



A Proposal for the Recovery of the Central Valley California Salmon Populations

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*Chairman - Randy Repass President - John McManus
Science Committee*

Dick Pool (Chair), John Atkinson, Mike Augney, Sara Bates, Marc Gorelnik, Mike Conroy

GoldenStateSalmon.org

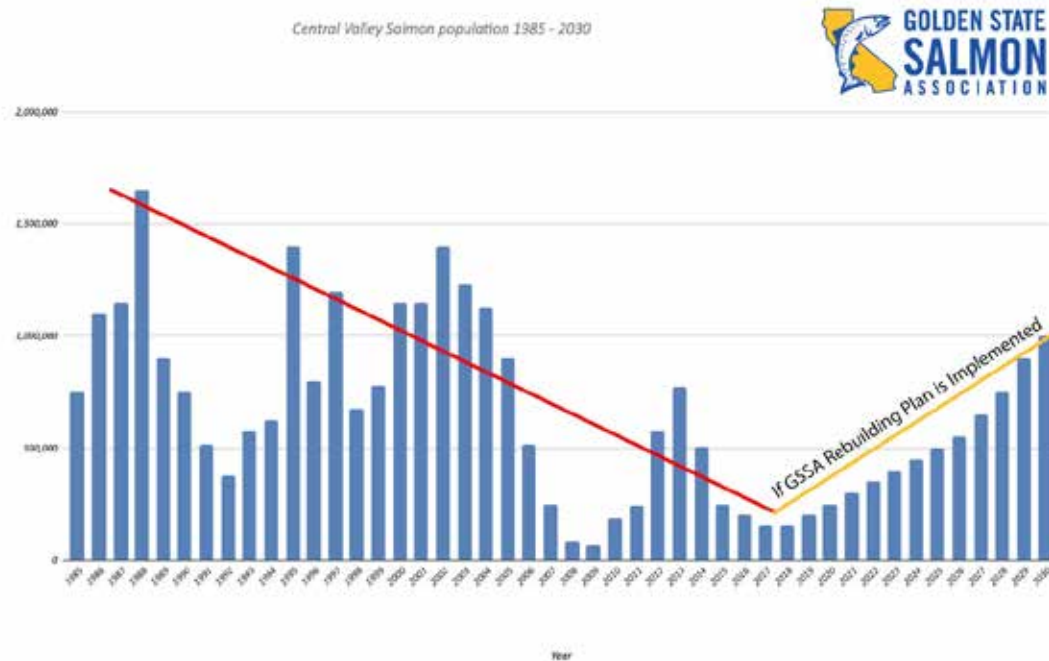
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Introduction and Executive Summary

Historically, the salmon populations of the Central Valley of California reached many millions of fish and were second only to those of the Columbia River in the continental US. Today, some Central Valley runs are nearing extinction. The demise of these iconic fish is an environmental disaster. It is a story of government ignorance, private greed and the gross mismanagement of California's water resources.

Between 2004 and 2008 there was a large decline in the salmon populations. As a result, in 2008 and 2009 the entire salmon industry was totally shut down to avoid extinctions. This was a major wake-up call and in 2011, the Golden State Salmon Association (GSSA) was formed to develop recovery plans and to advocate for these fish. GSSA has formed such a plan and today, it is actively working to see it implemented.

The chart below illustrates a long term dramatic drop in California's Central Valley salmon population and a hopeful vision of what the future could be. California's iconic salmon, which provide \$1.4 billion in economic value to California's economy and supports 23,000 jobs throughout California in recent years is now in danger of a total collapse.



The salmon industry, which includes sport and commercial fishermen and women, seafood processors, restaurants, markets, boat yards, marinas, and others, count on a healthy population of the fall-run salmon, which historically has been the largest. GSSA is working to improve all the runs but we emphasize the fall-run projects that support the 23,000 industry related jobs.

The GSSA approach first looks at the large areas where the current fish are being lost. We then designed or identified projects that will improve survival of both natural spawned and hatchery fish.

We seek stakeholder and government support for the following high priority projects that will make a major difference in the salmon populations.

They will:

- Increase the number of juveniles entering the Delta by 5.1 million fish that currently do not survive by increasing the Sacramento River flows in the early months.
- Add 30 miles of new tributary wild spawning and rearing area in the Feather River and in Battle Creek for the fall, late fall and spring runs, creating up to 20 million new fry annually.
- Increase the survival of juveniles in the Delta by 2.1 million fish by completing the notching of the Fremont weir and opening the migration routes through the Yolo Bypass.
- Increase the survival of the Central Valley hatchery fall-run fish by 2.3 million juveniles by trucking them around the predation and Delta loss areas.

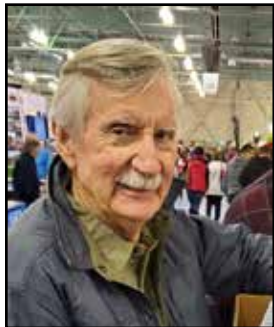


If these 12 projects are completed, the ocean salmon abundance will increase from the current average of 474,000 fish to over 1 million fish. With that, the future of these fish, the fishing industry and consumers will be secure. We urge support for this plan and hope that the citizens of California will once again say “stop, this is not right and we want it fixed”.



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Randy Repass
Chairman GSSA
Retired founder and developer of West Marine Corp. 55 Stores



John McManus
President GSSA
Former commercial salmon fisherman and Media Executive



Mike Augney
Vice Pres GSSA
Owner of USA Fishing and Bodega Bay Charter Boat Reel Magic



Dick Pool
Secretary GSSA
Owner Pro-Troll fishing and 2019 Inductee Calif. Outdoor Hall of Fame

