Steering an Outrigger Canoe

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Maybe you have been paddling Hawaiian outrigger canoes for years but have never had the opportunity to steer. Doubtless you've wondered what is so difficult about being the rudderman and why your new seat six can't keep the boat pointed at the right island.

Whatever the case, there is likely a good deal more to steering a fast canoe than you realize. Just how should you poke and exactly when? How should you change your style to accommodate high winds and big swell? Get these things wrong, and it doesn't matter who is in seats 1-5; your canoe is going nowhere fast.

Learning with a coach on the manu behind you is ideal, but most of us don't have that luxury. Instead, we hop into the driver's seat on rare opportunities and proceed to learn little as we weave around the ocean so wildly that we are never given the chance again.

That is a shame, because until you know how to steer that boat you pull around three hours a day, you haven't really enjoyed the whole of outrigger canoeing.

There is a better way. Learn the basic concepts of technical steering – by which I mean poking and paddling to keep the boat straight and fast – by reading them here before you get in the driver's seat. Use your limited time on the water to put these ideas to practice and learn the inimitable feel of steering the Hawaiian outrigger canoe. Then come back, and read this again, because it will belatedly start to make some sense.

Before you start yelling at your crew and dragging your paddle in the water though, you should understand the tendencies of the 45' imitation log you are trying to direct across the ocean.

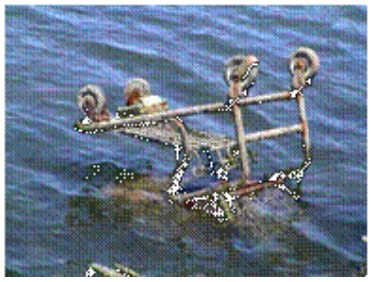
AN UNRULY BOAT

Let's take a quick detour to the local Longs Drug Store before we get started in earnest. As you prepare for the weekend race and load the slippers, snacks, and suds in your shopping cart, pause and do things a little differently. Have a look at your shopping cart.

Notice that it has fixed wheels in back and freely-rotating casters in front. Now stand in front of the cart and give it a push backward. More than likely, it will swerve a little off course and then spinout. It swerved a little because nothing is perfect, then it swerved a lot because the front wheels held the handle-end in the slight turn while the casters let go sideways and thus the cart turned ever more sharply until it reversed heading completely.

Now let's go to a waveless and windless) body of water – say the Ala Wai Canal at 6:00 am . Granted, that shopping cart is unlikely to perform its fancy tricks quite as well in a foot of water and a foot of muck, but we can draw useful insights from its behavior in aisle 8A.

All six-man canoes, be they Malia or Mirage, behave much as the humble Longs shopping cart – once the begin turning, they continue to turn and at an increasing rate.



For example, suppose we are cruising along in a straight line, and the steersman falls out of the canoe without seats 1 -5 noticing. Some imperfection will start the canoe turning ever so slightly to one side – say to port (ama-side). Just like the shopping cart, the bow of the canoe will hold better than the stern, thus causing the boat to turn still further and faster to port. Within 30 strokes the canoe will be turning as sharply as a regatta turn,and needless to say, will be making little progress toward the finish line.

Luckily a good steersman rarely falls out of the boat and has two big advantages over the shopping cart – water and a paddle to push against it.

KEEP THINGS STRAIGHT

Nearly every boat on the ocean has a rudder, and even surfboards and paddleboards have skegs tacked on for stability. The most straightforward way to steer a canoe is to imitate a rudder with a paddle. In the parlance of our times, this is called "poking." A steersman will place his paddle in the water at his side such that the shaft is near vertical and the blade is nearly flush with the hull. To choose the ideal poking equipment and technique, we should first define exactly what it is we want to achieve.

Most often we want to steer the canoe from point A to point B as quickly as possible. Ignoring course quirks, that means two things: traveling in a straight line, and minimizing drag (the force impeding forward motion). All other things being equal, the steersman would also like to minimize the time spent poking so that he can paddle a stroke or two forward to sympathize with the crew.

Essentially then, we wish to use our paddle as a wing braced against the side of the canoe and maximize sideways ***lift*** , or corrective turning force and minimize ***drag*** , or slowing force. Doing so requires a deliberate paddle selection.

