Journal of Emerging Investigators
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Engineering: Biomimicry

Paper citation: Weitzman S and Lambert A (2013). More Efficient Helicopter Blades Based on Whale Tubercles. J Emerging Investigators *15*: 1-7

Paper questions

In reading through the assigned paper, please answer the following questions:

1. What is the question being investigated by the researchers?

   The authors asked with adding tubercles (or bumps on the tails of whales) could increase the efficiency of helicopter blades.

2. What is biomimicry?

   Biomimicry is the science of copying nature to produce more efficient and productive human-designed products.

3. What are tubercles? Why does the authors suggest they make swimming more efficient for whales?

   Tubercles are bumps on the tails of whales that increase swimming efficiency. One possible explanation for this is that tubercles work by creating vortices behind the bumps of the fin, changing distribution of pressure over the fin and reducing drag.

4. Describe the authors' experimental approach.

   The authors purchased a R/C helicopter, and after affixing small 'bumps' of modeling clay (with either 4 tubercles or 8 tubercles per blade), and measured the downward wind speed generated when the helicopter ran at one of three different settings.

5. What variables did the authors manipulate in their experiments?
   The authors manipulated tubercle number and R/C helicopter speed setting.

6. What were the results of the authors' experiments? What statistical test do the authors use, and is any data statistically significant?
   The authors found that the four tubercle design decreased helicopter blade efficiency, while the eight tubercle design increased blade efficiency.

7. Why do the authors suggest that that they see a relationship between tubercle spacing and helicopter efficiency?
   Wind speed generated when there were eight tubercles on the blade was greater than when four tubercles were used. Because the eight tubercle design had less space in between them, the authors reasoned that this could be the reason they saw the positive effect on efficiency.

8. What are some shortcomings of this paper?
   The authors did not account for increased weight on the helicopter blades, nor were the 'tubercles' of very consistent size or shape. The helicopter may also been operating at different output levels on different days, and this was not controlled for.

9. Propose two follow-up experiments that could be performed given the data presented in this paper.
   Some examples of follow-up studies are repeating the experiment with different size tubercles, different spacing between tubercles (independent of number), and repeating the experiment on a larger helicopter (or a free-flying helicopter, not one that is affixed to a table).