

Merrymeeting Bay Drifter Animations - Read This First Please

Intro

In order to run our drifter animations you will need to download Flash Player from the animation folder here on our web site if your computer doesn't already have it. Once this is installed you can play any of the animations. As of this writing, February, 16, 2007 the six drifter deployments from 2005 and 2006 have been completely animated and posted. Deployments are posted in two speeds, one slower [Chops-60 frames/sec] than the other [system-wide-90 frames/sec]. Also posted are two jpeg LANDSAT images showing extent of ground-truthing deployments done in 2006 on each river [see separate link].

Animation Controls

Control buttons for the animation are from left to right: 1. Reset, 2. Fast Rewind, 3. Stop, 4. Play, 5. Fast Forward. You can zoom in or out on a section of the image with the slider at lower left or zoom in drawing a rectangle with your cursor. Maximizing the image with the middle tab at upper right will give best results. Drifters can be checked on or off individually in the table. Clicking a left column check box either for hourly deployment or river, will short-cut clicking on or off that entire row of drifters. New for 2007 is an auto-zoom feature retrofitted to all previous deployments. The auto zoom will follow active drifters. As drifters stop, they will no longer be tracked by this feature.

Deployments

System-wide deployments are large and long deployments setting 4 drifters out on the same falling tide at the head of tide for each of the 6 tributaries [Kennebec, Androscoggin, Eastern, Abbagadasset, Muddy and Cathance Rivers]. These deployments lasts about 10 days.

Incoming or Chops Up deployments last about 1 ½ days. We set 4 drifters into the Chops every hour for the 6 hours of an incoming tide. We let them go up, come down and go upstream again to get a sense of net upstream movement, and then we recovered them on the next falling tide.

Outgoing or Chops Down deployments are the opposite of Incoming. The cycle here is down, up, down, recover.

Acknowledgements [2005 & 2006]

Thanks to field volunteers Simon Beirne, David W. Chipman, Andy Ellis, Ed Friedman, Jim & Susan Gillies, Barry Goodman, Kathleen McGee, Dick Nickerson, Owen & Brandon Pierce, Leonard Skelton, Kermit Smyth, Bob Weggel, David Whittlesey & Elisa Vandervort and for animation to Carey Phillips, Geno Carpentier and Woodlot Alternatives. Thanks also to our major funder: The Merrymeeting Bay Trust, to our sometime host; Chop Pt. School, to Hancock Lumber for donation of buoy materials and to Downeast Building Supply, DeLorme Mapping, and Tracker Radio Systems for discounts on various materials. Special thanks are due to David W. Chipman who performed extensive R&D on possible GPS units and means of extending their battery life in the field. David also researched battery types, designed the battery packs and machined the fixtures holding GPS and transmitter units. In addition, David has

processed all of the data from the loggers prior to creating final animations, which we contracted out to Woodlot Alternatives

Background

See: Merrymeeting Bay Current Study, Summary and Links [here in this Cybrary section]

Materials/Methods

Drifters were fabricated from 3" PVC pipe and are 32" long. Only the top 6" or so extends out of the water to minimize wind effect yet provide something to see for recovery and avoidance. Inside there is a foam donut in the bottom to minimize impact to PVC base from battery pack. Battery pack consists of 12 NiMH rechargeable batteries that do double duty as ballast and extend the life of the DeLorme Blue Logger GPS unit to approximately 10 days. Above the battery pack is a foam pipe insulation spacer to minimize component shifting and at the top is a nylon plate with GPS unit and radio transmitter attached with cable ties. Transmitters are Tracker Lites from Tracker Radio Systems and receivers used to locate units are the Tracker Maxima. Drifters were sealed with standard threaded cap using several wraps of Teflon tape. After encountering some leakage in the first deployment we used the boot waterproofing "Snow Seal" as an additional sealant around the top of the threads. Drifters had a small surveyors flag taped to the top of their shaft and extending another 6 "above the drifter. This helped immensely in spotting them. Photos of all equipment may be found in the accompanying PowerPoint slides.

Tracking of drifters was done by air, car and boat. An external yagi antenna from Telonics was helpful in mitigating interference when tracking from car or fixed wing aircraft but was of no significant help when in an open boat or helicopter bubble cabin. The Maxima receivers have their own very effective integral antenna.

Results

Previous Acoustic Doppler Current Profiler [ADCP] work by FOMB with a contractor and then with the Augusta office of the USGS had established that for the most part flows in the Bay seemed pretty uniform from top to bottom. This has been confirmed through ADCP work done by Peter Lea and his Bowdoin College students in the last few years. An exception to this might be during very low river flow conditions with high tides that probably occasionally allow a salt wedge to extend up into the Bay towards Swan Island. The ADCP data made us relatively comfortable with using a drifter near the surface as a surrogate for what might also happen at depth.

