AMERICAN FISHERIES SOCIETY
California-Nevada Chapter

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Policy Statement Supporting Total (100%) Marking of All California Hatchery Produced Fall Run Chinook Salmon

Policy

In order to enhance opportunity for improved salmon management, and minimize genetic and ecological impacts of hatchery programs, the Cal-Neva Chapter of the American Fisheries Society proposes and supports 100% marking (by adipose fin clip) all fall run Chinook salmon produced at Central Valley (CV) and Klamath anadromous fish hatcheries.

Issue:

California's Chinook salmon populations are in serious peril. Many runs are listed under State and Federal Endangered Species Acts (ESAs). Fall run Chinook have been a candidate for ESA listing since 1998, but since 2007 even fall run, formally our most abundant and stable run, have declined to record lows. Coupled with recent findings that up to 90% of adult Central Valley salmon originate from hatcheries (CalTrout 2008), an elevated ESA listing status (Threatened) for fall run Chinook may be imminent.

Furthermore, monitoring and managing California salmon is confounded by the presence of unknown numbers of captive-reared fish originating from seven hatcheries. Accumulating data indicate that hatchery-origin fish have lower fitness in natural environments than their wild counterparts (see Araki et al. 2008 for review) and that hatchery origin fish compete with natural origin fish for spawning habitat (Hatchery Scientific Review Group 2008). Improved management and recovery of California salmon requires that scientists and fisherman be able to easily distinguish hatchery-origin fish from natural origin fish as they are encountered in juvenile monitoring programs, ocean fisheries, inland fisheries, and in adult salmon sampling programs.

Analysis:

Total Marking (TM) hatchery Chinook salmon makes it possible to visually distinguish hatchery origin and natural origin fish. Adipose fin clipping currently provides the only practical means for marking all hatchery origin Chinook salmon. Reliable and immediate visual identification of hatchery fish provides numerous management benefits. For example, TM:

- Allows biologists to manage hatchery broodstock and natural spawning escapement such that the natural environment (rather than the hatchery) drives adaptation and fitness.
    - Hatcheries could improve genetic fitness of hatchery broodstock by including known natural origin fish
    - Broodstock segregation weirs could be operated on some rivers to limit hatchery origin fish spawning naturally
    - Better genetic diversity and fitness among natural origin Chinook stocks will improve resilience to changing environments such as poor ocean conditions observed in 2005
- Provides the option for managers to allow selective harvest of hatchery origin Chinook, just as currently occurs with CV steelhead.
    - Benefits natural origin salmon populations (including ESA stocks) by reducing harvest losses
    - Benefits natural origin salmon by reducing competition, and reducing threat of genetic introgression from hatchery origin salmon.
- Probability of detecting and quantifying hatchery strays to spawning grounds in sensitive rivers will be greatly increased.
- Fisheries managers benefit from instant, and more precise estimates of natural and hatchery origin salmon abundance, and greatly simplified monitoring of natural origin and endangered stocks.
- Hatcheries may continue to produce fish, satisfying mitigation requirements while also maintaining ESA compliance.
- Scale, otolith, and genetics sampling programs will benefit from sampling which can specifically target either hatchery or natural origin Chinook.
- Managers' efforts to determine the effectiveness of restoration, river management, and recovery programs for natural origin fish would be greatly simplified.
- Fisheries may benefit more consistent fishing opportunities (less restrictions and closures) and higher allowable harvest in many years.

The benefits of total marking as described above are well documented, well understood and largely undisputed (for details see www.hatcheryreform.org). Concerns about TM revolve around two interrelated issues: 1) program cost, and 2) changes necessary to existing sampling and harvest programs.

PROGRAM COSTS

Costs for implementing TM for Central Valley and Klamath hatcheries will be several million dollars annually. Though TM will be expensive, compared to alternatives of closed fisheries, economic disaster relief, lost hatchery effectiveness, damage to wild and ESA salmon stocks, less effective habitat restoration, and impaired water deliveries the program is expected to be very cost effective. Given apparent benefits and cost

effectiveness, ample financial resources will be available to implement this program and refine elements of sampling and harvest management. However, if the program is evaluated and found to be cost-ineffective the Cal-Neva Chapter AFS would certainly withdraw this policy statement.

