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New evidence suggests some birds gave up flight to become better swimmers

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Murres, which resemble flying penguins, have the highest wing-loading of any bird, which results in exceptionally high flight costs and could explain why Antarctic penguins have evolved flightlessness. Credit: Kyle H. Elliott.

(Phys.org) —An international team of wildlife researchers has found evidence to support the theory that some birds, such as penguins, lost the ability to fly because of adaptations that allowed for better swimming. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes the results of testing energy efficiency levels of birds that both fly and dive as compared to birds that have lost the ability to fly.

To gain a better understanding of the factors that led to flightlessness in some birds, the team traveled to two remote locations: Nanavuk, Canada and Middleton Island in Alaska. By attaching sensors to captured cormorants and murres, the team was able to measure energy efficiency in both species. Both kinds of birds are able to fly and both find prey by diving underwater and swimming. Cormorants use their webbed feet to maneuver underwater, while the murres use their wings.

In analyzing the data from the sensors, the researchers found that murres are relatively efficient swimmers—the amount of energy they burn is just 30 percent lower than that of similar sized penguins. In the air, however, things were quite different. The birds set a new record for inefficiency—they burned 31 times more energy when flying than when sitting still—the highest ever seen in a bird. Studying murres is particularly important when looking to find why penguins lost the ability to fly because they are so similar to their non-flying cousins. Because of their coloring and body shape, they actually look like flying penguins.

The data shows, the researchers claim, that penguins and other flightless birds almost certainly lost the ability to fly as their swimming abilities grew stronger. You can't have both, they note—becoming better at swimming causes wings to slowly morph into flippers, which of course won't allow for flight. They suggest that murres are at a crossroads—just good enough to get by in both the air and water. If the need arises to dive deeper, the team notes, the murres could also lose the ability to fly. On the other hand, if the need to avoid predators by flying away remains critical, they could become bet

More information: High flight costs, but low dive costs, in auks support the biomechanical hypothesis for flightlessness in penguins, *PNAS*, Published online before print May 20, 2013, doi: 10.1073/pnas.1304838110

Abstract
Flight is a key adaptive trait. Despite its advantages, flight has been lost in several groups of birds, notably among seabirds, where flightlessness has evolved independently in at least five lineages. One hypothesis for the loss of flight among seabirds is that animals moving between different media face tradeoffs between maximizing function in one medium relative to the other. In particular, biomechanical models of energy costs during flying and diving suggest that a wing

designed for optimal diving performance should lead to enormous energy costs when flying in air. Costs of flying and diving have been measured in free-living animals that use their wings to fly or to propel their dives, but not both. Animals that both fly and dive might approach the functional boundary between flight and nonflight. We show that flight costs for thick-billed murres (Uria lomvia), which are wing-propelled divers, and pelagic cormorants (Phalacrocorax pelagicus) (foot-propelled divers), are the highest recorded for vertebrates. Dive costs are high for cormorants and low for murres, but the latter are still higher than for flightless wing-propelled diving birds (penguins). For murres, flight costs were higher than predicted from biomechanical modeling, and the oxygen consumption rate during dives decreased with depth at a faster rate than estimated biomechanical costs. These results strongly support the hypothesis that function constrains form in diving birds, and that optimizing wing shape and form for wing-propelled diving leads to such high flight costs that flying ceases to be an option in larger wing-propelled diving seabirds, including penguins.

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