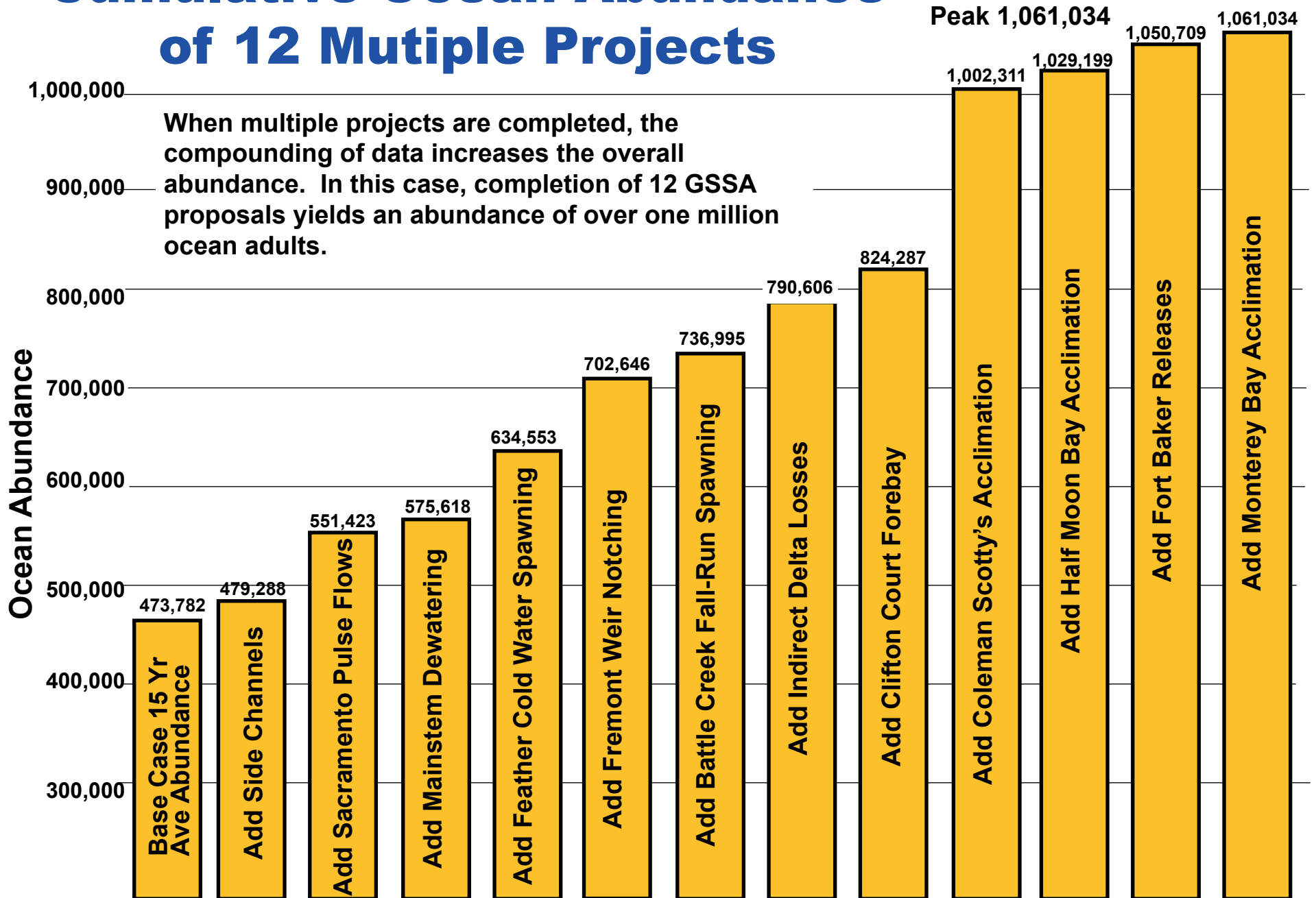


David Zeff
Treasurer GSSA
Lawyer and Chief Council GSSA



Marc Gorelnik
Exec Committee GSSA, Lawyer Chief Council ASA and President Coastside Fishing Club

Cumulative Ocean Abundance of 12 Mutiple Projects



Problems, Solutions, Proposed Actions and Results

Wild Fish Problem #1 - Lack of Side Channels

Channelization and rip rapping (armoring) of the Sacramento River has destroyed the shallow edges of the river where juvenile salmon can hide, feed and rest. The result is heavy predation and low survivals particularly in low flow years.

Solution - Restore existing shallow side channel zones where the juveniles can hide, feed and rest.

Action - Continue the Side Channel program started by the CVPIA and open more channels further down the river. Up to twenty sites are proposed.

Results - Three recent upper river side channels covering eight acres increased the juveniles entering the Delta by an estimated 939,000 fish.



The side channel process levels the area and then covers it with shallow gravel

Wild Fish Problem #2 - Inadequate River Flows

When Sacramento River flows into the Delta are below 40,000 to 50,000 acre feet during January, February and March when the winter, spring and fall runs are migrating, the runs become unsustainable. The result is continued population declines.

Solution - Provide a minimum of 40,000 acre feet into the Delta for the three months in low water years.

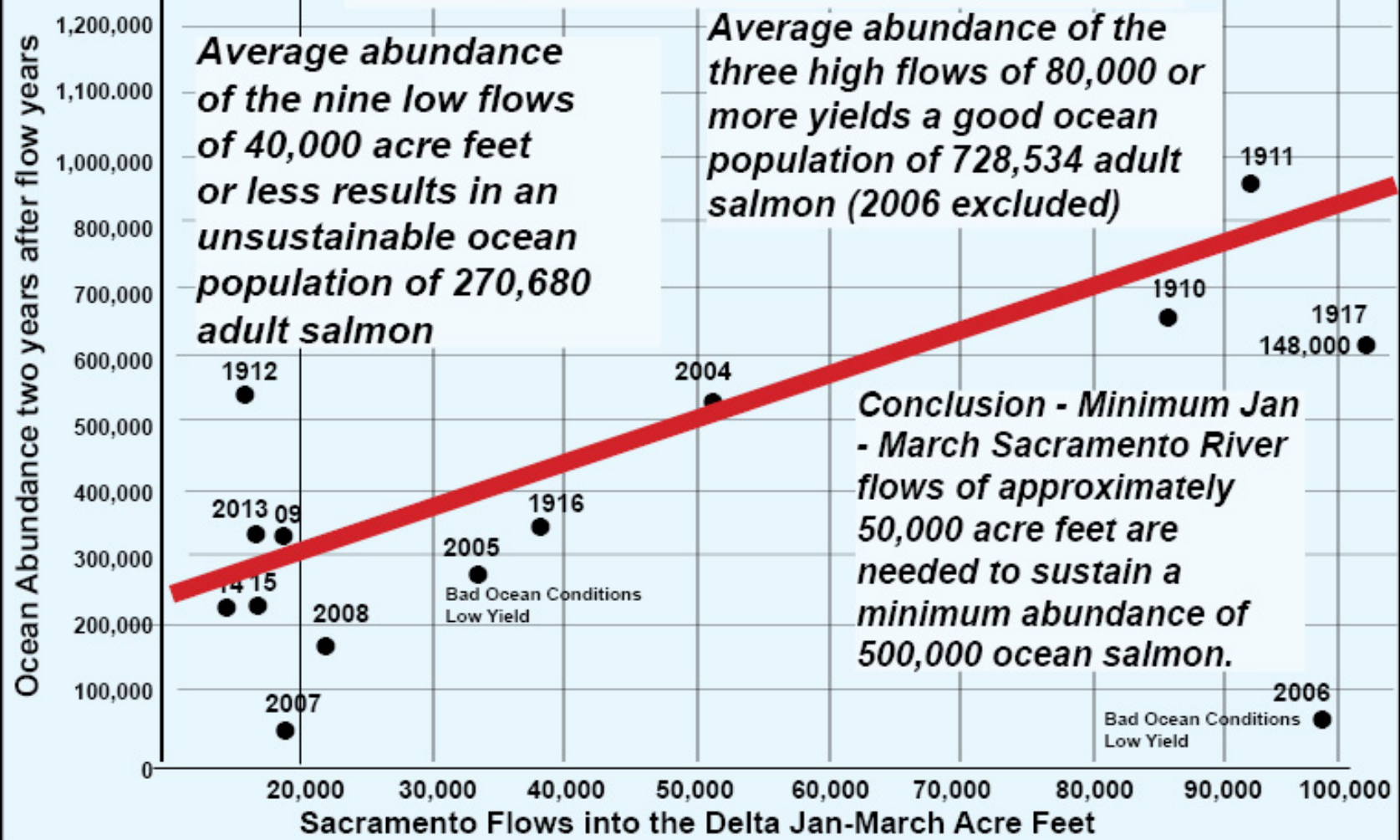
Action - Provide Sacramento River pulse flows reaching 40 to 50 thousand acre feet for the January through March migration period in low water years.

Results - In the nine low water and drought years starting in 2007, the average Sacramento River flows into the Delta in January, February and March were 21,000 acre feet. The average ocean salmon yield from that period was an unsustainable 271,000 fish. Had that flow been 40,000 acre feet, the estimated yield would have been 425,000 fish. The graph on the next pages shows the comparison.



