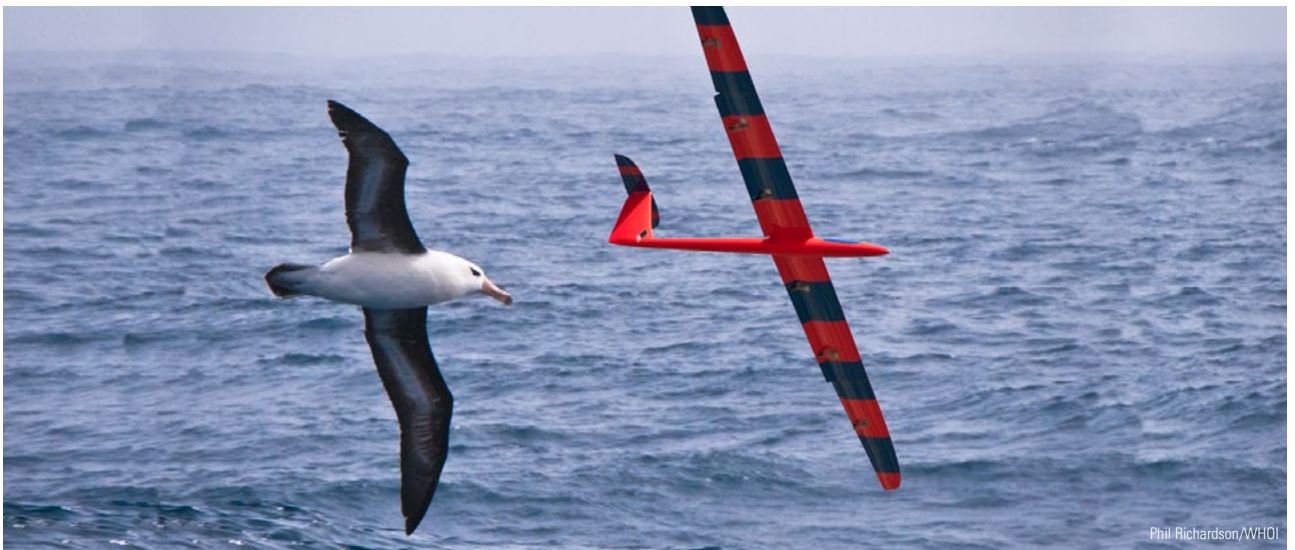


It's a Bird, It's a Plane

SOARING SEABIRDS OFFER TIPS FOR GLIDER TECHNOLOGY *by Lonny Lippsett*



Phil Richardson/WHOI

This photo montage illustrates the dream of an unmanned aerial vehicle that can exploit the same wind phenomena that albatross use to soar.

Can engineers build a high-speed robotic albatross? Not long after WHOI oceanographer Phil Richardson examined how albatrosses elegantly harness winds and waves to fly (a phenomenon called “dynamic soaring”), he began working with radio-controlled (R/C) glider pilots to see if they could exploit the seabirds’ flight strategies. The goal is to develop an unmanned aerial vehicle (UAV) that someday could soar over the ocean on surveillance, search and rescue, and environmental monitoring missions.

In his research, Richardson browsed for “dynamic soaring” on the Internet. He found that R/C glider plane hobbyists had begun to exploit the same strategy since about 2000. Instead of waves, however, they used mountain ridges. They guided their gliders toward a ridge crossing a wind-shear boundary where winds blew fast over the ridge top. Using this technique, they dramatically accelerated their planes from previous top speeds of about 170 miles per hour to a new record of 498 mph, achieved in March 2012.

Richardson struck up a correspondence with several glider pilots and was invited to watch them flying their aircraft at Weldon Mountain, a mecca for R/C glider pilots above Lake Isabella, Calif.

“Glider enthusiasts come from all over the world,” he said. “You can’t believe it until you see and hear it—gliders weighing, say, 30 pounds, zooming at 450 miles per hour. The high-frequency whizzing sound of these gliders is incredible.”

Soon Richardson’s mind was calculating. After observing at Weldon, Richardson extrapolated his albatross soaring model to fast-flying gliders, factoring in their mass, lift, drag, and a few other factors specific to planes rather than birds. He concluded that as long as sufficiently fast winds and large waves generate troughs and strong shear layers above them, “then in principle, dynamic gust soaring could be used for high-speed flight over the ocean.”

Albatross reach average speeds of 36 mph, he said, but dynamic soaring would allow them to fly much faster if the high

speeds didn’t cause excessive force on their wings.

The wings of R/C gliders, however, are stronger. Richardson calculated that dynamic soaring could allow UAVs to fly about ten times the speed of the winds. He published his results in 2012 in two research papers in a journal that rarely gets submissions from oceanographers: *R/C Soaring Digest*.

Gliders would have a few limitations that albatrosses don’t, however, Richardson said. First, in the low-level part of a swoop, albatross fly so close to the ocean surface that they often graze the water with their wings. Gliders can’t risk flying so low, because a glider wing hitting water could cause a crash.

Second, faster speeds cause more drag; to compensate, gliders would need to make quicker swoops to cross the wind-shear boundary more frequently.

Third, if winds died down, an albatross could start flapping its wings, but a robotic albatross would require a backup power source.

“To test these limitations, it would be beneficial to have experienced R/C glider pilots take high-performance gliders to sea and experiment with field trials to measure how fast dynamic soaring could be accomplished in real winds and waves,” he said.

Envisioning the future, Richardson said a robotic albatross UAV could be developed to measure and respond to changes in wave crests and troughs, wind fields, and obstructions such as ships, much the way underwater autonomous vehicles now navigate their environment. And like their underwater counterparts, a dynamically soaring UAV could efficiently survey large areas over long time periods without requiring much battery power. Equipped with various sensors, it could help locate sailors in distress, protect harbors, or monitor whale populations or currents.

Richardson’s new glider pilot pals are keen to pursue the idea, and he has also contacted a few robotics companies that are interested. ▲