Al Leydecker, April 23, 2013

Some Thoughts on Trees and Algae:

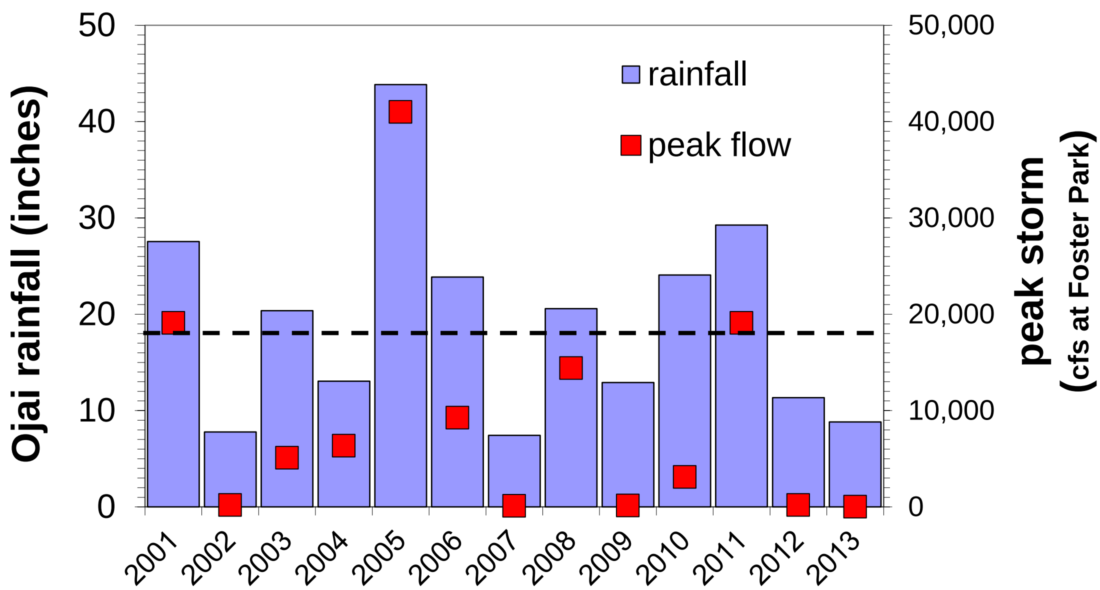
During the last Santa Barbara Channelkeeper (SBCK) Ventura sampling exercise (April 6, 2013) the group I was with talked about the extravagant tree growth at a number of monitoring locations in what once was the river channel. To move a step or two beyond the anecdotal, I've put together some photos taken at roughly the same locations over the past six years. Most of the figures that follow show photos from the years 2008, 2010 and 2013; all but one of the photos taken during the month of April. Photos from the intervening years only reinforce the story of continual growth told by those shown.

The ecology of the Ventura River, and of its tributaries to a somewhat lesser extent, is based on the advent of a very big rainfall year – El Nino winters like 1998 and "pineapple express" winters like 2005. These might be termed "clock-cleaning" events since they leave the river bottom completely scoured – riparian vegetation, trees, aquatic plants and sediment swept out to sea – with only clean gravels, cobbles and boulders left behind. In the dry-season following these winters algae dominate – taking advantage of a now rocky bottom to hold themselves against river currents, the expanded habitat made available by greatly increased flow from big-winter groundwater recharge, high nutrient levels (years of land-based nitrogen accumulation having been carried along with groundwater recharge), and, most important, lots of sunlight now striking the water surface with no interference from aquatic plants or over-hanging vegetation.

By the end of the first dry-season after a big winter however, aquatic plants will have begun to establish a toe-hold, aided by the accumulation of fine sediment. And the first shoots of new riparian brush and trees will have made their appearance. The second year, absent a winter flood big enough to reverse plant progress, will see vegetation beginning to take over the entire river bottom. In a dry-season contest between aquatic plants and algae, algae *always* loose. Being able to shade out competition by intercepting sunlight before it reaches the water surface is an unbeatable competitive advantage.

As dry year follows dry year riparian trees grow taller and become more deeply rooted. The river (or stream) bottom and Ventura's climate provide near-ideal growing conditions: plentiful water (if not on the surface then at shallow underground depth), a long, warm, growing season, and abundant nutrients. A successional struggle between aquatic plants (most commonly between watercress and Ludwigia on the lower Ventura) likewise favors the more deeply rooted as they usually grow faster, denser and taller. As this process continues it becomes self-reinforcing. Deep-rootedness provides protection against flood, and the minimum size of the winter storm that would disrupt the cycle, or force it back a step or two, increases year by year. The rainfall that might have torn out newly established riparian brush and swept aquatic plants out to sea in year one becomes only a temporary setback in year three.