Choose your blade

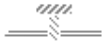
The ideal steering paddle design can most readily be take from sailplanes and high-performance sailboats. Your steering paddle should be relatively long with a foil, or cross-section, that is smooth and moderate with some dihedral on the power face (the side facing you) to give the blade some bite on the water when it is placed with its leading edge and spine flush against the canoe (see Figure 3 : Steering Paddle). A large, abrupt spine is undesirable as it will cause excess drag. Secondarily, the profile should have an elliptical "teardrop" shape, or at least rounded corners

The bend between shaft and blade is usually between 5 and 7 degrees to keep the top grip close to the hull while poking yet still allowing for paddling efficiency and "cranked" turns (to be described later). Your shaft should be topped with a "T" grip for maximum grip and sensitivity to blade angle. The steering paddle should be about as long as your paddling paddle.

And it should be obvious that steering paddles need to be strong. A loaded six-man canoe can weigh 1,600 lbs. Your balsa-wood ultralight isn't going to hold that mass straight on the face of big channel swell.

Now that you are geared up, it's time to turn your canoe with the most effective, least slowing poke.

The Sideways Paddle



We will get into the niceties of exactly when to poke soon enough, but first we must address the rough topic of just how to stick your paddle in the water to turn the canoe without slowing it unduly. For example, say that you'd like to turn the canoe to port.

Begin by holding your paddle as you would a normal paddling paddle. The paddle blade is on the left side of the canoe, your right hand wraps around the "T" grip, and your left hand is wrapped around the shaft about one hand width above the blade top.

Next, **hold the paddle against the hull's port side with its leading edge and spine flush against the boat** (see Figure 4). Because of the paddle's foil, this means that the blade's trailing edge is pointed away from the hull, and the blade meets oncoming water at an angle – the "angle of attack". The paddle thus deflects water to port as it moves forward, creating a starboard "lift", which turns the canoe.

The shaft should be about ½ -thigh in front of your body, with **the paddle shaft tilted neither forward nor aft.** This angles the paddle vertically in the water to maximize its "aspect ratio" – or wing length (i.e. blade tip depth) to chord (i.e. approximately the paddle width perpendicular to water flow).

A higher aspect ratio gives a higher lift / drag ratio and so gives more turning force for less slowing force. Some steersmen let the shaft tilt far forward so that the paddle is nearly horizontal in the water and has a very low aspect ratio. Poking like this often leads to cavitation (a vacuum or air bubble forming behind the paddle), a loss of useful lift, and an increase in drag.

Ideally, **submerge the blade until only the top four inches or so contact the hull.** The shaft will tilt to port by the amount of shaft-blade bend (i.e. about 5 degrees). Submerging the blade deeply increases poking efficiency (via the increased aspect ratio and decreased cavitation), and increases the turning force (because more paddle area is in contact with the water), thus letting you poke for less time.

There are two situations when you would poke at less than full depth. First, you may want less turning force than the full poke would give. Shortly you will learn to paddle-steer to make these small corrections.

Second, you might be in unstable conditions and in danger of huli. A full right poke tends to pop the ama up, and a half-depth poke while leaning to the left may be more appropriate. Ruddering (high-bracing on port to turn to starboard) is not a good long-term solution in these conditions because it is very tiring and takes energy you should be using to paddle forward.

During the entire poking operation, continue to **look ahead** , not down at your paddle. This is an absolute requirement to poking the right amount at the right time.

Poke Early and Poke Often

In fact keeping your eyes and attention on the direction the canoe is pointed is probably the most important thing you can do to know just when to poke and keep the canoe straight and fast. **Sight down the canoe as with a rifle toward a target** (see Figure 5). First, you must pick a mark – a target you want to head to (e.g. a landmark, a cloud, even an angle to oncoming waves). Choose something, even if you need to change it every minute or two. If you don't have a specific mark, you will weave around the ocean like as if you were DUI.

Second, you must watch your canoe like a rifle's sights. Check where seat 1's head is in relation to the target every single stroke.

