Consequences on flight performance of fat accumulation in birds.

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Flight mechanical theory was used to study the consequences of fat accumulation on various aspects of flight performance (maximum linear acceleration in flapping flight, maximum speed in horizontal flapping flight, maximum speed in gliding dive, rate of climb) in birds. The performance is reduced with increased fat load in three, most likely four, flight characteristics and independent of fat load for maximum terminal speed in a gliding dive with folded wings. Three measures of manoeuvrability (maximum roll acceleration, minimum turning radius, minimum gliding speed) also showed reduced performance with increased fat load. Together, these findings suggest that there must be a selection pressure for keeping fat load as low as possible, and that tyhere is an upper öimit for maximum possible fat load where crucial manoeuvres (e.g. sustained climb and take-off) are lost. Further, the effect of fat load for bounding flight is analysed. The effects of fat load are illustrated for three real bird species, which demonstrate a relatively higher penalty in flight performance with increased size of the bird. This relation is successfully tested with data from the literature. Finally, I discuss possible adaptations to alleviate narrow power margins in larger birds.