Giving Rivers Room to Flow: Restoring Floodplains at Setback Levees

Lessons Learned on the San Joaquin: Transitory Flood Storage and Rabbit Recovery

Setback Levees Mute the Damage of the Oroville Dam Failure Scare

Out and About: River Partners Connecting With Communities
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(Cover) When improved flood safety and environmental enhancement coincide: Highway 132 (also Maze Blvd.) crossing the swollen San Joaquin River in March 2017 looking south. Over 5,000 acres of the San Joaquin River National Wildlife Refuge received rejuvenating flood inundation this year, and public infrastructure saw almost no flood damages in Stanislaus County. River Partners has proudly been a project partner for over 18 years in this area, demonstrating the values of multi-benefit project design and implementation.

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“River Partners does many things that are exciting, important and innovative. It is an organization which preserves and restores floodplains along with important animal species. The truly amazing aspect of this work is that it is done in a non-political, scientific and factual manner. Rather than theorize or politicize, River Partners simply gets the job done.”
— Tom Lando

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Our mission is to create wildlife habitat for the benefit of people and the environment. Unless otherwise specified, all photographs were taken by River Partners staff.

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Boardmembers Ken Grossman, John Carlon, Monroe Sprague, and Irv Schiffman survey a project site.
In recent years, River Partners has been restoring large swaths of floodplain habitat in conjunction with the construction of setback levees by the Army Corps of Engineers and the Three Rivers Levee Improvement Authority. These setback levees replace levees built years before, many of which are considered historic resources.

On California’s Feather River, for example, levee construction began in the mid-1850s to remove sediment and save cropland. Hydraulic mining washed millions of tons of silt into the riverbed, and levees were built very close to the river channel to keep water velocity high, thereby removing the sediment. To protect the extremely fertile soil of the Feather River floodplain, farmers built levees right on the riverbank to enable them to plant valuable crops as close to the river as possible.

Levees placed adjacent to rivers constrict water flows and are vulnerable to failure. Levees are also often built over incoming streams, which allows water to seep under the levee, causing a levee “boil” to form which damages the levee. Levees can be overtopped during flood events that are larger than the levee system was designed to contain. Levee failures in 1986 along the Yuba River flooded south Yuba County and caused hundreds of millions of dollars in damages. Levee failures on the Bear and Feather Rivers in 1997 caused devastating flood damages as well.

Setback levees represent a modern approach to flood control. They’re built away from the river channel, with the natural floodplain between the levee and the river. Setback levees allow the river to meander along its natural floodplain, with floodwaters spreading out and slowing down over a wide area. This increased water retention relieves pressure on narrow levees upstream while helping to lower the elevation of the river downstream. Setback levees are more resilient than traditional levees, which is even more important with threats of massive rain and flooding brought on by climate change.

Beyond their flood control benefits, setback levees provide increased opportunity for significant environmental enhancement consistent with federal and state mandates that flood reduction be combined with ecosystem restoration.

The setback levee built at the confluence of the Feather and Bear Rivers enabled River Partners to restore wildlife and habitat in the 639-acre setback area through the planting of one hundred thousand shrubs and trees. Fish have more areas in which to feed or be protected from predators on this expanded floodplain. In addition, the recharge area for groundwater is also greatly increased, providing additional benefits.

The setback levee on the Feather and Bear Rivers held up very well during last winter’s rain storms and the Oroville Dam disaster while the base of more traditional levees located close to the river showed signs of erosion.

We are now at work on the Sacramento River restoring habitat on the expanded floodplain created by the 6.8 mile Hamilton City setback levee being constructed by the Corps of Engineers. River Partners is happy to be involved in such innovative, multi-benefit levee setback projects.

