occurred in the area.

Several species of Falcons are known to cache food during the breeding season, and some species even outside the breeding season (Cade 1982, Village 1990). Previously, Merlins have been reported caching prey items close to the nest in the breeding season (Sperber & Sperber 1963, Greaves 1968, Dickson 1979) but the observation from Öland is apparently the first case described from outside the breeding season.

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## Star-navigation in night-migrating passerines

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Displaced migrants tested in funnels normally change their orientation and compensate for the displacement (e.g. Rabøl 1969, 1975, 1985, 1988). The mechanism is not well understood but the response seems to be at least facilitated by the sight of the starry sky (Rabøl 1988). Several hypotheses may be proposed.

1) The birds *navigate* towards a (moving) *goal area* somewhere along the migratory route. The process of navigation is based entirely on stimuli perceived *on site*.

2) The birds orient in a *cross-axes* system (Rabøl 1983, 1985), and the compensatory orientation is influenced by one of two *right-angle vectors*. As an example: if a migrant with a standard direction of SW is displaced towards W the SE-vector of the cross-axes system dominates the orientation. Which of the two right-angle vectors are in function is determined either *en route* (during displacement) or *on site* (e.g., a delayed sunset).

3) The birds make use of *vector orientation/navigation*, i.e., are endowed with a *clock-and-compass* system. In such a system the compensatory orientation should be considered as the resultant between a vector in the nor-

mal direction and a vector in the opposite direction of the displacement (SW plus E in the example above). The direction of displacement is determined entirely on basis of stimuli perceived *en route*.

Rabøl (in prep.) shows that significant compensatory orientation is carried out in Pied Flycatchers *Ficedula hypoleuca* displaced in autumn from Christiansø to Skallingen (western Jutland, 7° towards W). This compensation is found in both controls and experimentals deprived of any meaningful magnetic and celestial information during transport. Therefore, 1) or 2) (above) must be responsible for the compensatory orientation, and it seems reasonable to guess that the altered starry sky of western Jutland (delayed in rotation-phase compared to Christiansø) is the cue behind the reaction.

In general, however, the most powerful way for detecting the presence of 1) og 2) is a *simulated* geographical displacement where a single environmental cue-system is altered in such a way that it corresponds to the condition on another position at the very same moment. The starry sky is an obvious candidate for such a system,

and some years ago I made several test-series in a small planetarium – and found some evidence of star-navigation (Rabøl 1981, 1990). Therefore when the large Tycho Brahe Planetarium in Copenhagen opened in November 1989 I was ready for "displacements" in the autumn of 1990.

**Material and methods**

The diameter of the dome is 23 metres, and the Zeiss-projector displays about 9000 "stars" on the "sky". The starry sky looks rather natural though bright stars are substituted by large light spots. Unfortunately, the slowest rotational speed is one turn (360°) in a half hour. Therefore, the stars were moved during only 1.25 seconds each minute. The floor of the planetarium is not horizontal but slopes 30°, and the normal position of stellar N is uphill. In this position magnetic N is found 120° to the left of stellar N (but seems without any influence on the orientation). Two sets of each six funnels were placed to

the E and W of the projector. Because of some parallax – which was different from one funnel-position to the next – the same individual bird was always placed in the same funnel-position. The birds were exposed under the stars from 10:30 p.m. until midnight, and the orientation was recorded by means of the typewriter correction paper method introduced by Rabøl (1979).

On 23 Aug. 1990 12 Pied Flycatchers were trapped on Christiansø and used for experimentation in the planetarium during 2-20 Sep. However, the orientation was strongly dominated by an irrelevant downhill taxis. Obviously, the funnels should be shielded in some way. In the 1991-experiments I coped with the slope by attaching aluminum collars extending 8 cm above the wire-screen-covered opening of the funnel. In this way the lower 15°-20° of the hemisphere was screened away. In all experiments the rotational point (stellar N) was placed in 60°N and downhill (lower downhill latitudes were not possible). Our intention was to simulate E/W-

