

Conférence publique – Lundi 5 octobre 2015 – 14h00
Salle E 206 - UFR LSHS
UNIVERSITE PARIS 13 Sorbonne Paris Cité

Collective anti-predator behaviour in starling flocks

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A major functional reason of avian flocking is predator avoidance. Many bird species typically flock and display sophisticated collective behaviour as an anti-predator response, with a coordination that makes the flock behave as a whole. In this talk I will review a series of empirical studies on starlings (*Sturnus vulgaris*), a highly gregarious species, showing how and under which circumstances collective behaviour occurs and is effective in reducing aerial predation by falcons (*Falco peregrinus*) on the hypotheses commonly adopted to explain protection from predators by grouping: the many eyes theory, the risk dilution effect, the selfish herd theory and the confusion effect. I will show that flocking behaviour is flexible and context dependent in relation to the degree of perceived predation risk and that certain flock shapes are more likely to occur than others when and where the risk is high as a result of rapid collective decisions. As a vivid example of fast collective behaviour, wave formation and propagation within flocks are described and shown to be an effective mean in reducing predation success. Within and between flock information transfer are discussed in relation to possible mechanisms underlying collective phenomena. The side of the predator is also taken into account, since hunting behaviour shows a large and flexible repertoire leading to complex and dynamic prey-flock interactions, which are in continuous refinement. Finally, experiments in controlled situations mimicking predation risk show that individuals of gregarious species in a social context behave differently when exposed to simulated predation risk compared to individuals in isolation. This suggests intrinsic mechanisms of sociality that translate individual behaviour into the emerging properties of a flock by increasing inter-individual correlation and synchronization.

