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SHORT COMMUNICATION

Does a roosting flock of migratory birds also echelon in high winds?

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Abstract
The organized aerial manoeuvres of birds in "V" and "J" flock echelons have always captivated onlookers and several of these aspects are still a matter of ongoing research. However, we could not find any published evidence or report on echeloning in a roosting flock of birds in high wind conditions. Here, we provide first evidence of an echelon in a roosting flock of the Eurasian oystercatcher (*Haematopus ostralegus ostralegus*) at the onset of Storm Malik in Scotland on the morning of the 29th of January 2022, under ~ 11 ms^{-1} winds. This observation opens-up several new research questions on if, how, and why birds position themselves in a flock while roosting in high winds.

Keywords Bird flock · Cluster formation · Flock echelon · Eurasian oystercatcher · *Haematopus ostralegus ostralegus* · High winds · Storm Malik

Introduction

Humankind has always found various flying flock echelons of birds intriguing and its written accounts by Pliny the Elder can be traced back to 2000 years ago (Bostock and Riley 1855). Such "V" and "J" formations by flying flocks are suggested to be an example of coordinated group movements which various animal species display (Herbert-Read 2016). The written descriptions detailing on the organized flight in birds can be broadly divided in four phases (Bajec and Heppner 2009): (1) the first phase at about the beginning of the twentieth century, led by biologists; (2) the second phase in the 1970s where the mainstream biologists were joined by aeronautical engineers; (3) the third phase in the 1980s when computer scientists also started showing interest in this phenomenon; and (4) the fourth phase in the 1990s when physicists and mathematicians joined investigations on modelling such behaviours. Though much research focus has been on identifying local interaction rules (e.g., Ballerini et al. 2008) and group dynamics (Attanasi et al. 2014) in the flying flocks, we could not find any such published observational or experimental study which describes the echeloning in a roosting flock of migratory birds under high wind conditions. Through this Short Communication article, to the best of our knowledge, we provide a first-hand account of an echelon in a roosting flock of the Eurasian oystercatcher during Storm Malik on the 29th of January 2022. Given the succinct journal format of Short Communication articles, we first provide a brief detail on our observation, followed by a short discussion and some conclusions.

Behavioural notes

Eurasian Oystercatchers (*Haematopus ostralegus ostralegus*) is the most common and the most widely studied sub-species of oystercatchers, with key breeding and wintering regions centred on the North Sea (van de Pol et al. 2014). However, their population size has shown significant increase between 1960 and 1990s with a geographical distribution now covering the European Atlantic coast and even the coasts of Ghana (van de Pol et al. 2014). The UK coasts are known for being perennial habitats of Eurasian Oystercatchers, and northern England and Scotland are particularly identified as their breeding grounds.

This behavioural observation was made in a field adjacent to Kings Links Golf Course at the Aberdeen coast, south of Donmouth Local Nature Reserve (Fig. 1). Aberdeen is known for having probably the highest concentration of roof nesting Oystercatchers in Europe (Duncan et al. 2001). On the morning of the 29th of January 2022, Aberdeen was experiencing high wind conditions in excess of ~ 11 ms^{-1}

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Fig. 1 Observation location: **a** An overview of Aberdeen city showing the observation location in the red rectangle. The red rectangle in the inset map shows the location of Aberdeen city in the UK. **b** An overview of the location showing the area (yellow rectangle) where the roosting flock of Eurasian oystercatcher (*Haematopus ostralegus ostralegus*) was observed on the 29th of January 2022. The yellow arrow shows the wind direction. The red star shows the observers' position. **c** A Eurasian oystercatcher (*Haematopus ostralegus*) observed on the 30th of January 2022, before Storm Corrie

(north-westerly wind at the time of observation) at the onset of Storm Malik which was followed by Storm Corrie on the 30th of January 2022. It was a chance encounter but once we realised the peculiar flock behaviour, we made the observation for ~ 12 min (i.e., 11:23–11:35 am) before the flock flew away when we tried to reach closer. Echeloning in roosting flock of any migratory bird is never reported before and this being an unexpected encounter, we were not equipped with any high-end instrumentation to record the details. Nevertheless, upon a couple of minutes of continuous observation, we realised the possible importance and relevance of it, and we decided to take some behavioural notes and use our mobile phone camera to make some videographic recordings as a proof.

The camera on the device Samsung Galaxy S10 + has specifications of 12 MP, f/1.5–2.4, and a 26 mm (wide) lens. It was extremely windy at the time of the observation and we could not move any closer than ~ 100 m to avoid disrupting the flock. Therefore, using the zoom function of the camera for video recording was a compromise between overcoming the distant visibility and the poor pixelated quality caused by the high winds which were causing vibrations during the hand-held recording. We finally decided to record the flock at 4X zoom. This allowed us to generate sequential snapshots from the recorded video which we have included in Fig. 2.

