On the Topic of Weight (Reasons to lose those love handles) – Ken Altfather Dec 08

Recently I've been thinking a bit about weight and it's effect on a boat's performance. If you paddle for general recreation and pleasure, weight of the boat will mostly concern you getting it on and off the car. But, if you paddle for fitness, racing or long distance touring, the combined weight of boat, paddler and gear has a direct affect on the ease at which the boat moves through the water.

Elite racers paddle the lightest boats they can get their hands on. Sometimes they'll say, "I like this boat because it's really stiff". They always say it about a boat that is also really light and I doubt they'd say it about a boat that was heavy but really stiff. I think what they mean is that they like the way the boat accelerates. Weight is so important in racing, that some classes, like sprint boats, have a minimum weight specified in the rules just to make things fair. So, weight seems important if speed is in our definition of performance.

You can now reap the benefit of all my deep thinking, with "these here opinions", backed by totally unscientific research and just enough understanding of physics to get myself in trouble.

1) Consider that with each stroke you take, you accelerate the boat. Yes, that's right. The moment your paddle leaves the water, the boat begins to slow. Your next stroke has to bring it back up to speed and that cycle repeats with each stroke. One component of the force you feel on your paddle is the force required to do that acceleration. I recently did a rough timing test and found that paddling a kayak race style at 60 strokes per minute, about 1/3 of the time the paddle is in the water and powering the boat and 2/3s of the time the paddle is in the air and the boat is slowing.

   Recall from high school physics that ignoring friction and other losses that force equals mass times acceleration (F=MA). Weight is our surrogate for mass, so for any given force, when the mass increases, the acceleration will decrease.

   Here's a little experiment you can try to get a feel for the force to accelerate a mass. Next time you are in the fridge, pull out a gallon of milk and hold it in your hand. If it's full, it will weigh about 8 pounds. Now push it out forward and notice the energy it takes to do that. Ignore the energy it takes to hold it up and consider just the energy it takes to push it forward. You'll find it's not trivial and it's only 8 pounds. If you are paddling fast, you will experience this force (resistance) 60 – 70 times a minute.

2) Here's another reason weight is important. A boat floats because its weight is offset by the water it displaces. For example, if an object weighs 8 pound and it floats, it will sink until it displaces 8 pounds of water, about 1 gallon. If we have a boat floating and then add 8 pounds, it will sink a bit deeper than before. Since the boat now takes up more space, as it moves through the water it will have more water to push aside. As it pushes this additional water, it creates bigger waves and the force required to do this is called wave making resistance. I think I read somewhere that wave making resistance increases as the fourth power of displacement (read weight). So, if our boat and paddler together weigh 200 pounds and we add another 8 pounds, the combined weight is now 1.04 times larger than before. If the wave

making resistance increases as the fourth power of this ratio, then the resistance due to wave making has just increased by 17%. If you are skeptical, check other resources. I could be wrong on this.

3) And, now, to make matters worse, the fact that our boat with the addition 8 pounds sits lower in the water than before, more of the surface of the boat is exposed to the water. As the boat moves through the water, water molecules rub against other water molecules attached to the surface of the boat and create skin friction or surface drag. Let's do some math. For the sake of ease, consider a boat with a box shaped cross section 24" wide and 15 ft long. If our boat and paddler weight 200 pounds, it will need to displace about 3.1 cu ft of water. To do this, our boat will sink about 1.25 inches. Add 8 pounds and it will sink to 1.29 inches. With the additional surface area exposed to the water, wetted area, skin friction increases proportionately (I presume). So, our surface drag just went up 4%.

Add everything together, force of acceleration, force to make waves, and force to overcome skin friction and you get a Triple Whammy with increased weight. The proportion of the overall force that the components make changes with other things, like speed. For example if you are moving really slow, there is not much wave making resistance, so the paddling force mostly offsets the skin friction. At higher velocities, particularly above 6 MPH in most boats, wave making resistance becomes dominant.

So that's it. Now, I didn't say where the 8 pounds came from. Maybe it came from a heavier boat to begin with, or something you added to the boat, like gear, hydration system, or just maybe its those extra pounds you packed on over the winter If those extra pounds are muscle then you are probably ahead of the game. But if its love handles then you are just going to have to pay the piper. In this case, the piper's charge is either reduced speed or more effort.

Gotta go now and work off that piece of pie I just ate.