Ocean Salmon Fishery Management

L.B. Boydstun

Abstract

California ocean salmon fisheries are managed by the Pacific Fishery Management Council (Council) under the federal Magnuson-Stevens Fishery Conservation and Management Act. This chapter describes the ocean fisheries impacting California Central Valley (CV) chinook stocks, the federal regulatory process that is followed in managing these ocean fisheries, and discusses alternative management measures for protecting valuable natural resources. The CV supports fall, late-fall, winter, and spring chinook runs. The Council has adopted a spawning escapement goal for the fall run, while a federal rebuilding plan is used to regulate the fisheries to protect the winter run, an endangered species. The winter run plan is also protective of CV spring run, a threatened species. Some potential alternative management strategies include (1) a revised escapement goal for the Sacramento fall run, (2) a separate escapement goal for the spring run, (3) an escapement goal for the San Joaquin fall run, and (4) a selective ocean fishery for marked hatchery fish. The CV salmon management program is lacking in two areas: (1) river return estimates for coded-wire-tagged fish releases and (2) inconsistent tagging of hatchery fish releases, precluding estimation of hatchery fish contributions. I conclude that a comprehensive fishery management program should be implemented for CV chinook salmon under the Central Valley Project Improvement Act and that the Klamath Fishery Management Council be used as a model for developing such a program.

Introduction

Central Valley (CV) chinook salmon (*Oncorhynchus tshawytscha*) are primarily harvested in ocean fisheries off California between Point Sur and Point Arena, but are taken in significant numbers as far north as Cape Falcon in northern Oregon (Figure 1). Ocean fishing for salmon (*Oncorhynchus* spp.) off the Washington, Oregon, and California coasts is managed by the Pacific Fishery Management Council (Council) under the Magnuson-Steven Fishery Conservation and Management Act (Magnuson-Steven Act). Increasing concern for the protection of CV chinook stocks has led fishery and inland habitat managers to question the efficacy of current management strategies for ocean and

river fisheries. This report describes (1) the ocean fisheries impacting CV chinook; (2) the process followed by the Council for managing CV chinook stocks; (3) alternative or complementary management measures aimed at providing additional protection for these valuable natural resources; and (4) recommendations for developing and implementing a comprehensive program for addressing fishery management concerns for CV chinook.

River fishery management, which comes under regulation of the Fish and Game Commission (Commission), is not discussed in this report. A Council "overfishing" review report provides a summary of CV sport fishery catch data through 1993 (PFMC 1994).

Fishery Resource

The Central Valley supports four runs of chinook salmon: fall, late-fall, winter, and spring, so named because of the time of year adults enter fresh water to spawn, which occurs within a few weeks or several months following river entry, depending on stock. CV chinook mature at ages 2 to 4, with a few individuals at age 5, except for winter-run chinook which mature at ages 2 to 3. Age 2 fish of all runs are primarily males (jacks).

The fall run is the more abundant and ubiquitous of the four runs, occurring in all suitable spawning areas. The other runs occur in the main stem or the various tributaries to the Sacramento River above the mouth of the American River. The winter run is listed as endangered under the State and federal Endangered Species Acts; the spring run as threatened under the two acts; and the fall and late-fall runs as candidates for listing under the federal act. All CV hatcheries (Coleman, Feather River, Nimbus, Mokelumne River, and Merced River) propagate fall chinook, while Feather River and Coleman also propagate spring and winter chinook, respectively. Hatchery production has a major effect on the number of fish available to ocean fisheries and that return to spawn each year to the hatcheries and natural spawning areas. Trucking of CV chinook salmon production from the State hatcheries for release below the Sacramento-San Joaquin Delta is done to bypass Delta water diversions. This practice increases hatchery fish survival but also increases straying of returning adults.

Figure 1 Map of coastal landmarks and Central Valley streams and hatchery locations

Ocean Fisheries

Salmon taken for commercial or recreational purposes may be taken only by hook and line (8210.1, Fish and Game Code and 27.80, Title 14, California Code of Regulations). Most salmon fishing is conducted by trolling a baited hook or lure behind a diesel or gasoline powered boat. In recent years, a baited hook fished from a drifting vessel (mooched) has become the most popular fishing method in the San Francisco Bay and Monterey Bay sport fisheries. Salmon are rarely harvested from shore although they are occasionally caught by sport fishing from the Princeton Pier, located just south of the Golden Gate.

