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Compass calibrations in night migrating passerines revisited: the starry sky upgraded – a commentary to Sjöberg & Muheim (2016)

(Med et dansk resumé: Nattrækkende småfugle: Kompaskalibreringer set i bakspejlet)

Abstract Sjöberg & Muheim (2016) released Garden Warblers *Sylvia borin* in the more or less starry night after previous sunset exposure in a deflected magnetic field. The expectation was sunset calibration of the magnetic compass and a corresponding directional shift in the experimental birds compared with the controls. However, no shift was observed, and the rather sought explanation was that a previous magnetic calibration of the stellar compass was still in action. Apparently, the obvious and simple interpretation that a here-and-now dominant stellar compass was in action never occurred to Sjöberg & Muheim. The latter authors appear to be entangled in a dispute with Wiltschko & Wiltschko concerning which compass – the magnetic or the sunset – is the calibrating versus the calibrated one. As the stellar sky is not presented in the calibration phase (or enters very late) the scenario considered is obviously too restricted for proper generalizations.

Introduction

Sjöberg & Muheim (2016) is the latest contribution of R. Muheim's group in an array of calibration papers presenting evidence and estimates about the prime influence of a sunset compass (Muheim *et al*. 2006a, 2006b, 2007, 2008, 2009). Rabøl (2019) overlooked the paper by Sjöberg & Muheim, but these authors also missed Rabøl (2010). The purpose of the present contribution is to reevaluate the interpretation of Sjöberg & Muheim.

Results and discussion

According to the abstract by Sjöberg & Muheim (2016), the 'contest' between the calibrating and the calibrated compass is solely a matter about polarized light cues at sunset, versus the magnetic compass (Wiltschko & Wiltschko 2008a, 2008b, see also Rabøl 2019). According to these researchers, the stars first enter the scene later and are considered to play a secondary/tertiary role. The following words of Sjöberg & Muheim (2016) pick up the situation: "We tested whether

migratory Garden Warblers *Sylvia borin* recalibrated their compasses when they were exposed to natural celestial cues at sunset in a shifted magnetic field, which are conditions that have been shown to be necessary for the use of a reference based on polarized light cues." One should note the word "sunset" because the birds never were allowed to watch the stars in the period when exposed to the shifted magnetic field. This is the general scenario in most compass conflict experiments (where a few stars sometimes enter the scene in the end of the exposure), so no one should wonder about the claimed low rank of the stellar compass.

After exposure under the sunset sky (no stars visible), Sjöberg & Muheim (2016) released Garden Warblers under the more or less starry sky at Falsterbo, SW Sweden, where the directions chosen by the departing birds showed no calibration of the magnetic compass; there was no difference between the orientations of the controls and experimentals. Both departed towards SSE. As the reason for the lacking calibration of the magnetic compass in the experimentals "we cannot exclude the possibility that the birds recalibrated their magnetic compass but relied on their previously calibrated star compass to determine their departure direction." One may wonder about the wording "previously calibrated star compass" instead of perceiving the orientation as the result of a 'here-and-now' dominant magnetic or stellar compass. The authors cling to their perception of the dominant and calibrating sunset compass and the two-sided interplay between the sunset and magnetic compasses with the star compass in a modest inferior position.

Sjöberg & Muheim (2016) stated in their introduction that Giunchi *et al*. (2015) found a calibration of the magnetic compass in the sunset funnel experiments. However, Giunchi *et al*. selected away lean and reversely oriented birds, and the remaining bimodal orientation in reference to magnetic N obscures the relevance for what is going on in the real world and the suspected calibrating from the – first sunset calibrated – magnetic compass into the stellar compass. In an earlier experiment, Gaggini *et al*. (2010) reported no calibration of the magnetic compass in the sunset experiments. Furthermore, Sjöberg & Muheim also maintained that "Once released, the birds simply followed their star compass calibrated prior to the cue conflict and ignored the recalibrated magnetic compass." However, why was the release orientation not the result of a here-and-now dominant magnetic or stellar compass?

Very interesting – and counter-logical – Sjöberg & Muheim maintained that "the bird will have to calibrate the different compasses with respect to a common reference, which we propose is true geographic North, determined by averaging the vertically aligned e-vector of polarized light at sunrise and sunset." Why not consider the much more precise and accurate rotational stellar-N/Polaris? In the universe of Muheim and colleagues, the stars are not allowed to play a primary role in the orientation of birds. But one should take into consideration that very few star-exposures have been included in the calibration-phase of most investigations (with Rabøl 2010 and 2019 as exceptions) probably because people do not consider the possibility of a dominant and/or calibrating influence of star-orientation. In my opinion, it certainly makes sense that the star compass calibrates the magnetic compass for use on overcast nights.