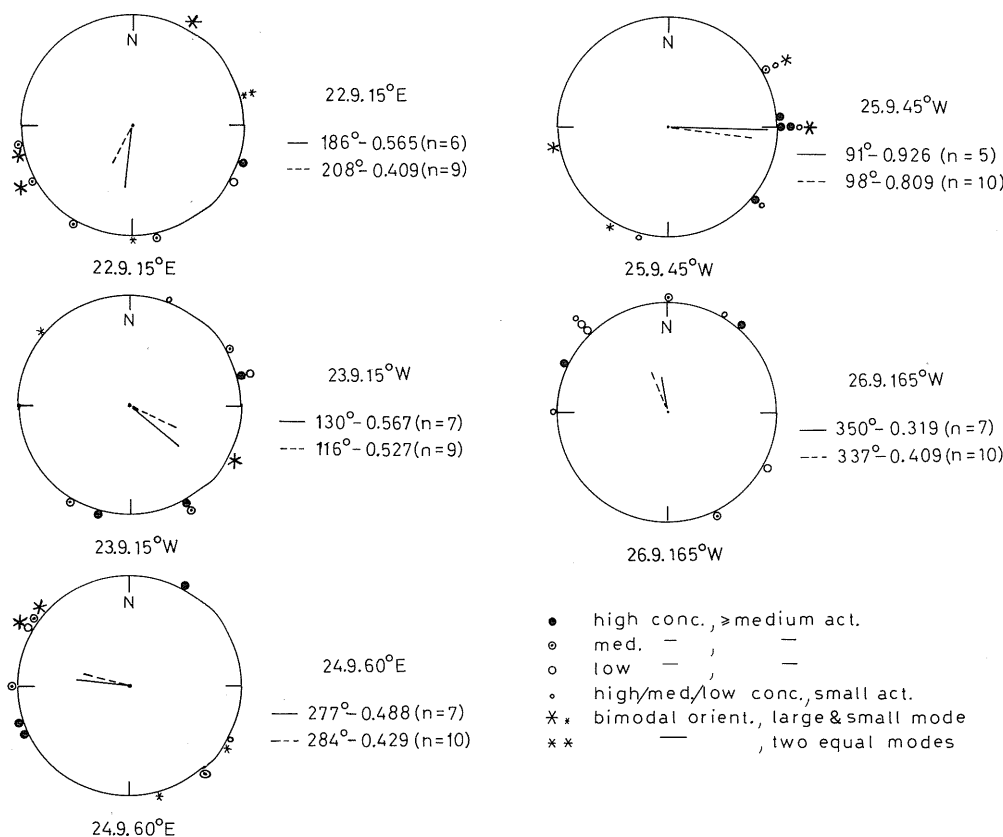


Fig. 1. The orientation patterns in the Tycho Brahe Planetarium on the five nights of 22-26 Sep. 1991. The fully drawn sample mean vectors are based on the big dots only, whereas the hatched sample mean vectors include the small dots and the big crosses. If the orientations on the five nights are pooled in relation to a) geographic N, or b) the great circle direction towards the presumed goal area in eastern France, the fully drawn mean vectors are: a) 126°/0.180 (n = 32, P > 0.10), and b) 5° to the left/0.542 (P < 0.001).

*Orienteringsmønstrene i Tycho Brahe Planetarium i de fem nætter fra 22. til 26. september 1991.*



Fig. 2. The black arrows show the mean orientation of birds "displaced" to the indicated positions (see Fig. 1). The migratory route from Finland to Spain is denoted by the big white arrow.

*De sorte pile viser gennemsnitsretningerne (Fig. 1) fra de fire positioner på 60° nordlig bredde, hvortil fuglene blev "forflyttet" under planetarie-stjernehimlen. Den hvide pil viser træktruten fra Finland til Spanien. Bemærk hvordan de sorte pile peger ind mod træktruten, hvad der tyder på, at fuglene korrigerer for "forflytningen" ud fra observation af stjernehimlens omdrejningsfase.*

displacements only. N/S-displacements were disregarded because of the unknown residual strength of the downhill taxis.

### Results

During 3–9 Sep. 1991 we trapped 8 Pied Flycatchers and 8 Redstarts *Phoenicurus phoenicurus* on Christiansø. The sample mean vector of the birds – all tested on site under a starry sky – was  $283^\circ/0.586$  ( $n = 12$ ), or  $278^\circ/0.496$  ( $n = 15$ ). The latter mean vector includes the large bimodal modes and small-activity orientations (cf. Fig. 1). The rather "northerly" orientation was probably compensatory in response to the strong northwesterly winds prevailing on most days in the period.

During the five nights of 15–19 Sep. the birds (8 flycatchers) were exposed under the contemporary planetarium starry sky of  $15^\circ\text{E}$ ,  $15^\circ\text{E}$ ,  $15^\circ\text{W}$ ,  $45^\circ\text{E}$ , and  $45^\circ\text{E}$ . On all nights the orientation was rather scattered. If the third and fifth nights are compared weak indications of compensation are observed: the rather concentrated orientation on  $15^\circ\text{W}$  is ESE, and the more scattered orientation on  $45^\circ\text{E}$  averages about NW.

On the nights of 20–21 Sep. the birds were placed outside under the natural starry sky N of Copenhagen on about  $55.5^\circ\text{N}$ ,  $12.5^\circ\text{E}$ . Perhaps this exposure had a positive effect on the orientation. Anyway, during the last five test-nights 22–26 Sep. the orientation was remarkable in terms of (compensatory) star-navigation. The results of the planetarium experiments in this period is shown in Fig. 1 and Tab. 1. Fig. 2 offers a summary of the results.