Fishery Monitoring. The California Department of Fish and Game (DFG) aims to sample 20 percent of the salmon fishery landings to collect fishery management data by time, area, and fishery (and has done so since 1962). The heads from all ad-clipped salmon observed in the sampling are retained and the coded wire tag (CWT) contained in each head is extracted, decoded and the associated data are entered into the coastwide CWT data base maintained by the Pacific States Fisheries Commission. Fishery catch estimates are based on (1) State landings reports required from commercial and charterboat landings, and (2) random stratified sampling of the private boat fishery by the DFG. The actual sampling rates achieved in the respective fisheries (commercial, charterboat, and private boat) are used to develop the CWT expansion factors that produce estimates of CWT contributions, which are available by fishery, time, and area strata.

Commercial Fishery. The commercial fishery harvests about two-thirds of the chinook salmon taken off California. For example, commercial landings during 1995–1999 averaged 407,700 chinook compared to a sport catch of 200,000 fish (see PFMC 2000 for extensive data on California fisheries and spawning escapements).

Commercial fleet size (under limited entry) has dropped from nearly 6,000 vessels in 1982 to about 1,800 vessels in 1999. In 1999, 101 vessels landed 50 percent of the fish compared to 438 vessels in 1982 (PFMC 2000).

Commercial fishing in recent years has taken place primarily south of Point Arena because of conservation and allocation requirements for Klamath River fall chinook salmon. Commercial fisheries operate as far south as Point Conception but most landings occur in Monterey, Half Moon, and San Francisco bays. The commercial season takes place from May through September and the fishery has a 26-inch minimum size limit, although 27 inches has been used at times in recent years to protect winter chinook. Most chinook are landed from May through July.

Commercial fishing north of Point Arena has generally been limited to the month of September when Klamath chinook abundance is low.

Sport Fishery. The sport fishery has traditionally taken place between February and November and had a two fish per angler bag limit and 20-inch minimum size limit. In recent years, the season length has been reduced and higher size limits have been applied to fisheries south of Shelter Cove (Horse Mountain) to protect winter chinook. Beginning in 2000, the season opening south of Point Arena was delayed until April to protect CV spring chinook.

Chinook are taken in the sport fishery from Santa Barbara to the Oregon border, but most are landed in San Francisco and Monterey bays where most of the fishing effort originates. Charterboats take most of the fish south of Point Arena, while private boats or skiffs take most of the chinook harvested in the Fort Bragg, Eureka, and Crescent City areas. Coho fishing has been banned off California in recent years due to federal listing of Oregon and California coho stocks. This has led to salmon fishing closures north of Point Arena during most of July when coho are most abundant.

June, July, and August are the most important sport salmon fishing months off California. Since 1995, an average of 134 charterboats landed salmon in California. Annual salmon angler effort in those years (charterboat plus private) averaged 227,600 angler days. This effort produced a catch of 200,300 chinook for a catch per angler day of 0.88 chinook (PFMC 2000).

Ocean Fishery Management

The Council's Salmon Framework Plan (Plan) contains the management objectives that are followed in regulating the ocean fisheries. It specifies the area of jurisdiction, species, types of regulations, and procedures the Council must follow to make any changes. Amendment 14 to the Plan has been completed and is aimed at the meeting the requirements of the Magnuson-Steven Act as amended in 1997. It includes a recent escapement goal amendment for Oregon coho salmon and defines "Essential Fish Habitat" for salmon stocks that come under Council purview.

The Council has three advisory bodies that provide input on salmon amendment and regulatory issues. The Scientific and Statistical Committee (SSC) provides multi-disciplinary peer review of proposed fishery management actions. This includes review of stock assessments and assessment methodologies as well as review of biological, economic, and social impact analyses. The Salmon Technical Team (STT) provides the reports that summarize the previous fishing season, estimate ocean abundance for the coming season, and analyze the impacts of the Council's proposed and final management

recommendations and Plan amendments. The Salmon Advisory Subpanel (SAS) develops annual regulation options and comments on all salmon issues that come before the Council, including habitat issues (PFMC 1996).

Each year the Council recommends ocean fishing regulations aimed to meet Plan escapement goals and jeopardy opinions for federally listed species. California fisheries are managed, in part, to meet escapement, allocation, and rebuilding goals for Sacramento River fall chinook, Klamath River fall chinook, Oregon and California coastal natural spawning coho salmon, and Sacramento River spring and winter chinook. A description of CV chinook salmon goals and Council stock management procedures follows.

Biological and Allocation Goals

Sacramento River Fall Chinook. The escapement goals for this stock is to achieve a spawning escapement in all years of 122,000 to 180,000 adults. The goal is based on historical river escapement levels and includes both hatchery and naturally produced fish. It should be noted the goal was modified in 1984 to establish a goal range because of the effect of Red Bluff Diversion Dam on upriver returns (PFMC 1984).