Increased riparian growth also narrows the stream channel. Greater plant density captures greater amounts of sediment and the riverbank increasingly intrudes on and restricts the open waterway. The ever-growing consumptive use of above- and below-surface river flow by plants and trees increases water loss via evapotranspiration. This measurably decreases flow and accelerates the process. And as aquatic plants once crowded out algae, growing riparian vegetation now crowds out aquatic plants, further armoring the river bottom against flood. This pretty much leaves us where we are today: much of the Ventura River having become a narrow, tree-choked, low-flowing stream.



The graph shows annual Ojai rainfall (water years, i.e. October through September) and the peak flow produced by the largest winter storm during the era of SBCK Ventura sampling. The dashed line represents median Ojai rainfall: 18 inches a year. This can be considered the expected annual rainfall: half of all past recorded years have had rainfall less than this, half have had greater. The last big clock-cleaning event was 2005. In 2008, higher than normal rainfall, but more importantly, a relatively big flood removed aquatic vegetation and gave us our last big algae year. As the subsequent photos will show, the sparse, newly established, riparian growth (mostly dating from 2006) remained relatively undisturbed.

Although 2010 proved to be an even bigger rainfall year, the peak flood was much smaller (only one fifth the size of 2008's), and not even aquatic plants were greatly disturbed. 2011 was an even bigger rainfall winter with an appreciable flood flow – as great as 2001's – but by this time the well established riparian vegetation was not much bothered and subsequent algal growth was greatly diminished. The dry winter of 2012 was followed by the even drier winter of this year, but what makes 2013 rather exceptional is not the low rainfall per se (rainfall was even lower in 2002 and 2007) but that it is the second very dry year in a row and the total absence of any sizable stormflow (we would have to go back to 1951 to find a worse year).

We are now two winters past the last big storm and the river bottom has become even more armored against flood. To change the situation will require more than a big rainfall winter, it will require a big flood – something approaching, or exceeding, what we had in 2005, 1995 or 1993. Our big years are most often El Nino years. The 1990s had three of them: 1993, 1995 and 1998. But we are in a different cycle now and haven't had a big El Nino since 1998 (2003, 2007 and 2010 were El Nino years, but rather puny ones – 2007 even produced a drought). That's the bad news. The good news, of course, is that there will be no substantial algal problem as long as the current situation continues.

Middle San Antonio (VR17): upper photo Sept. 2009, lower Apr. 2013. The photos show a reasonable amount of vegetation growth on both sides of the stream – roughly a doubling of brush height on the right-hand side of the creek.

Ventura River @ S. Antonio confluence (VR06.3): looking upstream in April, 2008 (upper), 2010 (middle), 2013 (lower). Growth here has been dramatic, the riparian brush is now over 10 ft. high.

Ventura River @ Foster Park (VR06): looking downstream from the bridge in April, 2008 (upper), 2010 (middle), 2013 (lower). Growth at Foster Park is even more dramatic, trees in what was the center of the river are now about 25-35 ft. high.

Ventura River @ Main Street (VR06): looking upstream from the bridge in April, 2008 (upper), 2010 (middle), 2013 (lower). Growth below Foster Park is equally impressive. Note that by 2013 the river is increasingly confined within an ever narrowing channel.

Middle San Antonio (VR17): These two photos were taken on April 6, 2013. In the upper, on top of the rock in the lower left-hand corner you can light green crustal algae growing. This is the typical alga at this location (and at others) near the end of winter and at the beginning of spring. Crustal algae thrive at this time since they're able to resist fast-flowing water and take advantage of normally high nutrient concentrations at the end of the rainy season.

As flows slow, however, they are typically replaced by cladophora – the algae we usually associate with Ventura's algal problem. Cladophora are able to resist moderate current speeds and, as long as nitrogen concentrations are high, rapidly overwhelm whatever algae preceded them (usually the crustal guys).

Interestingly, there is no cladophora in these photos, nor was it growing at other San Antonio or middle Ventura River locations we visited. Instead, we found lots of dead and rapidly-fading spirogyra – a very slimy, dark-green alga that you can see signs of in the lower photo. I've never seen spirogyra growing in such profusion this early. Typically it only appears late in the year as it requires almost quiescent water and is better adapted to low nitrogen concentrations than cladophora. The presence of spirogyra indicates a number of things: (1) we've had no appreciable runoff for a very long time (otherwise these fragile algal conglomerations would have been swept downstream); (2) nitrogen (mostly nitrate) concentrations are probably very low since there has been no meaningful groundwater recharge (older groundwater is typically much lower in nitrate); that spirogyra has been unable to thrive may also indicate nitrogen exhaustion at this location); and (3) we are in for an unusual year – and I don't mean that in a good way.

I can say with some confidence that due to very low flows, reduced habitat, lower nitrogen concentrations, and an excess of dense, overshadowing riparian vegetation, there will no algal problem in the Ventura watershed this year.