

## Prism-experiments on Christiansø, autumn 2008

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4 prisms were in use on 8 starry nights. For a picture and a description see the document *Prisme2* in [www.jorgenrabol.dk](http://www.jorgenrabol.dk).

The question is whether juvenile nocturnal migrants gradient/coordinate navigate in their first autumn by means of the starry sky. The normal procedure for answering such a question is to find out whether compensatory orientation is carried out as a reaction to real or simulated geographical displacements.

By means of prisms on top of the funnels a simulated latitudinal displacement 4° to the S could be carried out, and the expectation is that if stellar navigation a significant amount of northerly orientation should show up (assuming a southerly standard direction). However, a displacement of just 4° could be insufficient to demonstrate the presence of stellar navigation.

The document *Prisme2* up cit. describes the prisms and set-up and gives some indications of stellar navigation, but the question is whether spurious directional influences from the thin edge of the prism is involved. To elucidate this possibility we investigated for directional influences of the prism under the clear or cloudy **sunset** sky (i.e. no stars were visible) during autumn 2007. Under these starless conditions there seemed to be no influence of the prism. However, this finding should be considered pre-mature and in autumn 2008 appropriate control experiments were carried out under a **starry sky**.

In 2008 the thin edge of the four prisms was directed towards geographical N, E, S, and W, respectively, and the combined orientations of the samples could now be found in reference to a) geographical N and b) the thin edge of the prism. If the standard direction is S and **no influence of the prism (thin-end “taxis”) and if (only) stellar compass orientation** is carried out) the expectation should be a) southerly standard orientation, and b) disorientation, i.e. a mean vector concentration close to 0\*.

**Africa-migrants** tested during three nights were oriented 229° - 0.484 (n = 10) in reference to N, and 33° - 0.380 (n = 10) in reference to the thin edge of the prism. In fact, the latter distribution is described better following doubling of the angles: 81°/261° - 0.397.

**Robins** tested during five nights were oriented 225° - 0.345 (n = 17) in reference to N, and 348° - 0.339 (n = 17) in reference to the thin edge of the prism.

The orientation of the two samples combined is denoted on Fig.1. The orientation in reference to N (227° - 0.396\*, n = 27) is statistically significant whereas the orientation in reference to the thin edge of the prism (6° - 0.328, n = 27) is not significant – at least when focusing alone on the concentration and applying the Rayleigh test. According to the V-test the birds are significantly oriented in the direction of the thin edge of the prism (P < 0.01).

However, this thin-edge “taxis” may be spurious/apparent and caused by inclusion of some very small activities: The nine orientations derived from **very small activity** (small white circles on Fig.1) are – considered as a sample – disoriented in reference to N (252° - 0.296, n = 9), but significantly oriented in reference to the thin edge of the prism (28° - 0.671\*, n = 9).

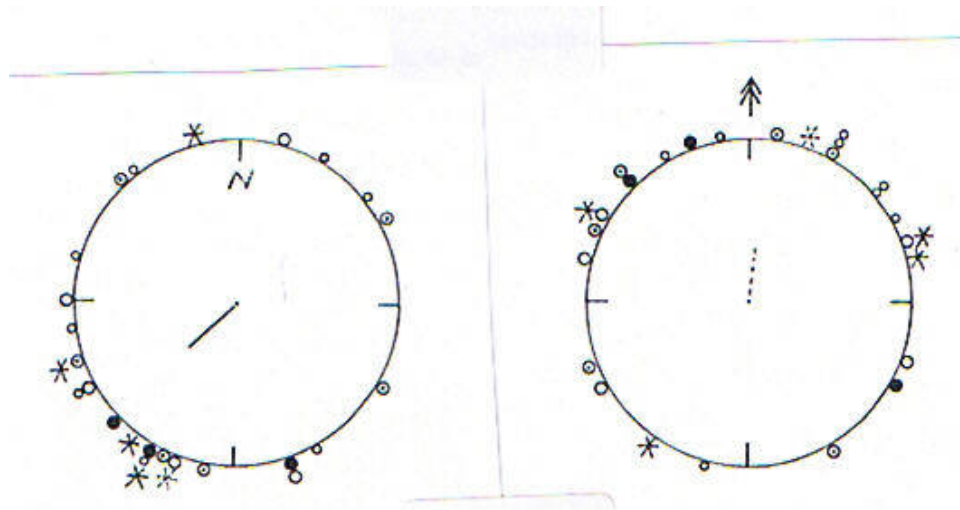
The 18 orientations derived from **at least small activity** are – considered as a sample – significantly oriented in reference to N ( $219^\circ - 0.465^*$ ,  $n = 18$ ), but disoriented in reference to the thin edge of the prism ( $331^\circ - 0.220$ , or – better described –  $285^\circ/105^\circ - 0.283$ ,  $n = 18$ ). Applying the V-test to  $331^\circ - 0.220$ ,  $n = 18$ ) leads to  $P > 0.05$ .