A predictor model has been developed to project CV chinook adult abundance. The model uses an index of abundance for CV chinook salmon runs (Central Valley Index or CVI), which is the sum of ocean fishery landings south of Point Arena and the adult CV spawning escapement in the same year (Table 1). The ocean prediction is based on the relationship between the CVI and the previous year CV jack estimate (Figure 2). The CVI harvest rate represents the sum of ocean fishery catches divided by the CVI for the same year. Recent years' CVI harvest rates and the proportion of adult fall chinook returning to the Sacramento River are used to project the Sacramento River fall chinook Salmon escapement under the proposed or adopted ocean fishing regulations (PFMC 2000).

The Sacramento River escapement goal has been met in all years since 1970 not including 1972, 1983, and 1990–1992 when the escapement declined to between 85,300 and 121,000 fish (Figure 2, PFMC 2000).

Table 1 Indices of annual abundance and ocean fishery impacts on California Central Valley chinook in thousands of fish

	Ocean chinook landings south of Point Arena			*Hatchery and natural escapements of Central Valley adults*				
Year	*Troll*	*Sport*	*Total*	*Fall*	*Other*[a]	*Total*	*CVI abundance*[b]	*CVI harvest index (%)*[c]
1970	226.8	111.1	337.9	190.5	55.6[d]	246.1	584.0	58
1971	150.7	166.3	317.0	190.6	62.0	252.6	569.6	56
1972	299.8	187.6	417.4	99.6	46.1	145.7	563.1	74
1973	422.5	180.9	603.4	227.1	27.1	254.2	857.6	70
1974	282.7	141.6	424.3	205.6	35.7	241.3	665.6	64
1975	234.4	92.7	327.1	159.2	47.6	206.8	533.9	61
1976	237.9	68.6	306.4	168.8	43.8	212.6	519.0	59
1977	263.8	76.6	340.4	148.7	42.8	191.5	531.9	64
1978	291.0	65.9	356.9	136.9	17.1	154.0	510.9	70
1979	234.1	108.5	342.6	167.9	11.3	179.2	521.8	66
1980	294.3	77.1	371.4	155.9	31.6	187.5	558.9	66
1981	289.9	73.8	363.7	189.3	18.8	208.1	571.8	64
1982	418.4	122.5	540.9	177.2	38.3	215.5	756.4	72
1983	178.2	53.0	231.2	121.0	12.8	133.8	365.0	63
1984	221.7	78.7	300.3	197.5	17.0	214.5	514.8	58
1985	212.3	121.8	334.1	308.9	18.1	327.0	661.1	51
1986	502.5	114.8	617.3	259.0	33.2	292.2	909.5	68
1987	446.8	152.8	599.7	188.0	25.5	213.5	813.2	74
1988	830.5	130.4	960.9	244.9	28.0	272.9	1,233.8	78
1989	363.8	130.9	494.7	149.6	17.9	167.5	662.2	75
1990	336.2	112.7	448.9	108.3	13.6	121.9	570.8	79
1991	254.6	62.1	316.7	112.3	15.3	127.6	444.3	71
1992	163.5	66.7	230.2	85.3	8.2	93.5	323.7	71
1993	259.7	99.3	359.0	131.5	10.4	141.9	500.9	72
1994	290.4	159.9	450.3	148.8	6.8	155.6	605.9	74
1995	670.6	354.6	1,025.2	272.0	16.2	288.2	1,313.4	78
1996	348.9	129.3	478.2	255.3	8.7	264.0	742.2	64
1997	482.5	208.4	690.9	350.8	17.4	368.2	1,059.1	65
1998	221.5	114.5	336.0	253.0	40.1	293.1	629.1	53
1999[e]	258.8	76.1	334.9	294.5	14.9[f]	309.4	644.3	52

[a] Spring run of the current calendar year and late-fall and winter runs of the following calendar year.

[b] Ocean landings + escapement.

[c] Ocean harvest landed south of Point Arena as a percent of the CVI.

[d] Percent of adults in 1970 spring run assumed the same as 1971 (72%, 5,500 total).

[e] Preliminary.

[f] Late-fall and winter contributions unknown—respective averages of 1995–1999 escapement used.