Message from the Board Chair
Restoring Floodplains at Setback Levees

Irv Schiffman
Board of Directors Chair
CSUC, Political Science (Retired)
Over the years, we have embraced the core value that quality ecological restoration requires design considering all types of future site conditions, ranging from disturbed to protected, frequently burned to frozen, and severe drought to prolonged flood. Given California’s status of “extreme drought conditions” over the past four years, it was difficult to imagine how our more recent restoration designs would be impacted by high waters. This past winter, flooding on the San Joaquin River provided a spotlight for management decisions made and designs implemented over the past decade at the San Joaquin River National Wildlife Refuge (Refuge). We have learned a lot of lessons that will guide future projects as we continue to attempt to account for the suite of possible future conditions. Here is what we learned:

On February 15, 2017, California had already experienced several months of steady rainfall; flows at the Vernalis flow gauging station (a few miles downstream from the Refuge) were just reaching flood stage and were projected to continue rising over the next few days. But then, something happened. The earthen banks of the West Stanislaus Irrigation District’s (WSID) main canal breached, leaving a 100-foot wide, 10-foot deep gap; through which river water began pouring into the 1,500-acre Refuge at an estimated rate of 2,000 cubic feet per second. Water accumulated on the dry side of the levees to the north and south of the breach, submerging nearly 3,000 acres of restored riparian and seasonal wetland habitat that was funded through $25 million in state and federal grants.

By March 3, the water level in the Refuge was over 10 feet deep. Fortunately, the landowner, the US Fish and Wildlife Service, had obtained an emergency allowance from the Army Corps of Engineers and California’s Central Valley Flood Protection Board to breach the downstream levee holding water back. Floodwater flowed out of the Refuge through the emergency levee breach, eventually draining back to the San Joaquin River.
feet of water flowed onto the Refuge. This was enough “storage” to keep the San Joaquin River from reaching peak stage for over 24 hours at the Vernalis gauge station and 12 hours at the Mossdale Bridge gauge station (over 25 miles downstream). This extra time can make a big difference for evacuations and emergency responders.

However, two issues arose that are of serious concern for terrestrial wildlife: The rapid flooding caused mortality – drowning wildlife immediately; and the long duration flood also caused mortality, by eliminating food plants for flood survivors. This rapid flooding happens much faster than wildlife are able to respond to. A bunny simply can’t outrun a flood rush that large. Creating numerous high water “refugia” across the floodplain for terrestrial species is one design concept that we’ve incorporated into floodplain restoration here to help with the problem. And they have mostly worked. Following floods in 2006 versus 2011, we saw a significantly faster post-flood repopulation of the habitat with rabbits once elevated refugia were present. For a more detailed description of the workings of the elevated refugia, see the next section Impacts to Wildlife.

River Partners sees this example as an opportunity. Just across the San Joaquin River from the Refuge lies Dos Rios Ranch, with the capacity to store an additional 10,000 acres of water that large. Creating numerous high water “refugia” across the floodplain for terrestrial species is one design concept that we’ve incorporated into floodplain restoration here to help with the problem. And they have mostly worked. Following floods in 2006 versus 2011, we saw a significantly faster post-flood repopulation of the habitat with rabbits once elevated refugia were present. For a more detailed description of the workings of the elevated refugia, see the next section Impacts to Wildlife.

The events of February 15th - March 3rd provide a real-world example of “transitory flood storage” or the idea that floodplains can be used to reduce flood stage locally by accepting a slug of water quickly. When the WSID canal bank breached, water experts were projecting flows continually increasing in the river channel, reaching a peak stage within the next few days. Instead of reaching peak flood flows, however, up to 20,000 acre-feet of water flowed onto the Refuge. This was enough “storage” to keep the San Joaquin River from reaching peak stage for over 24 hours at the Vernalis gauge station and 12 hours at the Mossdale Bridge gauge station (over 25 miles downstream). This extra time can make a big difference for evacuations and emergency responders.

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channel. This drainage reduces the threat of fish stranding behind the levee, and promotes water circulation that protects the restored vegetation from damage. Water depth in the Refuge remained high (6-8 feet in places) until July.

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acre-feet of peak stage flows. We will continue working with multiple stakeholders to identify ways a levee breach can be engineered to open at the exact moment when peak flows are coming down the river in order to protect downstream communities, while incorporating the necessary habitat components (elevated refugia, drainage swales and breaches) that protect wildlife populations too.

Impacts to Wildlife

The “Godzilla El Nino of 2016” ended with a dull thud in the Central Valley, producing above average precipitation, but nothing near the torrential rains predicted by most climate models. By all accounts this winter wasn’t supposed to be anything remarkable, but reservoirs filled to capacity, rivers inundated floodplains, and snow packs hit historic highs. While all of this water is great for a drought-weary state, it can spell disaster for many of the terrestrial inhabitants of the floodplain. One such species is the Riparian Brush Rabbit (*Sylvilagus bachmani riparius*), found only on the Valley floor. Their historic range stretched as far south as possibly the Merced River and north into the San Joaquin Delta. Currently their populations are confined to small fragments of habitat in the south delta near the town of Lathrop, Caswell State Park along the Stanislaus River, and the Refuge.