The Sacramento River

Ocean Survivals vs. Sacramento Actual Flows from Jan- March in the 15 years 2004 to 2019



Wild Runs Problem #3 - Dewatering Fall-Run Redds

Problem - In the fall, the Bureau of Reclamation maintains high Keswick release flows in September and October while the winter-run eggs are in the gravel. During that time, the fall-run fish deposit hundreds of thousands of eggs along the edges of the river. In mid to late October, November and December the Bureau drops the flows stranding the fall-run eggs which perish.

Solution - Hold the flows steady until both the winter and fall-run fish emerge from the eggs



Keswick Dam at maximum release volume



Each mound is a stranded fall-run redd. Each redd holds 5000 dead eggs

Action - Either drop the flows before the winter run spawn and then hold them steady until the fall-run eggs emerge or continue to hold them high until the fall-run fry emerge.

Results - Holding the Keswick flows steady until the fall-run fry have emerged will improve the juvenile fall-run survival entering the Delta by 2.2 million fish.

Problem # 4 - Lack of Feather River Spawning and Rearing Habitat

Problem - The fifteen miles below the Feather River Thermalito outlet are currently unusable for the fall and spring-run spawners because the water is too hot for spawning and rearing.

Solution - Implement the FERC Oroville Dam Re-licensing Settlement agreement which calls for modifications which will provide cold water from Oroville Dam to the 15 mile zone.

Action - Continue working with DWR and other stakeholders to select a final preferred alternative water bypass to replace the hot water from the Thermalito Outlet and help to obtain permits.

Results - Completing this project will result in an additional 9.9 million additional spring-run and fall-run juveniles entering the Delta. That would be a major accomplishment for the two runs.



The Thermalito Outlet currently allows hot water from the upper reservoir to flow into the Feather mainstem below. This outlet would be blocked as part of the project.

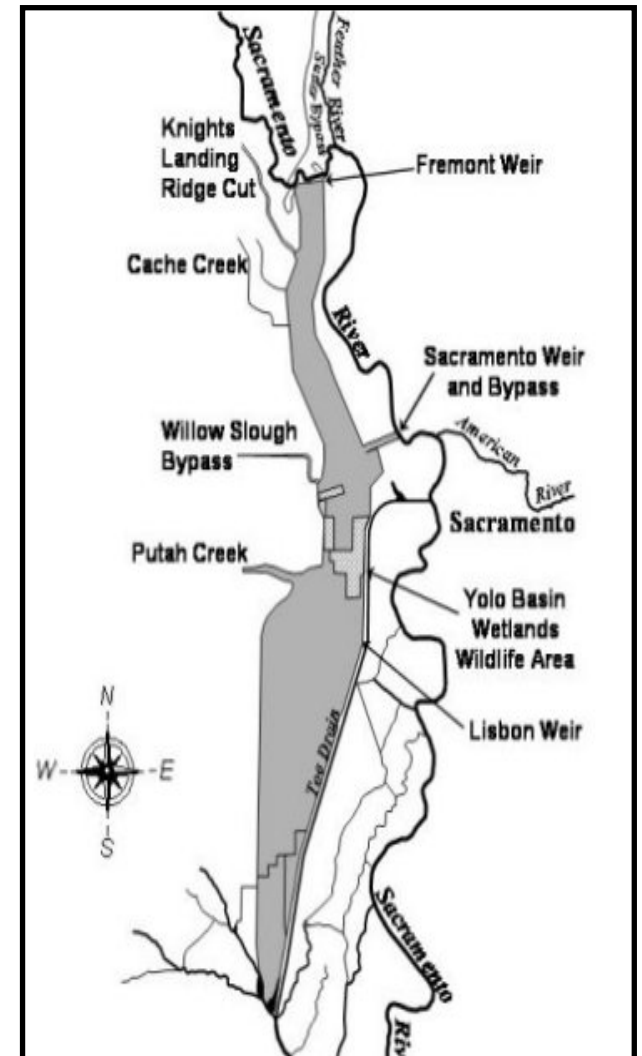
Wild Runs Problem #5 - Delayed Fremont Weir

Problem -The Fremont Weir in the Yolo Bypass is being notched so that more water and juvenile salmon can pass through the bypass, get the growth benefit and then exit at Chipps Island in the Delta. The juveniles that pass through the Bypass will avoid the high direct and indirect losses that currently take place in the Delta. It is taking a long time to get these things done.

Solution - There are many parts of this complex project including permits, landowner approvals and construction. Fast tracking the juvenile outmigration part of the project will yield significant salmon benefits at early dates.

Action - Push parties to complete landowner flood easement agreements and construct the big notch and start operating it.

Results - This project is one of the leading opportunities to improve the survival of all four of the Central Valley salmon runs. Assuming 20% of the Sacramento River outmigrants will pass through the Bypass, the juvenile fall-run population at Chipps Island will increase by 2 million fish.



Wild Runs Problem #6 - Loss of Fall-Run in Battle Creek

Problem - In some return years, up to 80,000 adult fall-run fish enter Battle Creek and the Coleman hatchery. Generally returns over 40,000 are destroyed as surplus to the hatchery's and creek's brood stock needs. In the last twenty years 50% of all the fall-run returns above Red Bluff now enter Battle Creek instead of moving further upstream.

Solution - Consider allowing fall-run fish in excess of 40,000 to spawn upstream of the Coleman hatchery but below areas reserved for listed spring and winter-run. We could roughly double the amount of available spawning habitat in upper Battle Creek simply by removing the rock barriers above and below the Eagle Canyon Dam and operating the fish ladder and diversion screen at the dam. A segregation weir installed on Battle Creek somewhere above the hatchery could be operated like Clear Creek is today. In years when fall run are allowed upstream, the weir would be closed in September to protect spring and winter run spawners further upstream, thus preserving a significant stretch of Battle Creek for the listed fish.



Superimposition at the Coleman Barrier

Action - First, work at the federal level to get already appropriated funds released needed to remove the rock barriers. Second, resolve with PG&E and other stakeholders the issue of operating the diversion screen and fish ladder at Eagle Canyon. Third, adopt a design and operation plan for a seasonal removable segregation weir upstream of the hatchery to allow additional fall-run spawning and rearing.

Results - This project would be a major contributor to the rebuilding of the upriver fall and late fall runs. For example, 15 miles of prime new fall-run spawning area would add an estimated 3.4 million fry to the upriver production.

Wild Fish Problem #7 - Indirect Delta Losses

Problem - Currently up to 80% of the Sacramento River juvenile salmon entering the South Delta through the cross channel gates and Georgiana Slough do not survive. Disorientation, high temperatures, lack of suitable habitat and predation all take a heavy toll. This is a major salmon problem in the Central Valley system and on average destroys about 10 million juveniles annually.

Solution - Once the fish are in the South Delta, there are few if any survival options. To solve this problem, steps must be taken to keep the juvenile salmon in the Sacramento River. Alternates include:

- Barriers to force more juveniles into Sutter and Steamboat sloughs.
- A fish screen a few miles upstream of the gates and a diversion canal moving the screened water into the existing canal below the cross channel gates. Then block Georgiana slough and close the cross channel gates when the juveniles are migrating.