The sub-species was identified based on its usual characteristic appearance: black and white plumage, broad red bills, and red legs. In total, there were 19 oystercatchers in the flock. In the points below, we summarise several salient observations:

1. One oystercatcher at the front and one at the end were observed in all the successive observations for the static flock after each reshuffling. In total seven such observations for the static flock were made, two of which have been recorded in Figs. 2 and 3.
2. In the roosting flock (red outlined scenes in Fig. 2) when none of the members was mobile, the flock

Fig. 2 Recorded observations of the roosting flock of Eurasian Oystercatchers (*Haematopus ostralegus ostralegus*) over a span of ~ 1.5 min. The dashed black arrow shows the temporal sequence of images. The different coloured arrows (blue, yellow, violet, red, and cyan) and ellipses (dashed and solid red, and dashed cyan) show some of the movements which have been discussed in the text. The thick black arrow in top right shows the wind direction. The scenes with red outline show the arrangement after reshuffling within the flock when it was completely static. These scenes have been further emphasised in Fig. 3

organisation was middle-heavy, making it spindle- or double spindle-shaped (Fig. 3).

3. Maximum number of birds in one row reached up to three.
4. All the static flock members were facing against the wind direction.
5. The birds in the front-half of the echelon were the ones mostly searching for insects or earthworms.
6. The birds at the back shifted their position only when they noticed the birds from the front coming to take their positions.
7. Three of the oystercatchers were observed to be leading the flock in succession throughout the observation. Two of them have been marked by red and cyan arrows in Fig. 2 while the third one is leading the flock in the last scene of Fig. 2.
8. While a minimum of one flock member shuffled at a time, the maximum simultaneous but quick shuffles reached up to eleven.
9. During shuffling, the members primarily at the front, showed quick repositioning and reorienting (birds marked by violet and yellow arrows, and solid red and dashed red ellipses in Fig. 2).
10. We also observed at least four instances when one member moved from its position to catch some insect but quickly relocated to the original position within the echelon (e.g., dashed cyan ellipse in Fig. 2).
11. 11. In the same field and at the same time, we also observed a group of three European Herring (*Larus argentatus*) gulls sitting in a perfect "V" formation facing against the wind direction (Fig. 3c).

Discussion

Eurasian Oystercatchers (*Haematopus ostralegus ostralegus*) have been extensively studied for their eating habits (e.g., van Dijk 2014), vigilance (e.g., McBlain et al. 2020), escape behaviour (e.g., Azaki and Cresswell 2021), and breeding (Tratalos et al. 2021). However, our interesting observations reveal several new research questions. Considering that it is first such reported observation, we are not sure if this echeloning behaviour of roosting flock in high winds is only limited to oystercatchers or can be observed in other birds too. Although it was not a big flock, we also simultaneously observed a group of three European Herring (*Larus argentatus*) gulls in the same field, sitting in a perfect