In the late 1990’s, the brush rabbit was thought to be on a path to extinction, numbering as few as 300 in the wild, so state and federal agencies began working with the Endangered Species Recovery Program (ESRP), based out of California State Univer-
sity Stanislaus, on captive propagation and reintroduction efforts. Native rabbits were captured and placed in enclosures with the intention of releasing their offspring into the wild. The Refuge was the chosen location for these captive born offspring, having both the appropriate location and habitat needs of the species. By 2012, approximately 1,500 brush rabbits had been released at the Refuge at several locations with the appropriate habitat. The population has endured both fires and floods, two natural disturbances associated with riparian habitat, and continue to thrive.

River Partners has been working at the Refuge since the early 2000’s as well, restoring over 2,500 acres of riparian habitat. During that time, we’ve documented the effects of major flood events that left restored fields inundated for months and brush rabbits stranded on sparsely vegetated levees.

With each flood event there are so many opportunities to learn. In the flooding that occurred in late 2005 and early 2006, brush rabbits were able to make it to high ground, primarily the levees surrounding the floodplains of the Refuge, which had little useable vegetative cover. This in turn concentrated the rabbits in small fragmented patches of cover, which funneled the predators into these areas as well. These conditions had a dramatic effect on the brush rabbit, approximately 98% of the captive-bred, radio-collared rabbits perished.

After the flood event of 2006, River Partners, ESRP, and the Refuge staff began working on options for vegetating high ground, both on the floodplain and the linear levees. Mounds were constructed and vegetated near suitable habitat on the floodplain, levees were vegetated throughout a majority of the

(Above) One of the released rabbits in the San Joaquin River Wildlife Refuge (west of Modesto, along the San Joaquin River) in 2005.

(Right) Vegetated Bunny Mounds as part of the restored landscape, with vegetated levees in the foreground. Photo from 2009.

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Refuge, and captive-raised brush rabbits were added into the environment. All that was needed was another flood event to see if the vegetated high ground worked. In March of 2011 the Refuge was again inundated with several feet of flood water, forcing brush rabbits to seek shelter on vegetated high ground.

ESRP was able to visit several mounds on the floodplain to determine if brush rabbits were in fact using these recently constructed mounds to ride out the flood. Brush rabbits were documented on mounds and Refuge levees, which was a good indication that at least a few were able to survive. Unfortunately, what we learned was that due to the duration of the flood event, many of the mounds had their food resources exhausted quite rapidly. This led to over-browsing and as a result many of the rabbits died from lack of food. ESRP and the Refuge staff supplemented the food sources in an effort to keep the remaining rabbits alive, which was successful, but was not a sustainable management action for the future.

Trapping data indicated that after the 2006 flood, brush rabbits were not captured on the floodplain until the fall of 2007, even with brush rabbits being actively translocated to portions of the Refuge. But in 2011, once flood waters receded, brush rabbits were captured on the floodplain adjacent to bunny mounds, without supplemental introductions, so we know that rabbits survived the flood and repopulated the floodplain habitat naturally.

ESRP ended their breeding and reintroduction efforts in the summer of 2012 due to lack of funding, but the brush rabbit population at the Refuge seemed to be holding. Project partners are currently working on funding to continue monitoring for brush rabbits on the Refuge and surrounding habitat. River Partners is also working to secure funding to revegetate several mounds on the floodplain that have experienced negative effects of the ongoing drought. We are looking into more drought tolerant plant species, such as quail bush, in an effort to provide more long-term cover for the rabbits, as well as grasses and forbs for rabbit forage during future flood events.

The recent flooding in early 2017 seems to have put an end to the ongoing drought but it has again inundated large portions of the refuge and surrounding floodplains. Brush rabbits were documented on several mounds on the floodplain and all of the vegetated levees but they again exhausted their food resources. The timing of this flood event, mid-January, meant that some of the annual grasses which would normally provide forage and cover had not germinated. What little forage was available was quickly eaten by the hundreds of rabbits forced onto the levees and mounds. Refuge staff and ESRP began moving rabbits to other portions of the Refuge to relieve some of the pressure for resources. For nearly three months, Refuge staff supplemented the food sources on the levees and mounds with bales of alfalfa and alfalfa pellets. This proved essential for maintaining a healthy and robust population.