Cross Channel Gates

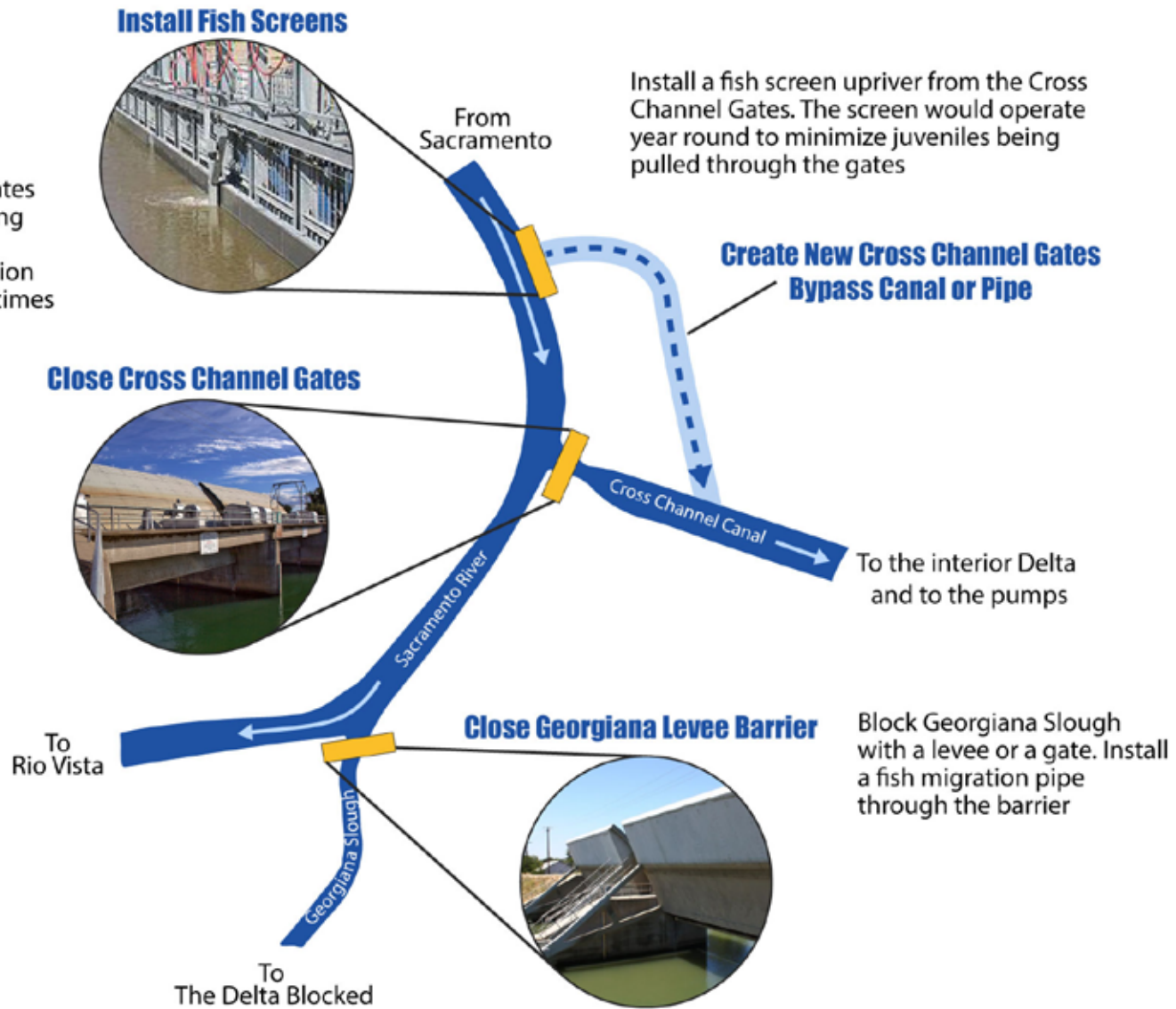
Action - Undertake an evaluation of the location and design of a fish screen and a bypass canal. Any solution will have to preserve or enhance existing Delta Outflows.

Results - This is a major undertaking but it fixes the severe loss problem that has existed ever since the Central Valley Project was designed. The fish must be separated from the water diversions. Screening is the only practical way to do this. Reducing the loss to 50% would save 2.9 million juveniles. See the diagram on the next page.

Concept to Reduce Indirect Delta Salmon Losses

Currently up to 80% of the juvenile salmon pulled through the Delta Cross Channel and Georgiana Slough into the interior Delta from the Sacramento River do not survive

The Cross Channel Gates would be closed during the heavy winter and spring salmon migration periods and at other times as needed to protect salmon.



Wild Fish Problem #8 - Losses at Clifton Court Forebay

Problem - Clifton Court Forebay is a 2,000 acre lake that feeds Delta water to the State Water Project Banks pumping plant. It has long been known as a major loss location for juvenile salmon from the San Joaquin and Sacramento Rivers. In 2013, DWR completed a study of salmon predation losses in Clifton Court. The conclusion was that 83% of the juveniles were lost to predation before they got to the louvers at the pumps. This amounts to an estimated 2 million lost juveniles annually including ESA listed endangered species. DWR has made several attempts to remove predators but none have been successful.

Solution - One option: Drain the lake and remove most of the weeds and other predator habitat. Fill the shallow areas and convert the main channel to a faster moving canal without predator resident areas. Fill the scour holes near the radial gates to remove resident predators.

Action - Undertake an evaluation or a science study to refine the strategy to remove the predator habitat.

Results - Reducing the loss to 50% would save 717,000 juveniles.



Clifton Court Forebay

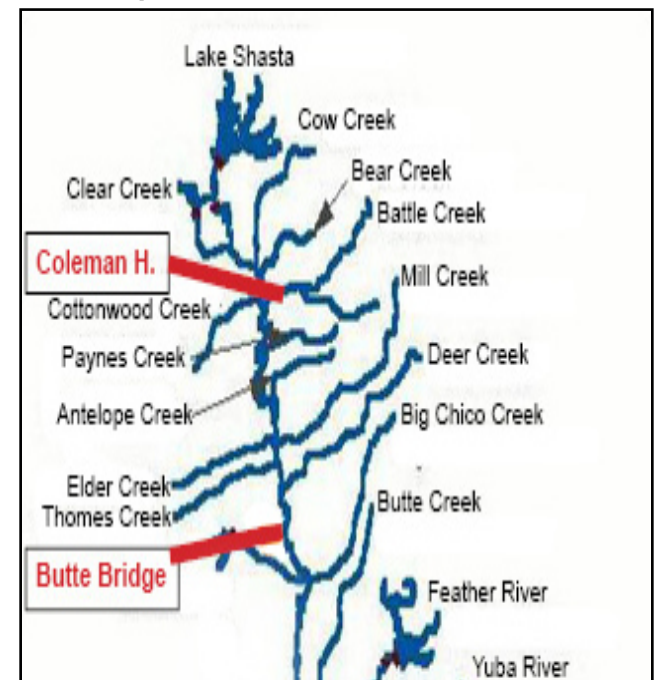
Hatchery Fish Problem #1- High Loss of Upriver Coleman Fish

Problem - The Coleman Hatchery releases approximately 12 million fall-run smolts annually from the hatchery on Battle Creek near Redding. The NMFS Santa Cruz Science Center studies indicate that in low flow years, up to 70% of these fish are lost to predation in the first 80 to 100 miles of the Sacramento River. This amounts up to 6 or 7 million lost smolts and seriously damages the overall survival of the Coleman hatchery fish in the low flow years.

Solution - The US Fish and Wildlife Service, the Golden State Salmon Association, the Bureau of Reclamation and the Northern Calif. Guides Assn. are testing a system of trucking Coleman smolts around the predation zone to Scotty's Landing, near the Butte Bridge on the Sacramento River. They will be acclimated in net pens at that location. The test will run for three years.

Action - Continue the tests and measure the results with acoustic tags and coded wire tags. If successful, expand the numbers acclimated and put the system into regular use at least in low water years.

