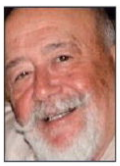
Where the water goes

Bob, the castaway, is off the rig and begins a long trip

Good time to fish. Sun's almost down. Wind subsiding. Rain clouds clearing. High tide was an hour ago; the tide is ebbing. Dock lights flicker on. Soon a gang of snook will arrive, followed by mullet, catfish, tilapia, baitfish, bugs—and behind them, sometimes, bats. My rig is simple: weighted bobber, BB weight and a shrimp impaled on a circle hook.



RICHARD WHITMAN, PH.D.

First cast. A long one. Almost reached the neighbor's dock. The rig is on target, except for the float, which flies off to starboard and lands mid-canal.

"Oh no!" Actually, I said something with more salt.

Can I chase it downcurrent and net it? Snag it with my hook? How far will I dare trespass? And what about those dogs?

I surrender my float and declare it free. Farewell, fair winds and following seas.

Where will it travel? Will it come back? Can't hide it—I liked that float. I'll call it Bob.

Bob's journey will not be straight. More likely, it will be a little Sisyphian: out with one tide, back with the next.

Perhaps Bob heads toward the Gulf, a distant shore or a nearby stand of mangroves. He might drift upriver on a rising tide, then downstream on the falling tide, or catch an eddy and circle awhile. Waves will make him bob, wind will push him too, but currents will largely determine where he goes. Bob's now a castaway, and his destiny is "currently" unknown.

Charlotte Harbor isn't a bathtub that fills and empties each day. Water moves, slows, circles and reverses. Bob might beach at low tide, snag on a dock or disappear into mangroves. But if he remains afloat and free, his chances increasingly favor eventual movement toward the Gulf.

Bob begins mid-canal on an outgoing tide. Without much wind or wave action, the weighted float should travel roughly with the surface current. Water generally moves faster through deeper, unobstructed portions of a channel and more slowly near the bottom and sides, where friction creates drag. Seawalls, bends and bottom contours steer the flow.

ILLUSTRATION BY CHATGPT. CIRCULATION PATTERNS ARE CONCEPTUALLY BASED ON PUBLISHED STUDIES BY THE U.S. GEOLOGICAL SURVEY.

One hundred floating "Bobs" illustrate how tides, currents, eddies and retention can keep water moving back and forth through Charlotte Harbor before eventual exchange with the Gulf.

Just past my dock, Bob enters Spring Lake, where islands, channels, docks, mangroves and bridges alter local currents. Bob might leave quickly or move back and forth for days or weeks.

One float, of course, tells us only what happened to one float.

A scientist might release a hundred Bobs—or use a harmless tracer dye—and watch where they spread. That could help estimate how long water tends to remain in a canal, lake, embayment or the harbor itself.

This is related to what scientists call residence time.

Tidal water does not simply leave and get replaced with every tide. Much of it moves out, then back in, mixing along the way. Residential canals may retain some water for days or weeks, while water in Charlotte Harbor may take much longer to exchange—sometimes months—depending on rainfall, river flow, tides and wind.

That matters if what moves with the water is not Bob, but nutrients, bacteria, an algal bloom, spilled fuel or another pollutant.

Eventually, Bob reaches the open harbor. A falling tide generally carries him toward the passes; a rising tide may carry him partway back.

Two steps forward, one step back.

The major forces now acting on him are tidal and river currents, wind, and circulation shaped by the harbor's depth, channels, islands and constrictions.

Charlotte Harbor looks like one body of water on a map, but hydraulically it is more like a house of interconnected rooms. A dead-end canal exchanges water differently from the open harbor. The tidal Peace and Myakka rivers behave differently from Pine Island Sound, while Boca Grande Pass funnels huge volumes of water through a relatively narrow opening.

Wind can substantially rearrange these currents, especially in a shallow harbor. A persistent northerly wind can push surface water toward the lower harbor, while a southerly wind can oppose that movement. Bob, sticking partly above the surface, also feels the wind directly.

Wind-generated waves add another motion. They make Bob rise, fall and rock, but ordinary

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waves do not necessarily carry him steadily in the direction they travel. Waves and currents may occupy the same water yet move differently. For Bob, sustained horizontal travel depends much more on currents and wind than on simple wave motion.

Rivers add another wrinkle.

Freshwater is less dense than seawater, so in tidal portions of the Peace and Myakka rivers, fresher water may ride over denser saltwater. Sometimes the separation forms a saltwater wedge.

Then something surprising can happen: surface freshwater may move downriver while saltier bottom water moves upriver at the same time.

Bob, floating at the surface, would head downstream, oblivious to the water moving the other way beneath him.

Major storms temporarily overwhelm many of these normal patterns. Strong winds can pile water against one shoreline while lowering it along another. Storm surge can force Gulf water inland, while heavy rainfall and river flooding later drive freshwater, organic matter, sediment and debris toward the harbor.

The water itself may move through relatively quickly after a storm, but hydrologic recovery and ecological recovery are not the same thing. Nutrients and organic matter can contribute to later algal growth and oxygen loss, while abrupt salinity changes may stress organisms for days or weeks.

Bob's journey turns out to be about much more than Bob.

Charlotte Harbor's circulation determines how nutrients, organic matter, sediment, bacteria, pollutants, plankton, and the larvae of fish, shrimp and crabs are transported and distributed.

Where the water goes helps determine where all of those things go.

You cannot really understand how Charlotte Harbor works without understanding how its water moves.

My favorite float never returned on the next flood tide, and I still look for it now and then. You might think I wished Bob safely out to sea. Honestly, I hope another angler found him, adopted him and together they catch a lot of fish.

Or perhaps a conservation-minded beachcomber found Bob, decided his journey had gone far enough and quietly retired one more piece of plastic from Charlotte Harbor.

PHOTO BY//RICHARD WHITMAN.

"Bob" takes a detour and teaches us about the currents of Charlotte Harbor.

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