In a natural riparian system, this would not be necessary – the animals would simply hop up-gradient along the myriad drainages as the river slowly rose. However, if they tried now – assuming they could escape the unnaturally rapid inundation of the floodplain – they would encounter bare levees and farm fields, making it impossible to survive. The habitat and river system in the Central Valley of California remains highly altered, necessitating these “rescue” efforts – pending provision of an adequate supply of high-water refugia.

This flood event highlights the need for further work on the constructed mounds and levees, which are providing the necessary high ground to avoid flood waters, but are falling short on providing enough food resources to survive a long-term flood. Refuge staff and River Partners staff were able to visit several mounds during early February to look at available resources and numbers of rabbits per mound. One of the interesting discoveries during this trip was the number of brush rabbits found on one of the newest mounds constructed in the Hagemann Tract of the Refuge. Translocations never occurred in that area. These newest mounds, two “super bunny berms” were designed and constructed to provide several acres of contiguous high-ground cover for rabbits that connects some of the lowest elevations of the floodplain to some of the highest. The design concept imagined rabbits fleeing the floodwaters along the tops of the super bunny berms, eventually making their way to native high ground where they could weather the duration of the flood. This spring, an abundance of riparian brush rabbits were found on each super bunny berm. Estimates are in the low hundreds, although without monitoring data, population numbers are difficult to estimate.

The presence of brush rabbits on vegetated mounds and levees offers hope for the survival of the species at the Refuge, especially in the face of more frequent and intense flooding associated with our changing climate. Vegetated high ground on the floodplain and vegetated levees were certainly critical to rabbit survival, and there is so much more to learn as the Refuge weathers our future climate cycles.
In February 2017, the nation focused its attention on a flooding disaster... record snowfall in the Sierra Nevada, record rainfall throughout California, and the Oroville Dam Spillway was failing. The 24-hour news cycle continued airing scary footage of a massive eroding hole in the concrete spillway, and graphics illustrating the way that the emergency spillway (which had never been used before) was eroding the land below and possibly compromising the dam itself. This is the tallest dam in America. Its reservoir supplies the California Aqueduct with irrigation water for the San Joaquin Valley and municipal water for millions of Southern Californians. And it provides flood control for hundreds of thousands of downstream residents. It is a big deal.

When evacuations were ordered for 188,000 Californians, we knew this event was serious. Large flow releases were required to save the dam, and those releases caused significant damages to the river corridor downstream. This is part of the untold story behind the near catastrophe at Oroville. Naturally, the focus of the news coverage was on the human element: the congested evacuation of the city of Oroville, the horrific damage which would have been unleashed on communities downstream of the dam if it failed. Now, months later, high flows have gone down and we can evaluate what actually happened on the Feather River during these floods.

Years ago, flood managers at the Three Rivers Levee Improvement Authority (TRLIA) and California’s Department of Water Resources conceived and undertook the Bear River and Feather River Levee Setback projects. Eight miles of the existing levees were knocked down and rebuilt further from the rivers. This allowed floodwaters to safely expand across the historic floodplain where there was no longer any expensive infrastructure or homes. That’s why setback levees are built – to control where floods do and don’t occur. Opening floodplains downstream of Marysville means that there is less floodwater in the river when it hits Sacramento. Instead the water sits on the expanded floodplains where it doesn’t do any damage, in fact it does some good.

Inside the levee setbacks, River Partners and the TRLIA planted nearly 1,000 acres of riparian forest. Riparian forest is one of the most endangered habitat types in California. As our climate continues to change, forested riparian corridors will provide migration pathways for wildlife retreating into the mountains from the hot valley floor. The trees and shrubs that make up these native forests evolved with regular regimes of drought and flood. Their growth and regeneration is actually stimulated by flooding. Following the emergency flow releases in February, the restoration project site remained flooded through the first week of August. Aside from the road which needed repair, there was little damage. Contrast that with flood fights elsewhere where people lose their homes and their livelihoods. It is clear that giving our rivers room to flow is a sustainable method of reducing the pricetag of floods.