SAMPLING AND HARVEST MANAGEMENT

The Pacific Fisheries Management Council (PFMC), in coordination with the California Department of Fish and Game (DFG) is responsible for ocean salmon harvest monitoring and management. The existing sampling program calls for 20% of all harvested Chinook salmon to be checked for presence of adipose fin clips and tags. Currently, 25% of California origin hatchery Chinook salmon are marked and tagged (none are marked without also being tagged). In Washington and Oregon, tagging and marking rates are more variable and many hatchery origin salmon are marked without also being tagged. As a result, electronic detection equipment is necessary to distinguish fish that are marked but not tagged. Total marking absent total tagging complicates and adds cost to sampling programs. However, these problems can be overcome with proper equipment and sampling design, as is currently done in Oregon and Washington fisheries. Total marking and tagging alleviates problems identified above, but creates new problems by introducing a very large number of tagged fish into sampling programs. If sampling continues at 20%, costs for recovery and processing of additional tagged fish will be much larger. If sampling rates are decreased, recovery probability for rare tags will decrease and related harvest data will be less reliable. These sampling issues are not trivial, but can certainly be resolved by thoughtful and innovative study and planning.

As described earlier, TM provides many benefits for improved management of hatcheries and habitat, and minimizes adverse impacts to ESA species. However, TM also creates the opportunity for managing fisheries to reduce harvest on ESA stocks or natural origin stocks, and even to preferentially harvest hatchery origin fish. Though DFG currently employs a "mark-selective" harvest policy for Central Valley steelhead, they have opposed similar harvest regulations for Chinook salmon. Whether or not to implement a Chinook salmon "mark-selective" fishery is a decision that ultimately rests with DFG and the PFMC. However, future harvest regulation policy should not deter or hinder plans to implement the TM program for benefits provided to inland fishery management and recovery of listed salmon.

IMPLEMENTATION CONSIDERATIONS

CFM vs TM

The current DFG policy of marking and tagging 25% of hatchery Chinook salmon (Constant Fractional Marking or CFM), is not a viable alternative or substitute for TM. CFM will certainly yield improved (though still problematic) data, but unlike TM, the CFM program does not provide the means for implementing any of beneficial management actions necessary to benefit fisheries and protect endangered stocks.

As indicated above, the CFM program represents a substantial improvement over previous decades during which no systematic tagging program operated in CV hatcheries. However, it appears that the current CFM program may provide inadequate data about

spawning escapement composition in many CV rivers. A series of simulation studies were conducted by Dave Hankin, Ken Newman and Alan Hicks (funding provided by DFG via CALFED grant) to evaluate CFM rates necessary for accurate estimates of essential salmon management population parameters. In their analysis, Newman, Hicks and Hankin (2004) recommend "a constant fractional marking rate for production releases from *all* hatcheries of **at least** 1/3 or 33%" (bold emphasis added). Significantly, the authors further indicate that "relatively good estimates" for natural production in individual streams may require a CFM higher than 1/3. This is so because "the proportion of hatchery fish influences the (predicted) effect of CFM rate", and thus, in streams with potentially high proportions of hatchery fish "CFM rates should be as high as possible". Given the conclusions of the CFM simulation analyses, and increasing evidence for predominance of hatchery fish in Central Valley streams (e.g. Barnett-Johnson et al. 2007), the current CFM program may not provide adequate data for systems like the Feather, American, Sacramento, Battle Creek, and Mokelumne Rivers which likely have very high proportions of hatchery origin fish (>80%).

TM Applications

Though specific actions plans for taking advantage of total marking are still in development, below are specific examples provided by expert biologists for how management of natural and hatchery-origin stocks could be significantly improved with TM.

Feather River

- Feather River Hatchery (FRH) produces 10 million spring and fall run Chinook smolts annually. FRH Hatchery Genetics and Management Plans specify that all hatchery fish be marked such that natural origin Chinook can be incorporated into FRH broodstock. TM at FRH will allow the following management actions.
    - Though current natural-origin composition is unknown, as an interim goal FRH will seek to include up to 50% natural origin Chinook in hatchery broodstock.
    - Through use of a segregation weir, Feather River spring run Chinook will be managed to keep hatchery-origin in-river spawners to less than 50% of total in-river spawners.
    - Provide more reliable estimates of FRH origin fish straying to other basins. Seek to keep total spring run Chinook straying at or below 5% of annual Feather River spawning escapement.

  Information provided by Jason Kindopp, CDWR

Mokelumne River

- The production goals for the Mokelumne River Hatchery (MRH) include production of 5.4 million Chinook smolts and post smolts annually as part of mitigation requirements, and for enhancement of the ocean fishery. The MRH fall-run Chinook HGMP is still in development but will likely recommend that all hatchery fish be marked such that natural origin Chinook can be distinguished from hatchery origin Chinook. TM at MRH would allow many beneficial management actions, including the following examples.