Results - If the program is successful and expanded to 2 or 3 million Coleman smolts, it would add up to 5 million additional juveniles into the Delta in low flow years.



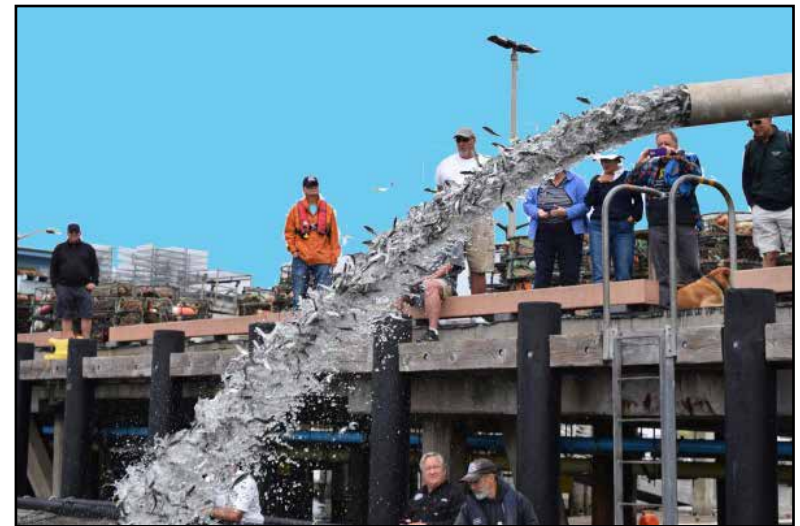
Hatchery Fish Problem #2 - Increase Acclimation at Half Moon Bay

Problem - The salmon industry and its customers are very dependent on the state and federal salmon hatcheries in the Central Valley. Originally, the hatcheries released all their juveniles at the hatchery locations. Unfortunately, as water demands grew, the river and Delta hatchery losses increased. Some of the runs became unsustainable. To offset these, in the 1990's some of the hatcheries began trucking the smolts around the losses to sites in San Pablo Bay and today more of the smolts are being trucked directly to the ocean salt water. That has taken the hatchery survivals from frequently less than 1% up to 3% and in some cases even 4% which produces strong sustainable results. The Coastside Fishing Club at Half Moon Bay has been a leader in developing this technology.

Solution - Continue testing and developing this direct saltwater technology.

Action - Work with willing partners to increase the number of acclimated smolts at the Half Moon Bay saltwater net pens gradually from the present 750,000 annually to 2 million.

Results - Making this transition will increase the survival of ocean adults by 27,000 fish.



Smolts move from trucks to net pens

Hatchery Fish Problem #3 - Increase Releases at Fort Baker

Problem Situation - Fort Baker is another saltwater ocean release site next to the Golden Gate Bridge. In this case, the smolts are released directly into the water without net pens. The releases are made in the evening after the bird predators have quit for the day. When possible, they are also released on outgoing tides. The survivals here are also reaching 3% to 4%.

Solution - Continue testing and developing this direct saltwater technology.

Action - Gradually increase the numbers released to 2 million.

Results - Making this transition will increase the surviving ocean adults by 22,000 fish.



Hatchery Fish Problem #4 - Low Populations in Monterey Bay

Problem - Juvenile fish are now being released in Monterey Bay at Santa Cruz and at Monterey directly into the ocean after nightfall to eliminate bird predation. In the near future each site will acclimate 240,000 smolts annually.

Solution - Continue testing and developing this direct saltwater technology.

Action - Gradually increase the numbers of fish acclimated.

Results - Finishing this project will improve the adult ocean survival by 10,400 fish.

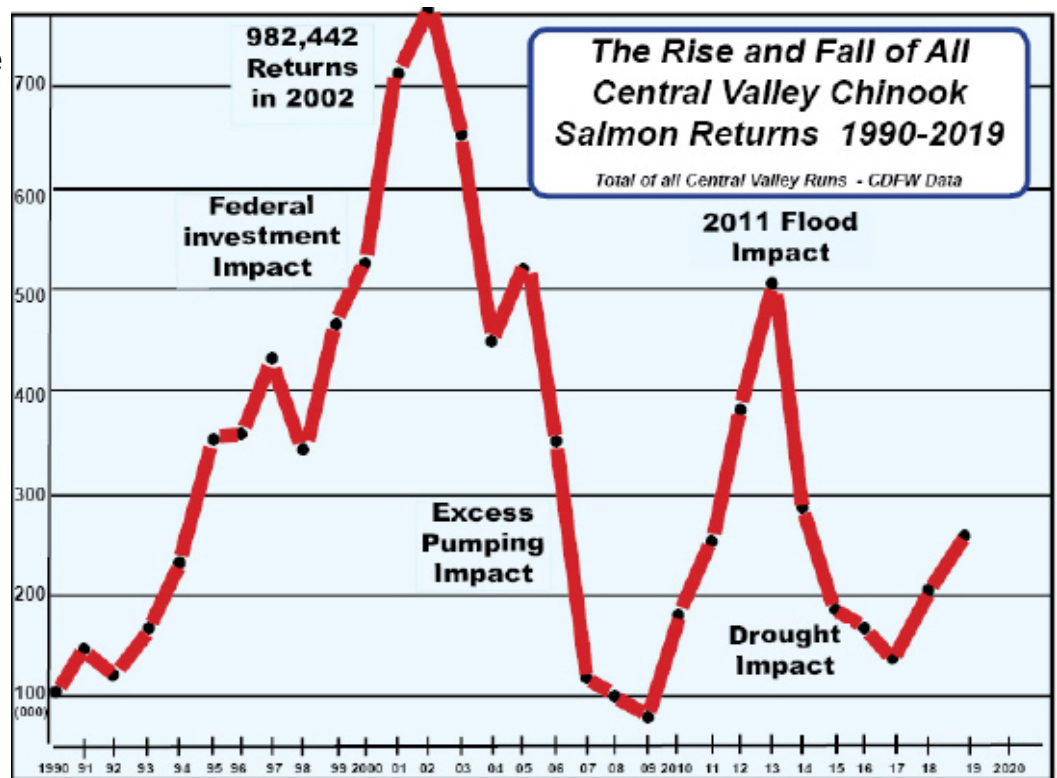


Salmon Status Total Central Valley

In the late 1980's, there was a severe drought. That, and other factors, caused a major crash in all four of the Central Valley salmon runs. By 1990, the population of the winter-run had dropped to only 191 spawners due to losses at the Red Bluff Diversion Dam. It was listed under the Endangered Species Act as Threatened in 1989 and Endangered in 1994. The Federal Government then spent \$1 billion fixing the problems in the Sacramento River and by 2002, a modern record of 944,673 salmon returned to spawn in the Sacramento River. The total Central Valley returns that year were 982,442. In a 2004 federal political action, most of the pumping restrictions were eliminated or weakened and the water delivery operations virtually ignored the needs of the salmon. The runs crashed. By the years of 2008 and 2009, all salmon fishing was shut down to avoid an ESA listing. In 2009, the pumping restrictions were restored which helped improve the returns in 2012 and 2013. A few years later, the recent drought hit.

In 2019, the Trump Administration repeated the 2004 policy change and virtually all the salmon protections were again eliminated. Extinctions could result. GSSA and others have filed a lawsuit in an attempt to overturn that policy.

