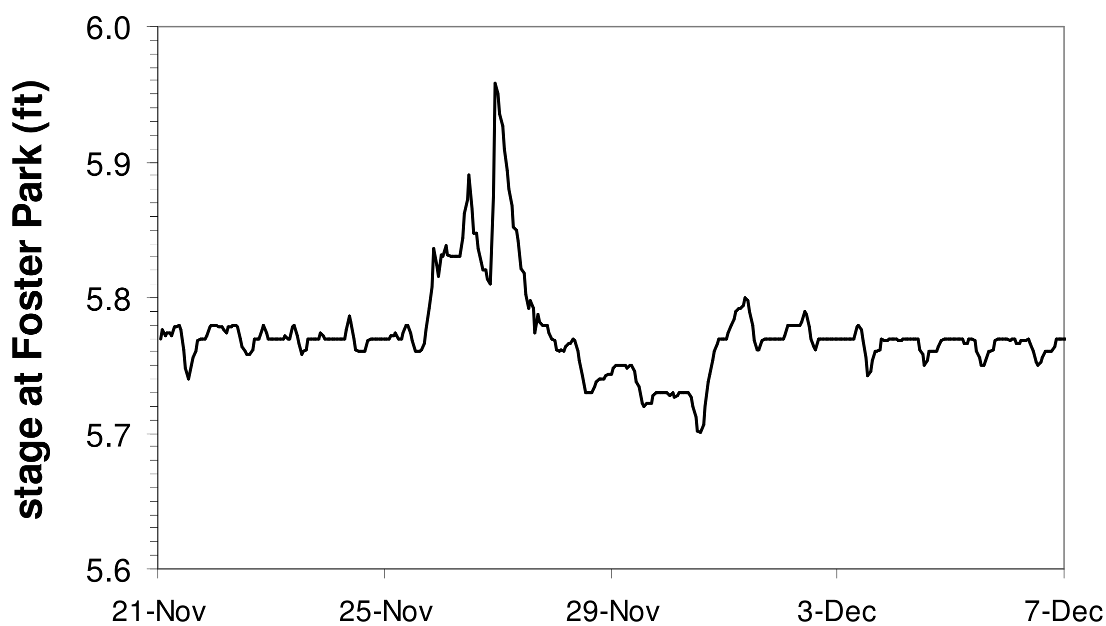
During the December 6th 2008, Channelkeeper sampling on the Ventura River we noticed an extraordinary change (to me at least) at the Canada Larga confluence. We were met by a field of green (lower photo, Figure 1), the "green" being a late-season revival of watercress. It was extraordinary in that the month was December, but more interestingly, because the month before, on the first of November, the dominant plant was Ludwigia but is now – Holy plant succession, Batman – watercress (the great majority of green plants shown in the upper, November, photo of Figure 1 are Ludwigia which began to dominate this location after the great plant die-off of August 2008 – see my "Attack of the Killer Effluent.pdf"). Let me repeat that: a December revival of watercress has overwhelmed three months of Ludwigia growth. Yeah, I know; it rarely gets any better than this.

The bottom photo in Figure 2 is the same December 6th photo shown in Figure 1, but I've replaced the November photo with one taken on October 4th. Back in October a lot of the dead vegetation was still visible – and there was a lot more open water – but Ludwigia can be seen to be making great progress. Invariably, plant succession in the past has been the other way around: taller Ludwigia overshadowing watercress and causing it's extinction – the less firmly rooted water cress always being rapidly displaced on the lower Ventura.

So what has caused the change? The only thing I can think of is that warmer than usual weather, reasonable amounts of sunshine and still appreciable flows have allowed watercress to take advantage of what is usually a dormant period for Ludwigia. The Ludwigia is still there (as evidenced by its substantial root system) but a lot of leaves are missing. It's also possible (but less plausible) that the Thanksgiving storm (November 26-27) may have played some part in stripping-off Ludwigia leaves. Below is a graph of stage changes at Foster Park during the storm.



The storm raised water levels at the bridge by around 4 inches (more on this later), not enough to seriously increase flow (which roughly doubled: from 5 to 10 cubic feet per second during the storm). During early storms the slopes above Ventura act as a sponge – these mountain soils are mostly sandy sediments – and can hold quite a bit of water as they go from bone dry towards wet.

Figure 1. (upper photo) View overlooking the reach just above the Canada Larga confluence on November 1, 2008. Most of the plants visible are Ludwigia. (lower photo) The same scene on December 6. Almost all the "green" is now water cress. Note also that a greater extent of the water way is now covered.

Figure 2. This is a similar comparison to that shown in Figure 1, the lower photo is the same (overlooking the reach just above the Canada Larga confluence on December 6th), but the upper photo is one taken a month earlier, on October 4, 2008. The killed vegetation was still visible and the new stuff was mostly Ludwigia (*Ludwigia hexapetala*, aka water primrose).

Early rains are almost totally retained in the soil. Only when these soils become saturated will appreciable runoff from undeveloped mountain terrain start to flow. On average, the upper soil layer is about 6 inches deep and can hold about 3 inches of water. So the storm that starts the slopes flowing -- with runoff, moving sediment and mud -- has to be of pretty good size. Or occur within a series of closely spaced smaller storms (soils dry out between widely spaced events and the saturation process has to first catch-up with moisture lost in the interim).