On a flat, windless day, that sight picture is all the information you need to steer a straight line. But **you need two pieces of that picture – angle off target, and rate of turn off target.** You would like the angle off target to always be zero. Thus consider a typical correction, for example say that you notice the canoe is drifting off course to starboard. Act as soon as you notice the deviancy.

First, you need to initiate a turn back toward the target by poking on the side of the target. In general, poke on the side to which you wish to turn, in this example on port, until the bow begins to swing toward the target. (If you are maneuvering and really have a long way to turn [30+ degrees], you can sacrifice drag for turn rate by "cranking" the poke – pulling the top grip in toward the canoe centerline.) Unfortunately, in any turn the canoe, like a backward shopping cart, starts turning and continues turning at an ever increasing rate. As the bow nears the target, it threatens to continue turning right beyond it!

Therefore a second step is needed; **just before the bow points at the target, poke opposite the direction of the turn to halt all turning movement.** Hold the poke just until the canoe ceases to turn. The boat should now be pointing steadily on target.

At the most basic level, that is all you need to know: keep your eyes up and poke deep in the water flush with the hull when you need to start or stop a turn. It is simple, but not easy. It is also not sufficient, for with only these skills, you are quite literally a drag.

START THRUSTING

Unlike crew and dragonboating, outrigger steersmen are blessed. We do not demand effort from a seat of luxury, but share the glory and conditioning that come with moving the boat further and faster with forward strokes. More quarterback than coach, we run the crew and inspire with performances of our own. To really move your boat along and add a sixth ***paddler*** you need to learn to paddle-steer.

But wait, there's more! With paddle-steering added to your quiver, steering a straight line will actually be easier. It is much easier to steal part of a stroke for small steering inputs than to use the rather blunt tool of poking.

So how do you replace the familiar rudder concept with fancy stroke-work? Again the idea is simple: paddle sideways. Consider the example of a canoe heading to port of our mark. Previously we would have poked on starboard to deflect passing water to starboard, create a force to port at the stern, and force the canoe to turn toward the target. Unfortunately, poking also created drag and slowed the boat.

Another way to create the force to port and a turn to starboard is to draw stroke on port. Conceptually this means to paddle sideways at 90 degrees and pull water from the side of the canoe under the hull.

Implementing the concept requires internalizing another layer of detail. First, if you paddle sideways like you paddle forward, your crew will be distracted either by the sideways rocking they feel, or their view of coral from a hulied canoe. The lesson here is to **keep your mass centered** , especially on starboard. Yes, this means you will arm paddle to an extent. Done correctly though, you can and ***should*** be paddle-steering on both sides of the canoe and making going that much faster.

Second, at normal paddling speed drawing sideways at 90 degrees doesn't work very well because the water flows aft so quickly. Instead, **pull at a diagonal** , from outboard and forward to your body. **The angle depends on the amount of turning force you need.** When you only need a small correction, the stroke should be normal or slightly angled (note: a steersman's normal fore-aft paddling stroke will act as a slight draw on that side). When you need to change direction quickly, begin your stroke as far out to the side and pull as at as sharp an angle as comfortable.

You will need to add two related skills to master the technique. **You should become expert at switching sides** from paddling on the left to paddling on the right. As you learn to use smaller, more frequent steering inputs, you will naturally tighten up the "wobble cone" – or angle the bow actually points to around your desired mark. That is a wonderful result, but requires more corrections on the right and left with less time between them. Eventually you should be able to switch sides every stroke while in time with your crew and still providing powerful forward strokes.

Moreover **you should do all of these tricks without looking at your paddle or your crew's paddles.** To keep your keen steersman sight on the mark, you will need to keep timing with the other five paddlers using only your peripheral vision, feel and rhythm while paddling forward and diagonally. You should also break the habit of looking at your paddle as you switch sides.

You might wonder why we spent so much time learning to poke and bought that monster steering blade if paddle-steering is better and easier. Well don't trade in your paddle just yet because the sea is not often without wind or wave.

WIND BLOWS

Continuing with our shopping cart science, let's consider what happens when we add some wind. Say you are taking your cart full of Longs purchases back to the car – still pushing it backwards of course – when suddenly a gust of wind hits directly from your right. You give the cart a little shove forward and before long it turns sharply into the wind. The wind pushed the entire cart to your left, but the fixed wheels in front held while the casters in the rear let go, resulting in a turn toward the wind.