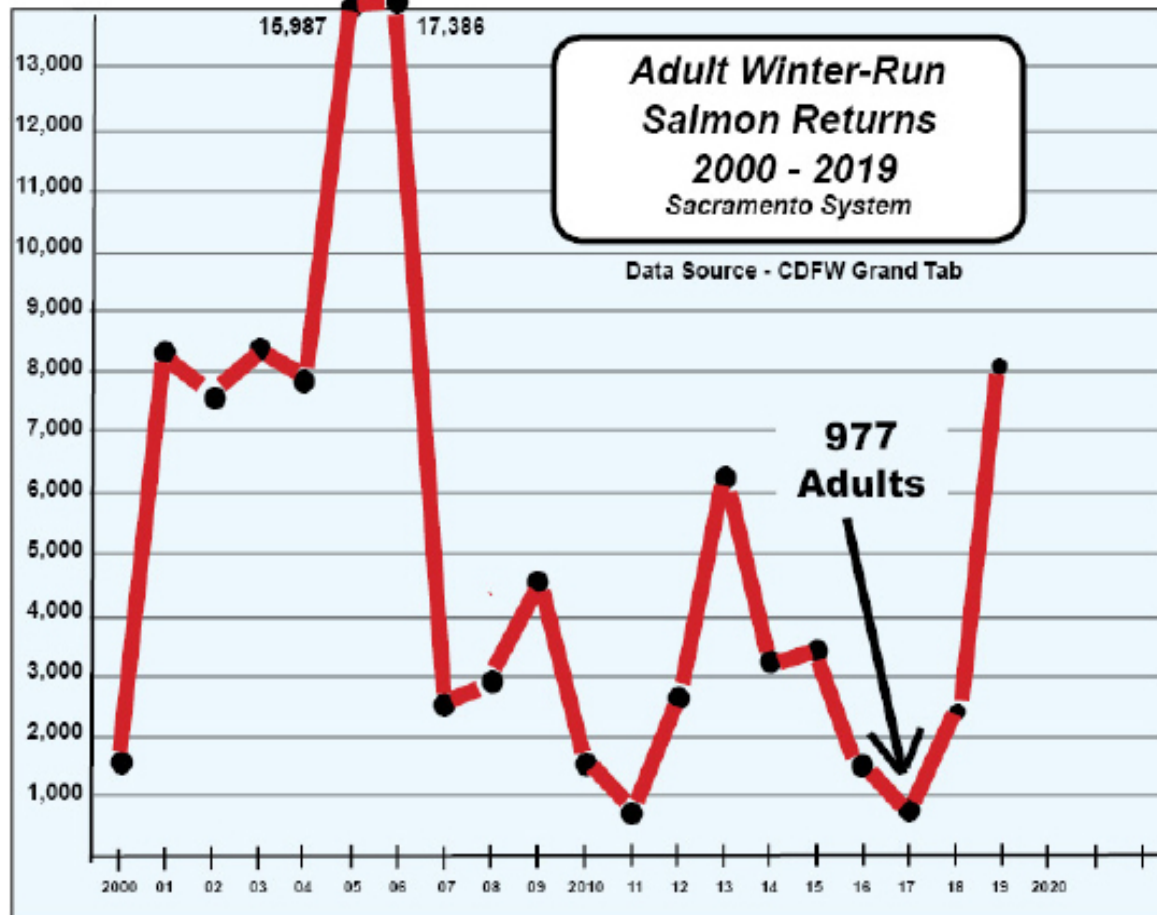
Currently, the only times the salmon populations begin to recover are in flood years. The floods in the spring of 2011, swept the migrating juvenile salmon past all the predation in the Sacramento river and past the Delta pumps and into the ocean. This yielded over 400,000 fish two years later in 2013. Unfortunately, the runs then dropped again in 2017 to a near all time low.



Salmon Status Winter-Run

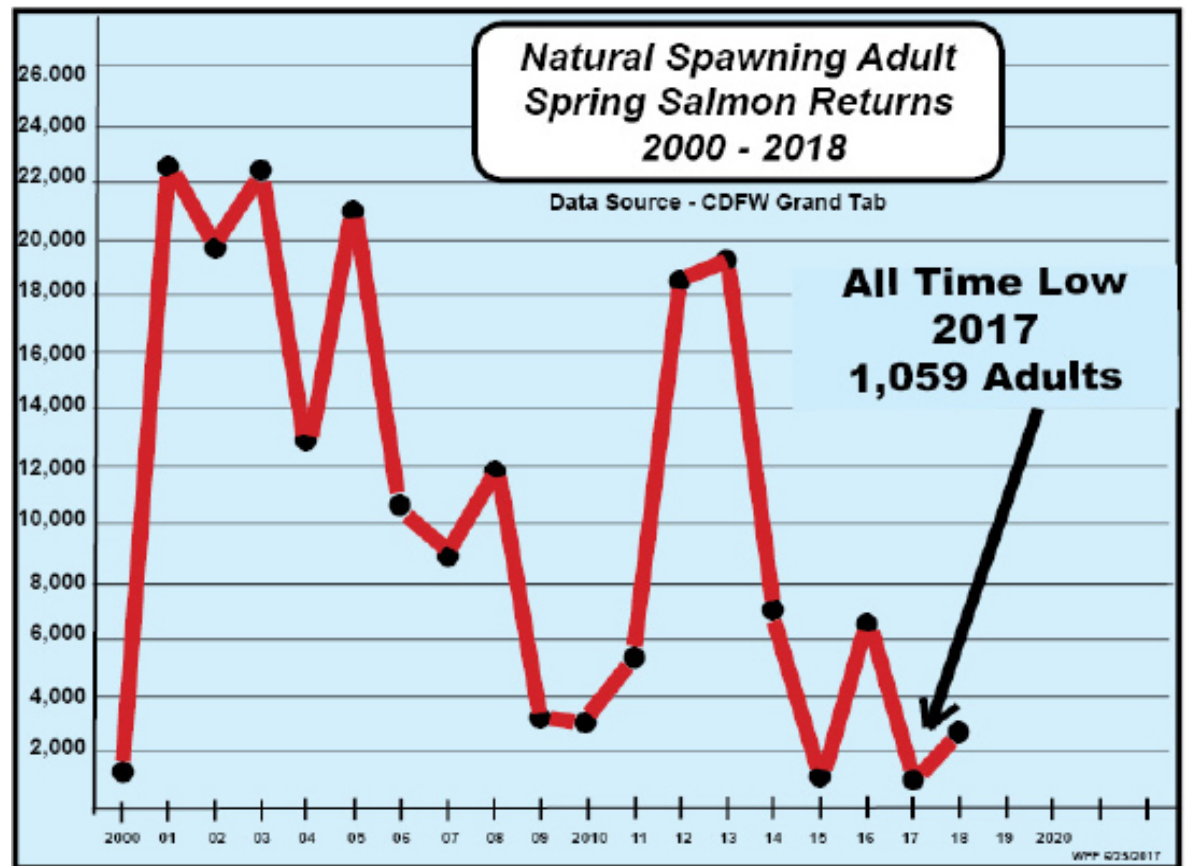
In 1990, only 191 adult winter-run spawners returned to the Upper Sacramento River. The run was listed as threatened under the Endangered Species Act in 1989. It was elevated to Endangered in 1994. The Federal Government then spent \$1 billion fixing problems in the Sacramento River. This run and all the other runs responded and in 2006 this population reached 17,386 returns. Since then, it has

been mostly downhill. The run is now struggling and in 2017 hit a low of only 977 returns. A conservation hatchery (Livingston Stone) was constructed in the upper Sacramento River to protect the gene pool. Winter-run have also been reintroduced in the upper Battle Creek watershed.