The conclusion should be that there seems to be a small spurious influence of the thin edge of the prism. But this influence is probably only displayed by birds showing very small activities. So the method seems rewarding for demonstrating either stellar gradient-navigation or the reaction of a reverse component in a more simple compass system.

\* If **stellar gradient navigation** is carried out under a **starry sky** the null hypothesis is not (necessarily) disorientation/zero concentration of the combined sample in reference to the thin edge of the prism. The following example may be given with a total of 20 birds, where 5 each were tested under the conditions of the thin edge directed N, E, S, and W, respectively: Thin edge N:  $360^\circ, 15^\circ, 170^\circ, 190^\circ, 345^\circ$  (for three of the birds the goal area is less than  $4^\circ$  to the S). Thin edge E:  $140^\circ, 160^\circ, 180^\circ, 200^\circ, 220^\circ$ . Thin edge S:  $150^\circ, 165^\circ, 180^\circ, 195^\circ, 210^\circ$ . Thin edge W:  $140^\circ, 160^\circ, 180^\circ, 200^\circ, 220^\circ$ . For the sake of simplicity the spread of the E- and W-edge birds is considered a little higher than in the S-edge birds (the stellar sky seen through the E- or W-prism is tipped  $4^\circ$  along an E/W-axis and may lead to minor confusion but the Polaris star is still very close in the direction of geographical N). For the combined sample the mean vector is  $180^\circ - 0.626^{***}$  ( $n = 20$ ) in reference to gN, and  $0^\circ - 0.281$  ( $n = 20$ ) in reference to the thin edge of the prism, i.e. there is a **spurious (but in the present case insignificant) thin edge effect of the prism**. However, a spurious thin edge effect is general in all/most reasonable constellations.

\*\* Another possibility is to consider alone the orientations when the thin edge of the prism is directed towards E or W. Here we expect a concentration close to 0 when the combined orientation is depicted in reference to the thin edge of the prism.

The orientation was  $212^\circ - 0.391$  ( $n = 13$ ) in reference to N, and  $53^\circ - 0.329$  ( $n = 13$ ) in reference to the thin edge (Africa-migrants and Robins combined). The expectation seems reasonably met.



**Fig.1:** All Africa-migrants and Robins tested under a starry sky when the thin edge of the four prisms was turned N, S, E, and W, respectively. The figure to the left shows the orientation in reference to N ( $227^\circ - 0.396^*$ ,  $n = 27$ ), and the figure to the right the orientation in reference to the thin edge of the prism ( $6^\circ - 0.328$ ,  $n = 27$ ).

Small, white dots refer to (unimodal) orientation based on very small activities, whereas the single, dotted cross refers to the prominent peak in a bimodal activity pattern (very small activity). For activities at or larger than small, 1) white, dotted and black dots refers to mean directions with low, medium and large concentrations, respectively. 2) the four full crosses refer to the prominent peak in a bimodal activity pattern. A fully drawn sample mean vector refers to a significant mean vector concentration ( $P < 0.05$ , Rayleigh test).