THE dark side

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Do dark upperwings improve flight performance?

It is well known that heating the upper side of an aerofoil decreases the drag induced by air friction, thus making the aerofoil more efficient. It has therefore been speculated that one reason why birds might tend to have darker upperwings is to improve their flight efficiency. This might sound somewhat unlikely, but a recent paper by Svana Rogalla and colleagues provides some evidence for this effect in seabirds (*J. R. Soc. Interface* 18: 20210236).

The authors used several approaches to make their case. A phylogenetic analysis of the distribution of dark upperwings across all seabirds suggests that they have evolved independently in numerous seabird groups. However, there is no correlation with body size, which might be expected if countershading to reduce predation risk were the primary selective force driving this pattern.

Also, regressions of inferred best glide speed and sink rates for a subset of seabirds for which wing loadings are available suggest that species with darker upperwings have slightly better flight performance, on average. But perhaps the most compelling evidence came from trials using gannet wings in a wind tunnel, which demonstrated that when the wings were heated from above by lamps to mimic solar radiation, there was a marked increase in the lift-to-drag ratio – up to 20 per cent at low flight speeds.

The fact that the effect is most marked at low flight speeds is intriguing because these are typical of seabirds with low wing loadings, such as frigatebirds and storm petrels. And both these groups almost universally have dark upperwings. Any benefit is also likely to be greatest in the tropics, where there is greater potential for solar heating of the dark upperwing. Perhaps this explains why tropical oceanic terns, such as Sooty and Bridled terns and most noddies, tend to have darker upperparts. However, that leaves the tropical White Tern as an anomaly.

Another question that remains to be answered is why some seabirds, such as the gannets and most large gulls and *Diomedea* albatrosses, become paler above with age. The authors suggest that inexperienced young birds may benefit more from having darker wings, but this doesn't explain why adults would forego such an advantage.

Seabird coloration probably is determined by many factors, including the need to reduce feather wear as well as social signalling and crypsis. However, we should not dismiss the possibility that flight performance might also have a role to play. The paper concludes that making aeroplanes with black wings might confer significant advantages, especially for gliders and slow-flying drones.

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above *Sooty Terns might have evolved dark upperwings to absorb more of the sun's heat and thus improve their flight efficiency.*