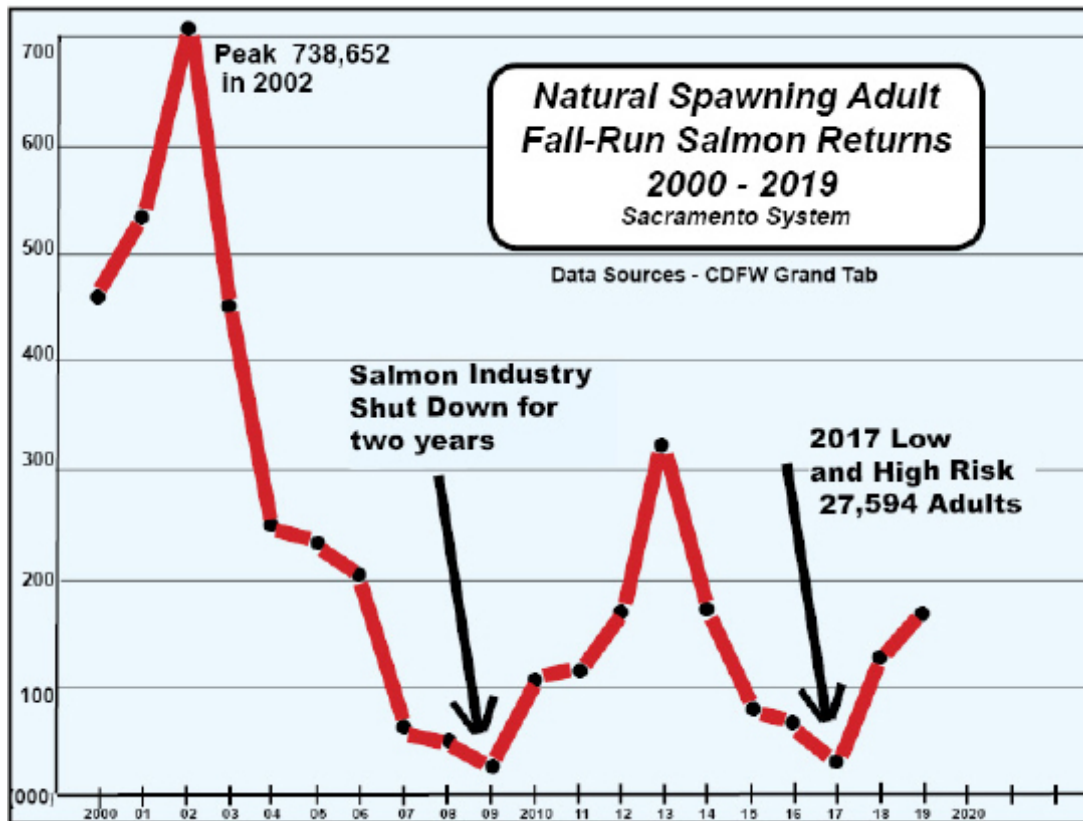
Salmon Status Spring-Run

The natural spawning spring-run mature adults migrate from the ocean in the springtime. They migrate to cold water tributaries of the Sacramento River where they can survive the summer heat. They then spawn in the fall. In high runoff water years, they do well, but in low flow years, survival is low. The chart is a good example of the importance of high river flows. The floods of 2011 resulted in a recent record return of the species in 2013. Then, because of the drought, the run hit a record low in 2017 of only 1,059 fish. This fish was listed as threatened in 1999 under the Endangered Species Act. Recovery has been difficult. Increased outmigration flows in some of the high elevation tributaries appears to be the key to improved survival. These fish are also now allowed to pass the barrier at the Coleman hatchery and spawn in upper Battle Creek.



Salmon Status Fall-Run

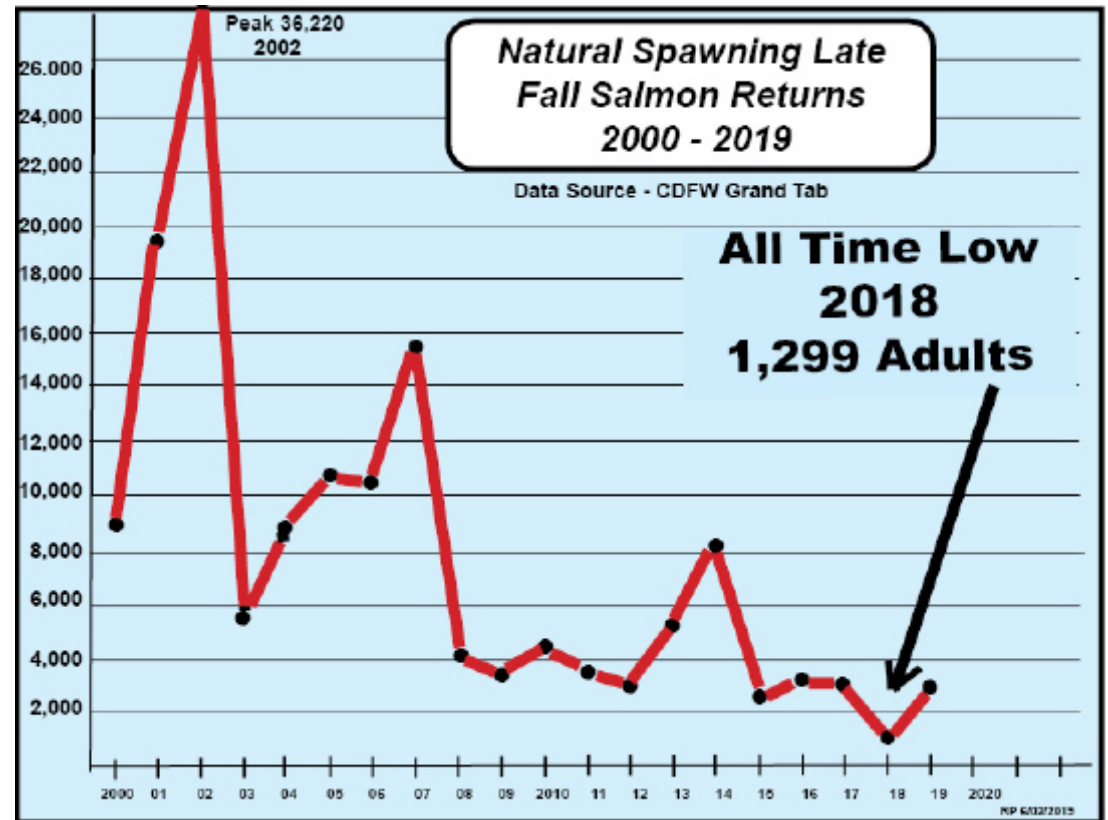
In recent decades, the fall-run has been the most abundant species and it is the run that commercial and sport fishermen traditionally harvested. But, in the seven years between 2002 and 2009, the run dropped 60% from a high of 835,000 Sacramento natural spawning and hatchery fish in 2002 to a low of 50,000 in 2009. The natural spawning (wild) portion of the run dropped from 739,000 to 29,000 fish. In 2008 and 2009, all salmon fishing was stopped completely because of low fall-run abundance. The only time this run now improves is when flood years like 2011 or 2017 push the juveniles past the river and Delta losses.



The salmon fishing industry and salmon production is in serious trouble. In recent years, two thirds of the commercial fleet has been lost along with thousands of jobs. The economic impacts have been similar for the charter fleet, recreational fishermen, hundreds of fishing businesses and the California coastal communities. The fall-run has been mostly ignored by the agencies in favor of the ESA listed species. The Golden State Salmon Association has a rebuilding plan but it needs funding and implementation.