This phenomenon, called "weathervaning", is also present in canoes. When the wind blows from port, the canoe will tend to turn to port and vice-versa.

However, canoes don't behave exclusively like a reversed shopping cart, rather as a cross between the cart and a crustacean. As the wind blows from port, the entire canoe will slip – or "crab" – to starboard. The result is a canoe moving downwind of where the bow points. The steersman beset by wind must therefore compensate for two effects: weathervaning and crabbing.

The solution to crabbing is straightforward but not straightforward. You should point your bow upwind such that the canoe is traveling toward your objective. Ideally you line up two objects at different distances in the direction you wish to travel (see Figure 6). If they become unaligned, you are traveling off course.

Then estimate the ***angle*** upwind of your objective necessary to travel directly at your objective. Your goal is to keep the canoe pointed at this angle. You may pick a mark along this heading (i.e. where your bow is pointed), but realize that the angle between your mark and the

objective will change as you near the target and so you will need to change your mark as well.

The weathervaning effect is a bit more vexing. In light winds, the bias to turn upwind will be minor and the canoe can be held perfectly straight with small paddlesteering inputs.

Stronger winds demand a different technique. Overpowering the wind with constant draw strokes is so tiring that in little time you will be forced to poke and rest. Even when you are paddling, your draws are angled so far to the side that you are adding little to the boat's forward motion.

The solution is to alternate strong pokes with strong forward strokes. This is less fatiguing allowing you to both add thrust and keep the boat on course – but not perfectly straight. While it is impossible to make the canoe always point exactly on target, the error, or "wobble cone" that the heading wanders through, should be consciously enlarged in high winds.

For example, imagine you are steering a boat with high winds from starboard. Check the canoe from turning to starboard by poking on port strongly until the bow swings 5 – 10 degrees port of your mark. Then switch sides and paddle strongly forward (with a bit of a draw) on starboard. As the wind brings the bow back to starboard of your mark, poke once again and repeat the process.

The optimal tradeoff between straightness and powerful paddling comes with experience. Try to keep the wobble cone width under 20

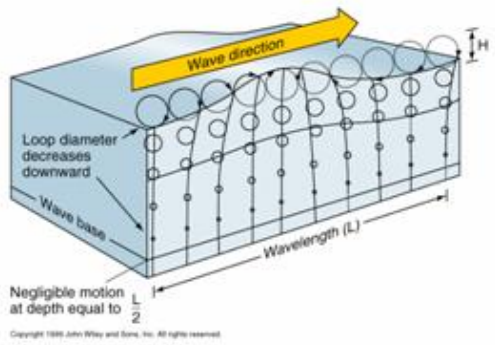
degrees. As a rule of thumb, if you must ever correct toward the ***upwind*** side (e.g. poking on the upwind side), you have pointed the bow too far downwind.

Managing the wobble cone is a skill you will also find crucial as you begin traversing waves.

WAVES SHOVE

Usually, if you paddle somewhere interesting you will have to deal with waves. Here I describe how to keep the boat moving in the proper direction over waves, but leave catching waves to another article.

Waves are made of moving water. As a non-breaking swell passes your canoe, the water beneath moves in an approximately circular orbit (see Figure 8). While the moving water obviously causes the canoe to rise and fall, it also moves the canoe in the horizontal plane. This horizontal action only causes problems for some headings.



When the boat is pointed directly toward or away from the wave direction, this horizontal movement only causes surges in speed fore and aft.

When the canoe heads 90 degrees off the wave direction, the horizontal water movement causes only port and starboard sway.

Apart from these four special cases – directly toward, away from, and at right angles to the wave direction – the wave will push the canoe bow and stern sideways by different amounts. As a result, the canoe naturally yaws back and forth in a cycle as it traverses a wave, but generally ends up pointed where it began (see appendix for more detail).

Your objective steering in waves is not to eliminate this wobble, but to ensure that the average direction of the wobble cone is pointed toward your mark. Two new skills are required.