Our study plan called for simultaneously deploying drifters at the head of each tributary during low, medium and high river flow conditions. Our point of reference for flows has been the USGS Kennebec River gauge at North Sidney. We hypothesized that once drifters got to the Chops that we would need to quickly recover them or they would rapidly move down and out the Kennebec to the sea.

What we found was that during low flow conditions [3000-5000cfs] typical of summer and winter at least, drifters only very slowly managed to work their way down through

the system. They did often hang up in grass or on the bottom and we would free them up, but these hang ups notwithstanding it was still clear that progress was slow as they oscillated their way down. After awhile on this big deployment we had to physically move drifters far down in the smaller tributaries to ensure they would reach the Bay. It needs to be emphasized that when the drifters are aground they tell nothing about the flow of WATER through the system. It is obvious that water gets out faster than our drifters, which get can get hung up in mud or grass or in eddies, while the water does not (or in eddies, only for a limited period). In the future we hope to develop a flow model of the Bay to test with and supplement our data, rather than try to use our drifter data alone to describe the flows through the system.

When the length of time to descend the rivers became clear [and battery time was out], we decided to do some shorter deployments from the Chops as well. Assuming our drifters actually got to the Chops, what would happen if they arrived there at various levels of the tide?

Here again, we found that in these low flow conditions that no matter what tide level a drifter arrived at the Chops, getting out of the system was by no means assured. In fact most of the time drifters continued back and forth through the Chops a number of times before being picked up either somewhere upstream or not far downstream. On the downstream deployment, only 2 drifters of 24 made it as far as Bath and the next day one of those was recovered immediately below the Chops and the other well above and just south of Abbagadasset Point.

On the upstream deployment we had drifters go up the Kennebec as far as the north end of Little Swan Island [where they grounded out] and we recovered them on an incoming tide. Had they not gotten stuck they might have continued further upstream. Also evident in all deployments was “cross pollination” between the tributaries-Androscoggin drifters coming out through the Chops in a pair and then coming back up and splitting between the Kennebec and Cathance; Eastern River drifters coming down and then splitting upstream on either side of Swan Island. All of these patterns can be studied in depth in the animations.

Under low flow conditions our results seem to indicate that there is a long residence time for water coming into the system and that it is relatively well mixed. In FOMB’s yellow booklet on the Bay we have long referred to the Bay as a “mixing bowl” and these data bear this out. Most estuaries are linear in nature. Merrymeeting Bay has its two main tributaries entering the Bay in opposition. Four additional smaller tributaries and the added restraint of the 300meter bedrock restriction known as the Chops further magnify residence time and mixing. This goes a long way to making the Bay a very unique body of water worldwide. It may make a lot of sense to think of the four small tributaries under these conditions more as embayments than rivers as they really tend to mostly move up and down with the tide and have very low inputs.

What enters the Bay under these flow regimes would appear to stay here a long time, for better or worse with probably more time to act on or be acted on by the Bay’s sediments, vegetation, fish and wildlife. Think phosphorus, dissolved oxygen, wastewater

discharges, nitrogen, etc. Think also, multiple exposures to the Chops whether to seal predation or proposed hydro projects.

2006

This spring, with no snowpack or early rain we didn't have a spring freshet of high water. We did however towards the end of April think we could do a medium flow deployment with levels in the 7000-10,000cfs range. Shortly after we deployed system-wide, the flows nose-dived. What we ended up with was a flow regime perhaps not too different from 2005 but for the absence of grass in the river as an obstruction. In some respects this was good in that we were able to eliminate one variable and in fact we did see some evidence of slightly better transit times downstream.

Flow levels at the end of May did pick back up to the 10,000-11,000cfs range giving us solid mid flow data here for our Chops deployments. We did in fact see extensions downstream on the Sasanoa and Kennebec of our drifter travel with one drifter recovered in Hockomock Bay, one at Upper Hell Gate and several in the Fiddlers Reach/Doubling Point areas. Upstream drifters did not ascend as far as they did under low-flow conditions

Super high flood flows arrived in June of 2006 but we were not in a position to redeploy so quickly due to a combination of motor trouble, other duties, and battery charging. Unfortunately with our current charging system we need about a 9 day lead time to get all the rechargeables ready.

Ground truthing data from drifters deployed at the head of the tributaries and near their mouths confirmed, with the exception of the Kennebec, very little net downstream gain under the fairly low-flow conditions present. So while our drifters did hang up in mud and plants, these delays [until we would free them] did not appear to influence the end result appreciably.

We will update this site as future deployments and animations are completed.

For more information please contact Ed Friedman at edfomb@zwi.net .