### Discussion

If the orientation on the single nights is considered in isolation most distributions appear rather random: the concentration of the individual directions is not high and only the sample mean vectors of 25 Sep. attain statistical significance by the Rayleigh test. However, knowing the approximate position of the goal area, the orientation following a "displacement" can be predicted (Tab. 1), and the V test can be used as a test for randomness (Batschelet 1981). Now all sample mean vectors – except on 26 Sep. – become statistically significant.

Tab. 1. The mean directions of the sample mean vectors (Fig. 1). The loxodrome and orthodrome directions from the five positions (on  $60^\circ\text{N}$ ) towards the presumed contemporary goal-area in eastern France ( $47.5^\circ\text{N}$ ,  $7^\circ\text{E}$ ) are shown for comparison. Loxodrome means the constant compass course, orthodrome is the great circle course. The latter fits better for larger "displacements".

*Den observerede orientering i tragtene (mean direction) på de fem datoer og længdegrader (longitude) i relation til kursen fra "forflytnings-stedet" til det forventede, øjeblikkelige målområde i Østfrankrig. Loxodrome betyder den konstante kompas-kurs, orthodrome storcirkel-kursen.*

Date	Longitude	Mean direction	Loxodrome	Orthodrome
22 Sep.	$15^\circ\text{E}$	$186^\circ$ (208°)	$201^\circ$	$204^\circ$
23 Sep.	$15^\circ\text{W}$	$130^\circ$ (116°)	$134^\circ$	$124^\circ$
24 Sep.	$60^\circ\text{E}$	$277^\circ$ (284°)	$248^\circ$	$272^\circ$
25 Sep.	$45^\circ\text{W}$	$91^\circ$ (98°)	$112^\circ$	$98^\circ$
26 Sep.	$165^\circ\text{W}$	$350^\circ$ (337°)	$97^\circ$	$6^\circ$

When the orientation is compared from one night to the following most directional shifts are statistically significant applying the non-parametric Mardia-Watson-Wheeler two-sample test (Batschelet 1981). The most important exception is between the first two nights, but in this case significance is attained by application of the parametric Watson-Williams test ( $P < 0.05$ ). However, the latter test should be used with care since the sample concentrations are lower than 0.75 (Batschelet 1981).

Considered as a whole the orientation in the period 22-26 Sep. is indicative of compensatory star-navigation, and the pattern as summarized in Fig. 2 much resembles the orientation of B632 in one of Sauer's star experiments (Sauer & Sauer 1960). Of course, the results do *not prove* the hypothesis of navigation towards a moving goal area (Rabøl 1985). However, the results are *compatible* with this hypothesis but *not* with the clock-and-compass hypothesis. The results are also compatible with the cross-axes hypothesis.

The idea of "inherited" goal navigation in migrant birds has been ignored by recent reviews on the orientation mechanisms of migrant birds (e.g., Able & Bingman 1987, Wiltshcko & Wiltshcko 1988, Helbig 1990, Berthold 1990, Wallraff 1990). Only vector orientation/navigation (= clock-and-compass orientation) is considered. Only the homing pigeons and the adult Starlings *Sturnus vulgaris* of Perdeck (1958) are allowed to make use of some sort of coordinate navigation. Compensatory orientation following geographical displacement in juvenile, inexperienced migrants, as reported by, e.g., Evans (1968) and Rabøl (1969, 1975, 1988), is likewise ignored although such orientation is indicative of goal area navigation.

Perhaps it is time for the clock-and-compass people to extend the borders of their research field.

### Resumé: Stjerne-navigation hos Broget Fluesnapper og Rødstjert

Hvis fugle stjerne-navigerer, kan de bestemme deres position i relation til et måls position ved at kigge op på stjernehimlen (se kapitlet om "Fuglenes orientering efter stjernerne" i Rabøl 1988).

Hvis fugle stjerne-navigerer, kan man muligvis bilde dem ind, at de er på en anden position end den aktuelle ved at eksponere dem under en planetarie-stjernehimmel, der er i samtidig højde og omdrejningsfase med den rigtige stjernehimmel på denne anden position.

Jeg har tidligere med nogen succes brugt et lille, transportabelt stjerne-planetarium til forsøg, der skulle påvise stjerne-navigation (Rabøl 1981, 1990). Efter nogle indledende forsøg i det store Tycho Brahe Planetarium i København i efteråret 1990, lykkedes det så i september 1991 at finde klare tegn på stjerne-navigation som vist på figureerne og i tabellen.

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