Salmon Status Late-Fall Run

The late-fall Central Valley Chinook salmon are the largest of the four Central Valley runs often reaching 35 to 40 lbs in size. They are prized by fishermen. Its population has steadily dropped and it is now approaching an extinction risk. In eight of the last ten-year classes, it has been below 4,000 natural spawners and in 2018, the population hit an all time low of only 1,299 fish. The only time that its survival increases are following flood years. This fish desperately needs recovery actions to avoid irreversible declines but it has been mostly ignored by the fish and water agencies. The Golden State Salmon Association has some rebuilding proposals for it including improved river flows and the development of additional spawning areas in Battle Creek. Absent aggressive government actions, there is a high risk that this run will continue to decline until it is totally lost.



About the GSSA Salmon Survival Model

The GSSA Salmon Survival model is used to evaluate the contribution of flow and habitat projects targeted to improve the Sacramento River survivals of the downstream migrating juveniles. It is a structured decision model with abundance as its primary objective. It was originally developed in 2015 relying heavily on data developed by the Santa Cruz Science Center. Each year the Science Center releases acoustic tagged juvenile salmon in the upper Sacramento River and then tracks the survival in 17 reaches to the Golden Gate. The survival model contains this Science Center data summarized into seven reaches. Since most of the juvenile salmon are lost in low flow years, the initial model was based on the low water years of 2007, 2008 and 2009. Modifications to evaluate higher flows were built in later. The 7 reaches are:

1. Sacramento River above Jelly's Ferry,
2. Jelly's Ferry to the Butte City Bridge,
3. Butte Bridge to Freeport (entry to the Delta),
4. The Delta to Chipps Island,
5. Chipps Island to San Pablo Bay,
6. San Pablo Bay to the Golden Gate and
7. The Golden Gate to mature ocean adults

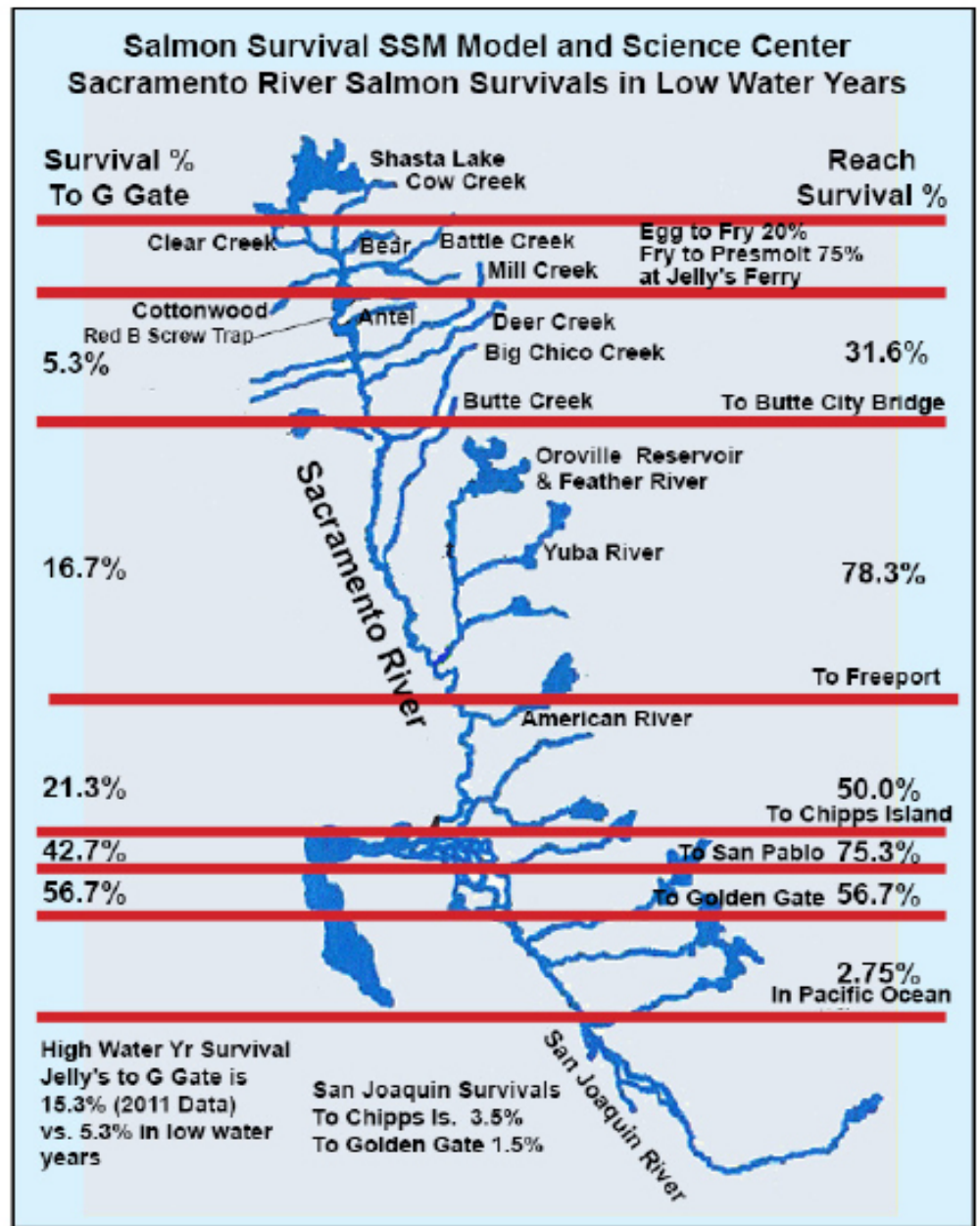
The model starts with a Base Case based on the 15 year average of adult returns, hatchery releases etc. from 2004 to 2017. The model uses that data to calculate the base population at each reach and an ocean abundance of 473,782 mature adults. Improvements can then be measured from that base.

A project under consideration is first estimated as to the new salmon juveniles it will create or the number of the existing fish it will save. That data is then put into the model and the downstream results can be seen at each reach and finally as mature adults in the ocean. SDM judgments can then be made as to the best projects. The results from this model closely parallel the results from the SIT DSM model.

Each of the twelve GSSA projects was run through the model and the survival gains are expressed in different ways and at different reaches. The total number of fry generated in the Base Case was 62,175,989. These generated 473,782 base case mature adults in the ocean. That is a survival of 0.76% which is very low and unsustainable. The cumulative twelve projects generated 1,051,034 adults in the ocean which is 1.69% survival. That represents a reasonable and sustainable population.

Current Survivals

The Santa Cruz Science Center has been studying the survival of salmon in the Sacramento River since 2007. They release batches of acoustic tagged Coleman smolts at Jelly's Ferry in the upper river and then track them in 17 reaches to the Golden Gate. The map on the right shows a summary of the results in the reaches for 2007, 2008 and 2009. Those years were low water years and survivals were low. The figures down the right side show the survival in each reach. The figures on the left show the survival for each reach to the Golden Gate. For example the survival from the upper river reach shows as 5.3%. That means that if 1,000 fall-run juveniles were released in the upper river that only 53 of them would reach the Golden Gate. The average survival in the ocean is then 2.75% which would result in only a little over 1 survivor (1.45 fish). Bottom line, the current low water survivals in the Sacramento River are extremely low and do not produce sustainable runs. The San Joaquin survival is near zero. This makes recovery there very difficult.





Contact

Email: info@goldenstatesalmon.org

Phone: 855-251-4472

Web: goldenstatesalmon.org