Due to the flow releases from Oroville, landowners have filed lawsuits about the amount of erosion it caused. But on our projects, we don’t mind erosion. In fact, we like it.
It’s a natural function of all rivers. That’s what they do. They meander. They move. Trees eroded into rivers become critical habitat for juvenile salmon. Gravel washed downstream becomes a place for salmon to lay their eggs. The finer sediments (dirt!) become the building blocks of future forests.

Still, there are areas where erosion is a problem – like when it structurally undermines dams and levees. At the setback levee area, River Partners planted an erosion buffer along the edge of the new levee to reduce erosion, and it worked! Levee segments up and downstream of the project that do not have trees and shrubs growing around them were hammered by water erosion to the tune of millions of dollars of needed repairs. At the setback levee area, that erosion didn’t happen and the needed repairs are minor. The trees and shrubs actually helped to hold the levee in place.

As of July, our flooded site had a happy riparian forest. Robins, grosbeaks, and lesser goldfinches nested in the vegetation above the floodwater. Otters and osprey hunted for fish washed in by the floods. And the fish hid in the vegetation we planted years ago. This is how riparian systems are supposed to work. And recreating them, especially with the use of setback levees, is not only great for wildlife, but is also the key to our future flood safety.

**Michael Rogner**
Senior Biologist, Sacramento Valley

**Julie Rentner**
River Partners
Board Director

Feb. 2017 Oroville Dam main spillway damage. (Photo: DWR)
Snow Goose Festival of the Pacific Flyway

As Snow Goose Festival participants walked by our River Partners booth last January, they would direct their eyes to the backdrop aerial display of the “J Levee project” on the west side of the Sacramento River.

River Partners was recently awarded a contract to complete large-scale riparian restoration work on the river-side of a new levee which protects Hamilton City from flooding. People were interested in seeing the line of the old J levee and where the new levee runs and the areas outlining some 1,480 acres to be restored in various preparation and planting phases by River Partners. River Partners is a proud sponsor of The Snow Goose Festival of the Pacific Flyway, held annually in Chico.

This year’s festival boasted record numbers – attendees, bird species seen (161) and marathon one-day bird count total of 118 species! Please check out the website http://snowgoosefestival.org/ for more information and to learn about the 2018 festival.

Hamilton City Levee Festival 2016

On October 23, 2016, River Partners teamed up with RD 2140, the Hamilton City Fire Protection District, the US Army Corps of Engineers, and many other community partners for a day at the Downtown Park to share information about the new levee currently under construction for this small community.

New infrastructure investment for small communities in the floodway is rare, and this project promises to deliver true multi-benefit public safety and environmental improvements for local residents. A special thank you goes out to the family and friends who attended the day at the park, and who shared their ideas and perspectives about the project.
Panorama Vista Preserve Field ‘n’ Dale Run 2017

Hundreds of participants laced up in the wee hours of a crisp March day for the 3rd annual Field N Dale 6K/12K at Panorama Vista Preserve in Bakersfield. River Partners was proud to sponsor the event which highlights riparian restoration currently underway and planned for the near future along 2.75 miles of the Kern River. The race was a big success raising funds for our friends at the Kern River Corridor Endowment to support their environmental education, habitat restoration, and land management objectives. To learn more about this race and the Panorama Vista Preserve, please see http://panoramavista.org/

Girl Scout Troop 70201 Plant Milkweed at Chico Office

Last spring, Girl Scout Troop 70201 chose us from a list of local non-profits to complete their “Giving Back Badge.” To help receive their badges, they spent a few hours on a Friday at our Chico office planting narrow-leaf milkweed (Asclepias fascicularis) and showy milkweed (Asclepias speciosa). Milkweed is an important host plant and nectar source for the Monarch butterfly. The loss of milkweed across America has contributed to Monarch populations declining more than 80% over the past 20 years.

The troop also generously donated a portion of their cookie sale proceeds to support River Partners’ work.

We appreciate their hard work and their wonderful donation!
Creating wildlife habitat for the benefit of people and the environment

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Please make checks payable to River Partners. You can also donate at:
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Wine TASTING

Join us for a fundraiser for River Partners
Nov. 30, 2017, 5-7 pm
Bidwell Golf Course, Chico
$7 per person

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