In conclusion, relying on a 'bound-to-be' very unprecise sunset-/sunrise-based compass would add further to the inbuild weaknesses (too much scatter) of a vector orientation system as the one and only inherited system. Time seems ripe to reconsider the (co)influence of a goal area migration system as already proposed 50 years ago (Rabøl 1969).

Among details and curiosities in the literature is the 'out-of-the-blue'-reference of Sjöberg & Muheim to Emlen (1967) for the view that "the star compass is recalibrated by the magnetic compass during migration." Not even in the important survey by Emlen (1975) is there any such reference. No surprise. In 1967 the magnetic compass was not yet born! The very first documentation of a magnetic compass came the following year (Wiltschko 1968), and the first claims of such calibrations by the magnetic compass into the star (not the sunset) compass were in Wiltschko & Wiltschko (1975a, 1975b, 1976). However, the 1975 natural starry sky experiment and '16-star-sky' experiment (1976) of Wiltschko & Wiltschko are not easily interpreted, and the conclusions are open to critics. Probably, the orientation was spuriously influenced by the restricted view (Polaris mostly not visible) of the starry sky (Wiltschko & Wiltschko 1975a, 1975b, Rabøl 2010) as seen from the depth of a Frankfurt cage, and what happens under a rotating or stationary '16-star-sky' (Wiltschko & Wiltschko 1976 and several times since) has not necessarily anything to do with orientation under a natural starry sky.

Resumé

Nattrækkende småfugle: Kompaskalibreringer set i bakspejlet

Sjöberg & Muheim (2016) slap Havesangere fri om natten under Falsterbos stjernehimmel. Forud havde forsøgsfuglene i solnedgangen været udsat for et drejet magnetfelt. Forventningen var nu, at et solnedgangskompas havde kalibreret magnetkompasset, der så senere kalibrerede et stjernekompas, der styrede nattens træk. Det skulle så vise sig ved en drejet orientering sammenlignet med kontrolfuglene, der ikke i solnedgangsfasen var blevet magnetfordrejede. Men begge grupper fugle fløj SSØ. Hvordan nu det, spurgte de to svenskere forundret. Jo, gættede de, stjernekompasset befandt sig i en fastlåst position fra en tidligere kalibrering af magnetkompasset, hvor dette ikke i en drejet tilstand var blevet kalibreret af solnedgangskompasset. Når man tror så meget på noget, overser man ofte en simplere forklaring, nemlig at SSØ-orienteringen i begge grupper var her-og-nu fastlagt af et ikke-kalibreret magnet- eller stjernekompas.

Sjöberg & Muheim (2016), som undgik min opmærksomhed, da jeg skrev Rabøl (2019), er et led i den fortsatte ret så private dyst mellem R. Wiltschko og R. Muheim om, hvorvidt magnetkompasset kalibrerer solnedgangskompasset (Wiltschko) eller omvendt (Muheim). Wiltschko og Muheim presser – ubevidst – stjernekompasset ud af muligheden for primær indflydelse ved at afslutte kalibreringsfasen ved solnedgangs/nattetide for tidligt, før stjernerne har været i lang tid nok på himlen. Nogle gange sluttes før, der overhovedet er synlige stjerner. Det er naturligvis ikke i orden. I mine forsøg får fuglene lov til at se stjernerne i hvert fald en time før de overføres til tragtene.

Jeg tror ikke meget på al den kalibrerings-snak, og det gør Havesangerne tilsyneladende heller ikke. Stjernerne er sagen; her og nu blinker de igennem og dominerer det i baggrunden beskedne levn fra fortiden, magnet-kompasset. og det alt for upræcise solnedgangs-kompas, der kun manifesterer sig, når alt andet går i sort.

Sjöberg & Muheim hylder tilsyneladende også princippet: Hvorfor gøre noget enkelt, når det kan gøres kompliceret. De foreslår, at geografisk N bestemmes ud fra en vinkel-halvering mellem retningen mod solnedgangen og retningen mod solopgangen. For at gemme og fastholde retningen mod solnedgangen skal den overføres til retningen mod fx en kirke i det fjerne. Så sidder fuglen og kukkelurer hele natten og retningen mod den opgående sol overføres så til retningen mod et træ i det fjerne. Fuglen laver nu en halvering mellem de to retninger, der overføres til en tredie terræn-genstand i det fjerne. Dette er så retningen mod geografisk N sådan cirka, for det kan være op til flere grader galt, thi solnedgang og solopgang befinder sig kun iblandt i den samme vinkel til venstre og højre for geografisk N. Herefter kalibrerer fuglen magnetkompasset ud fra geografisk N, og til sidst kalibreres stjernekompasset ud fra magnetkompasset. Hvorfor ikke bare kikke op på stjernehimlen og finde Nordstjernen; den står med brøkdele af en grads unøjagtighed mod geografisk N.

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Jørgen Rabøl (jrabol@bio.ku.dk; jrabol@hotmail.com)
Søndermølle 16
DK-8789 Endelave
Denmark