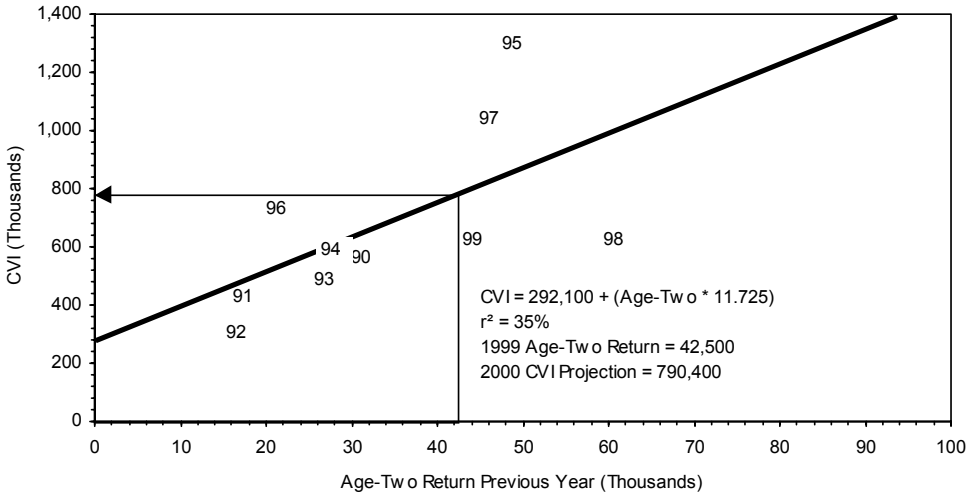

Figure 2 Linear regression of CVI on in-river age-two Central Valley chinook of the previous year, 1990–1999. Years shown are CVI year.

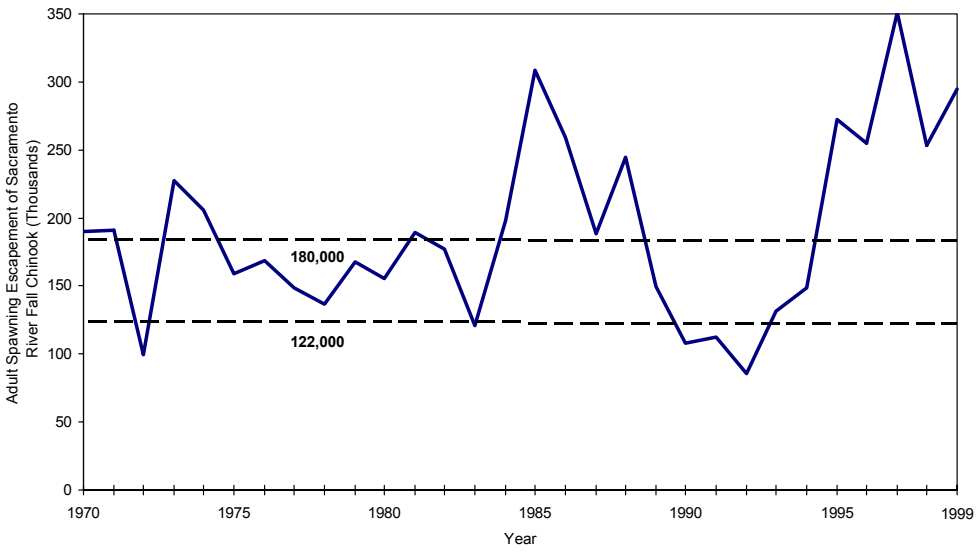

Figure 3 Spawning escapements of adult Sacramento River fall chinook, 1970–1999, and the goal range for the stock of 122,000 to 180,000 adult fish. Estimate for 1999 is preliminary.

Winter Chinook. The escapement goal for this stock is to achieve a 31 percent increase in escapement over the 1989–1993 mean rate. An ocean fishery model has been developed based on historical marked (fin-clipped) winter chinook data with which to compare proposed or actual ocean fishing regulations (DFG 1989). The model is stratified by the time and area and includes a length at age module to evaluate minimum size limits and the mortality associated with hook and release of undersized fish. It is noteworthy that the shift in recent years to mooching in the ocean sport fishery off central California has decreased the benefits associated with an increased minimum size limit (from 20 to 24 inches). This is because fish caught by mooching tend to swallow the hook, which is often fatal. Thus, in addition to an increased minimum size limit, time, and area closures have been required to meet the winter chinook harvest rate objective.

Spring Chinook. Spring chinook were listed as threatened under the State and federal acts in 1999. The NMFS recently issued a biological opinion regarding the effect of ocean fisheries on CV spring chinook. They concluded that recent action by the California Fish and Game Commission to delay the sport season opening south of Point Arena, in combination with the management measures in place to protect winter and spring chinook, should be sufficient to allow for stock rebuilding.