- Use a seasonal segregation weir in the Mokelumne River to allow natural origin fish exclusive access to high quality spawning habitat, reducing risk of competition and genetic introgression from hatchery origin fish.
- Provide more reliable estimates of MRH origin fish straying to other
- basins.
- As numbers of natural origin Chinook increase, natural origin fish can be specifically included with hatchery broodstock to improve fitness of MRH produced Chinook.

Information provided by Michelle Workman, EBMUD

Battle Creek/Coleman National Fish Hatchery

- Coleman National Fish Hatchery (Coleman NFH) is located on Battle Creek, a tributary to the upper Sacramento River. Management of anadromous fishes at the Coleman NFH is closely tied to fishery management goals for Battle Creek, which is the focus of a large scale habitat restoration project. Coleman NFH produces 12 million fall Chinook, 1 million late-fall Chinook, and 0.6 million steelhead annually. An additional 0.25 million winter Chinook are produced annually at the Livingston Stone National Fish Hatchery, a substation of the Coleman NFH located at Shasta Dam. Implementation of a TM program at the Coleman NFH would affect only fall Chinook, since all Late-fall Chinook, winter Chinook, and steelhead are currently marked. Management actions that would be implemented at the Coleman NFH and Battle Creek in concert with a TM program for fall Chinook are uncertain at this time, but may include the following:
  - Integration of a known proportion of natural-origin fish as broodstock
  - Management of naturally spawning fish in lower Battle Creek to restrict or control the number of hatchery-origin fish spawning naturally
  - Restricting or controlling the migration of hatchery-origin Chinook released upstream of the Coleman NFH to spawn naturally in that portion of the stream being restored through the Battle Creek Restoration Project
  - Improved ability to monitor and evaluate effects and impacts of hatchery-origin fish on naturally reproducing stocks Additional management options may be considered contingent upon a decision to implement a selective fishery. For example, if a selective harvest program were implemented for the ocean fishery it may be desirable to implement a blind tagging program (i.e. tag but not mark) hatchery-origin winter Chinook salmon produced at the Livingston Stone NFH; this would afford protection against harvest and, at the same time, allow for monitoring of the hatchery program using electronic detection at natural spawning areas.

Information provided by Kevin Niemala, USFWS

IMPLEMENTATION TIMEFRAME

Since TM appears capable of profoundly improving hatchery, habitat and harvest management, and facilitating recovery of ESA stocks, the program should be implemented as soon as possible. Even if total marking were implemented in 2010, Chinook salmon would not show up significantly in adult salmon sampling programs

until 2013 (at age-3). Interim tagging rates for 2010-2012 would need to be evaluated and determined by November 2009. Evaluation of final tagging rates and design of related sampling programs would be an important and necessary next step to be completed by July 2012, in time for field implementation by 2013. The following draft schedule illustrates how rapid TM implementation can be achieved while still allowing adequate time for developing plans for tagging and tag recovery programs.

Action or event:	Due Date:
Order additional AutoFish tagging trailers	March 2009
Study and determine interim tagging rate for TM	December 2009
Begin TM at Central Valley and Klamath hatcheries	March 2010
Study and determine final tagging and sampling program for TM	July 2012
Implement sampling program in time for age-3 TM Chinook	May 2013

Tagging and sampling evaluations necessary to implement TM should be fully funded by advocates of the TM program (State government, Federal government, and water users) and not by PFMC or DFG.

References

Araki, H., Barry A. Berejikian, Michael J. Ford and Michael S. Blouin. 2008. Synthesis: Fitness of hatchery-reared salmonids in the wild. Evolutionary Applications 1: 342-355.

Barnett-Johnson, R., Churchill B. Grimes, Chantell F. Royer, and Christopher J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. Canadian Journal of Fisheries and Aquatic Sciences. 64(12): 1683-1692

CalTrout. 2008. SOS: California's Native Fish Crisis- Status of and solutions for restoring our vital salmon, steelhead and trout populations. 98pp.

Hatchery Scientific Review Group. January 14, 2008. Letter to The Columbia River Hatchery Reform Steering Committee, "Preview of key findings for lower Columbia River Coho Hatchery Programs"

Newman KB, Hicks AC, Hankin DG. 2004. A marking, tagging, and recovery program for Central Valley hatchery chinook salmon. Unpublished report for California Department of Fish and Game and the CALFED Ecosystem Restoration Program.