First, you must learn how the canoe yaws over a wave period in order to determine where the center of the wobble cone is at any given moment. Pay careful attention to the pattern of movement so that you can predict whether the canoe is due to point port or starboard, and by how much. If, for example, the canoe is pointed to port of your mark and is due to swing back to starboard, wait for this anticipated action before you poke. On the other hand, if the canoe is due to swing even further to port, you should poke on starboard immediately.

The second new skill required is to poke for a given force * time (force multiplied by time), instead of poking until seeing the boat begin its turn. In effect, you estimate the appropriate magnitude of correction required, poke until you have felt sufficient force (through your grip on the paddle and your seat-of-the pants feel) over a sufficient time to effect this estimated correction, and then watch the boat's new wobble cone to see if it centers on the mark.

At some points in the wave cycle there will be virtually no sideways force on the paddle. Try to avoid cranking the paddle for greater effect. Instead, wait for the wave to push the canoe against your flat poke. With experience you can poke only when it will have effect and paddle forward when poking would be a waste.

GET IN SEAT SIX!

The preceding is really too much information to swallow at once. Worse yet, to steer really well requires not only hours of seat time, but also practice in the other aspects of steering such as running a crew, docking, regatta turns, race tactics, surfing, and strategic navigation. Still, you are now ready to steer intelligently and learn quickly.

And steer you should. Learning to steer will expose you to an entirely different side of the sport and provide new challenges to the saltiest of paddlers. Steering teaches you to be aware of all factors affecting your canoe, making you a more knowledgeable paddler in general. Your versatility and skill will make you more valuable to your club.

So seek out opportunities to steer, and always consciously improve your skills. ***Think*** about how you are poking and paddle steering. Make an effort to note the speed and direction of the wind. Make sure to always gauge the direction and character of the waves. Monitor your wobble cone to see if it is too broad or skewed

off course.

Once you learn, try to teach others your skills and give them the opportunity to practice.

The biggest drawback to learning how to steer is that you may like it so much that you won't want to paddle any other seat. But please, don't let that stop you.

AUTHOR'S BIOGRAPHY

Joshua O'Connor has been paddling outrigger canoes since he was 10 years old and steering competitively since a shoulder injury in high school, before which the lighter kids always got to steer.

In the past he has paddled for clubs in Hawaii and Southern California . Now he is adjusting to the colder waters in the San Francisco area and attempting to shed a grad school-induced sloth.

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APPENDIX: Canoes over Waves in Nauseating Detail

Imagine yourself floating in deep water with non-breaking waves rolling under you. On such a wave, you will not slide down the face as a surfer does. In fact, you do not move much relative to the water you are sitting in, rather you move about with it. The path that water – and you – take can be seen in Figure 8 . For a wave traveling to the drawing's right, water near the surface moves in a clockwise circle.

Thus as the wave passes under you, you would be moving:

Crest: to the right (in the direction of wave travel)

Back of crest: down

Trough: left (opposite to the direction of wave travel)

Front of crest: up

Now imagine a canoe heading into the waves from the right side of the picture, but with the bow a bit starboard of being directly into the waves. Now the canoe bow and stern are on different parts of the wave and are being thrown about in different directions. This action causes to boat to yaw, or turn port or starboard, depending on where the canoe is on the wave. For example, consider a canoe with the bow ¼ wavelength ahead of the stern (bow on wave part (water moving), stern on wave part (water moving), => yaw and pitch moment (i.e. movement, not position)) as wave crest approaches:

Front of crest (up), Trough (left) => yaw starboard, pitch up

Crest (right) , Front of crest (up) => yaw starboard and pitch down

Back of crest (down), crest (right) => yaw port, pitch down

Trough (left), Back of crest (down) => yaw port, pitch up

The final consideration is the movement of water beneath the canoe, because it is this against which you must press to turn the boat. The water will move port and starboard about the same amount of time, in sync with the passing waves. There are at least two effects that cause sideways relative motion of water beneath the canoe.

Water is moving in different directions at any given point along the canoe because it spans different parts of the wave.

Water moves relative to the canoe because the canoe inertia resists changes in velocity (translation) and rotation