However, below Foster Park storm runoff from the more developed parts of the watershed had to be appreciably greater – impervious surfaces, roads, parking areas, roofs, etc., absorb little rainfall – and flows near Main Street were likely to have been considerably higher. This might not have affected the reach directly below the treatment plant, but during storms effluent outflows are also considerably higher. Infiltration into sewage lines during rainfall means a large increase in incoming sewage, and a correspondingly shortened treatment cycle with increased output. During storms plant output can be two or three times the average normal flow. And, I might add, a flow rich in nutrients. But I doubt if that kind of increase would have significantly disturbed the Ludwigia. Or, if Ludwigia were impacted, the watercress resurrection could have taken place in the 9 days since the storm. But hey, you never know.

The upper photo in Figure 3 shows what a rise of a few inches in water level during the storm did do above the San Antonio confluence: it moved enteromorpha from upstream and the center of flow off to the side, and left it stranded when levels dropped a short time later. All that luscious green, and the red roots of the Ludwigia, kinda gave me that Christmassy feeling. Perhaps we should think of all that new watercress as a Christmas present. After all, Ludwigia is regarded as noxious aquatic weed, an exotic invasive from South and Central America (but there is some doubt about this, a few experts believing it to be native), while watercress . . . On second thought, I'll let Wikipedia explain (http://en.wikipedia.org/wiki/Watercress):

"*Watercress (Nasturtium officinale) is a fast-growing, aquatic or semi-aquatic, perennial plant native from Europe to central Asia, and one of the oldest known leaf vegetables consumed by humankind. Watercresses are members of the cabbage family, related to garden cress and mustard, all noteworthy for a peppery, tangy flavor. Its hollow stems are floating, the leaves are pinnately compound, and it produces small white and green flowers in clusters.*

Watercress is cultivated both commercially and in gardens. It thrives best in slightly alkaline waters, and is frequently produced around the headwaters of chalk streams. In many local markets the demand for watercress exceeds supply because, in part, its leaves are unsuitable when dried and can only be stored fresh for a short period. Watercress can also be sold as sprouts, the edible shoots harvested a few days after germination. Like many plants in this family, the foliage of watercress becomes bitter when the plants begin producing flowers.

New Market, Alabama is known as the "Watercress Capital of the World." (Perhaps Ventura could be a contender.) Watercress is one of the main ingredients in V8 Vegetable Juice and is often used in sandwiches, such as those made for afternoon tea. The English seem to be particularly fond of watercress, using it in "watercress soup," and "watercress pesto" as well.

For the health conscious, watercress contains significant amounts of iron, calcium and folic acid, in addition to vitamins A and C. It's a terrific antiscorbutic (if you're planning that around-the-

Figure 3. December 6, 2008: (upper photo) Enteromorpha stranded on rocks above the San Antonio confluence, (lower) turbidity caused by agricultural sediment entering river above Main Street.

world sailing adventure and are worried about scurvy).

Many benefits from eating watercress are claimed, such as that it acts as a mild stimulant, a source of phytochemicals and antioxidants, a diuretic, an expectorant, and a digestive aid. It also appears to have cancer-suppressing properties and is widely believed to help defend against lung cancer."

My last topic concerns the sediment problem we've been seeing at Main Street throughout the summer and fall. The lower photo in Figure 3 shows what the water looked like this month. Contrast it with the water clarity in the photo above (December turbidities elsewhere on the river were measured at 0.0 NTU). The sediment source is agricultural operations on the land to the west. Drainage from this property enters the river a few hundred meters upstream of the bridge. Up to now Channelkeeper has been unable to get a good look at the actual drain since the area around the outlet is covered by a dense growth of willows and brush (access via the river is difficult – and inability to often see the bottom makes it more so). However, given a good river-cleaning storm later this winter, access should become easier, and the actual situation clearer.

In point of fact, agricultural development on this parcel of land has grown appreciably over the course of Channelkeeper sampling and I decided to dig out a bunch of older photos to show its progress. The following three Figures show photos (or parts of photos) from 2002 and 2008 (and 2006 in the middle panel of Figure 4). (Unfortunately, there are surprisingly few photos available, most of camera work having been concentrated on conditions and changes within the river channel itself.).

Back in 2002, and up through the winter of 2005, agricultural operations were rather modest, confined mainly to bottom land on the flood plain. I have no information about the kinds of crops that were grown (it might be useful for someone to investigate the changes in cultivation that have been made over the years and how those might have had varying impacts on the river), but in 2006 an extensive series of greenhouses (seen on the lower right in Figure 4) were constructed. This was followed by extensive new cultivation on mid-elevation slopes. This up-the-slope expansion continues further south than my photos show, and has now rounded the ridge and is proceeding further west on the back side.

To be fair, other than the turbidity problem, there has been no noticeable changes in other stream parameters at Main Street. But given the emphasis on steelhead restoration in this watershed this is a problem that should be closely watched.

Figure 4. Northern view: (above) March 2002, (middle) November 2006, (below) September 2008

Figure 5. The view to the south: (above) March 2002, (below) September 2008. Intensive development of the mid-elevations slopes began after 2006. The development continues even further south, rounding, and even heading up the reverse side, of the ridge seen on the far right

Figure 6. A panoramic view (or at least as panoramic as I have available): the upper photo shows the scene on March 2002 and the lower was taken in February 2008. Agricultural development of the mid-elevation slopes and the establishment of the greenhouse complex seen ont the right are the most obvious changes. I also believe there have been some modification in the types of crops being cultivated, but have no direct evidence.