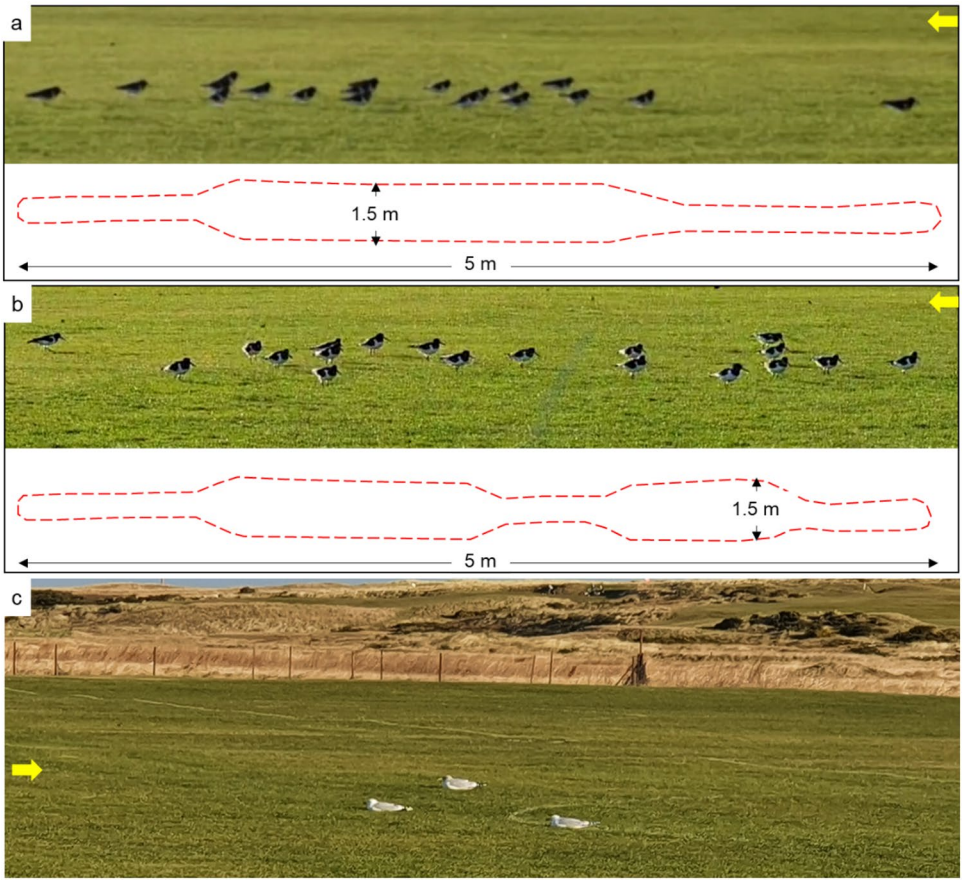

Fig. 3 Shape and dimension of the flock. **a** Spindle-shaped formation. **b** Double spindle-shaped formation. **c** Three European Herring (*Larus argentatus*) gulls in the same field and at the same time as the flock of Eurasian Oystercatchers (*Haematopus ostralegus ostralegus*). The yellow arrows show the wind direction

"V" formation, and facing against the wind direction. If this at all is an indication of such echeloning behaviour by other birds too then an investigation is needed to determine if it is limited only to migratory birds. Another topic of research can be to understand the reason behind spindle-shaped echeloning; whether it is purely related to streamlining the flock against high winds to offer minimal resistance to winds and conserve energy or it is also intended towards offering the flock a quick response time against any predatory attack in high winds. There might also be some thermoregulation benefits gained from maintaining the echelon and facing against the wind. Thermoregulation behaviour such as sitting tightly with folded feathers and bills underneath their feathers (Ryeland et al. 2017)), panting, and squatting with their wings drooping have been reported for African Black Oystercatchers (*Haematopus moquini*) under high heat load conditions (Akazi 2021). It is possible that the Eurasian Oystercatchers might want to do the opposite under cold and high wind conditions. So, by facing against the wind, the Eurasian oystercatchers, in addition to conserving energy from minimal resistance to the winds, might also be keeping warm at a reduced cost since the wind will force their feathers to be pressed closer to their bodies. Another possible research question is that could the positioning and shape of the echelon also contribute to the breaking of the wind thereby reducing it impacts on the birds. We observed the sustenance of this echelon for the entire observation duration, with intermittent reshufflings. The fact that the echelon was sustained even when a need to briefly move away (to forage) arose, suggests that it is an important behaviour that confers some benefits, otherwise why would the birds be so meticulous in maintaining the echelon? If the answer to all these questions is a yes, then how does the information transfer function among the group members and how are their relative movements and positioning determined? The observation regarding the persistent lead members of the flock also suggests that probably those are the strongest members and the members in the middle and towards the back of the spindle formation are the weakest ones. This notion is also strengthened by the observation that the birds in the front-half of the middle of the echelon were the ones mostly searching for insects or earthworms. Thus, an investigation on the age, gender, health, state of hunger, and other factors of the flock members with respect to their relative positions in such echelons can further reveal about their social behaviour while roosting in high winds. The emphasis on the constant maintenance of the echelon is evident from the observation that the birds at the back shifted their position only when they noticed the birds from the front coming to take their positions and after each such reshuffle, all the

birds quickly reoriented themselves against the wind direction. Another evidence in support of a behavioural echelon is the fact that in at least four instances when the echelon was static, we observed that when any member moved from its position to catch some insect, it quickly relocated to its original position within the echelon, thus maintaining the shape. We have captured and highlighted one of such observations in the bottommost panel of Fig. 2, marked by the dashed cyan ellipse. The bird within the cyan ellipse is one of the leaders of the flock and its previous positions are marked by the cyan arrow in Fig. 2.

There is one recent study by McBlain et al. (2020) which can throw some light on the expected behaviour of oystercatchers in high wind conditions. Although McBlain et al. (2020) focussed on sleeping flock of oystercatchers and the wind conditions during their observations were far from being stormy, they have reported several interesting behavioural aspects of oystercatchers. Many bird species have evolved eye-blinking strategies called peeking to compensate for the increased risk from predation while sleeping. Peeking allows them a certain degree of vigilance in a sleep-like state. McBlain et al. (2020) reported that stronger winds resulted in shorter average peek durations and increased peek frequency in a flock of oystercatchers. This proves their heightened perception and vigilance against any threat in windy conditions and provides an answer why they might be behaviourally inclined towards forming an echelon in stormy conditions even while the flock is awake and foraging. The observations made by Carr and Lima (2010) can further explain the relative positioning and reshuffling patters within any such echelon in high wind conditions. Flying flock members usually have the tendency to compete for better positions to avoid exposure to higher winds and this leads to increased interactions among the group and an overall higher social vigilance (Carr and Lima 2010). We postulate that this might also be the case in the roosting flock of oystercatchers during the high wind conditions, explaining their coordinated movements and echeloning. Finally, we believe that our novel observation and behavioural notes, although preliminary, have the potential like many other similar chance observations, to stimulate thinking among peers to work on the aforementioned research questions through planned experimental and observational studies.

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Declarations

Conflict of interest Authors declare no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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