Administrative Process

Regulatory. The Council is advisory to the Secretary of Commerce (Secretary) who has the authority to implement federal salmon fishing regulations for ocean waters 3 to 200 miles offshore. The DFG Director has the authority under Section 7650 et seq. of the Fish and Game Code to conform State regulations affecting the commercial fishery in State waters (0 to 3 miles) to the Council's salmon fishery plan (or the actual federal regulations). The Commission retains regulatory authority over the sport fishery in State waters and must follow the State's Administrative Procedures Act in conforming State regulations to the PFMC plan. Each year the ocean salmon fishing regulations (federal and State) are adopted to be effective starting May 1.

Plan Amendment. The Salmon Plan contains the basic elements for regulating the ocean fisheries. The states generally have the lead with regard to recommending Plan amendments, and Council concurrence is required to proceed with any amendment proposals. The Council generally considers amendments at its September or November meetings, but can make an exception at its March, April, or June meetings. The amendment process requires the development of a document for public review, public hearings, final Council action, and publication (if approved) by the Secretary in the *Federal Register*. Extensive Council review is provided during the Plan development process, and the Secretary can reject the Plan or return it for additional development and public hear-

ings. A Plan amendment generally takes a year or longer to complete. For species listed under the federal ESA, federal restrictions supersede the Council's goals.

Alternative Management Strategies

In response to the concern over the status of chinook stocks in the CV and elsewhere, the need may arise to implement additional or revised management objectives for CV chinook salmon runs. Alternative harvest strategies may also need to be considered. A discussion of possible Plan amendment options and the procedure to follow in implementing such changes through the Council process is presented in the following sections.

Revise the Escapement Goal for Sacramento River Fall Chinook. Raising the gates at Red Bluff Diversion Dam during most of the adult fall salmon run is expected to increase natural salmon production in the upper river. It follows that the Council goal range may no longer be appropriate for the stock and should be set at no less than 180,000 adult fish. This proposal would take a Plan Amendment and require the development of an analysis showing how a revised ocean fishing strategy would produce optimum yield to the U.S. fishing industry, as compared to the current goal (National Standard 1). Such an amendment would take a year or longer to complete. Listing under the federal ESA would supersede the Council's management goal for the stock.

Establish an Escapement Goal for Sacramento River Spring-run Chinook. The Council has approved Salmon Plan Amendment 14 in which a provision is included to allow for additional management goals for stocks not listed in the Plan as part of a two-meeting regulatory process. Such an action would have a time constraint, and would require a Plan amendment to complete the process. CWT spawning escapement estimates may not be available for CV hatchery spring-run chinook because a program has not been in place to make such estimates. The paucity of data could complicate the development of a fishery harvest strategy for the stock because it would be difficult to show the relationship between fishing and spawning escapement under historic or recent fishing regulations. A thorough review of available spring run CWT data is needed to assess the adequacy of available data for developing a spring run fishery model. Consideration should also be given to continuing or implementing a spring chinook CWT program at Feather River Hatchery, and to estimating river returns of CWT spring chinook beginning as soon as possible.

Establish an Escapement Goal for San Joaquin Fall Chinook. The original Salmon Plan developed in 1977 had an escapement goal for this stock, but the goal was removed in 1984 because Delta water withdrawals were affecting the run. The San Joaquin run has not been proposed for separate listing under the federal ESA, but was included as part of the fall and late-fall CV complex in the recent review of California chinook populations (Myers and others 1998). A separate goal could be established for the run under the Council's Plan amendment process. Any such proposal would have to show how goal attainment would affect the ocean fisheries, particularly with regard to their ability to access other chinook stocks when the San Joaquin run is depressed due to water diversion conditions. Analysis of CWT data might show a different ocean distribution pattern for San Joaquin chinook, which could ameliorate any reduction in harvest opportunity for other chinook runs. The amendment process would take a year or longer to complete.

Conduct Selective Fisheries for CV Hatchery Stocks. The Council has approved regulations since 1998 that allow for an ocean fisheries off Washington and Oregon for ad-clipped coho salmon. The fishery is for hatchery fish that were marked in the previous year for the purpose of providing for an ocean selective fishery. Post season analysis showed that the majority of fish encountered in the fishery were, in fact, ad-clipped hatchery fish. The ad mark historically was used as a "flag" for CWT salmon, but an exception was made in the case of Oregon and Washington hatchery coho releases. A selective fishery for hatchery-origin CV chinook salmon could be implemented in California fisheries. Hooking mortality of released (unmarked) fish would be an important consideration. Recent DFG studies show that hook and release mortality of sublegal chinook caught by mooching in the sport fishery is about 24 percent. Hooking mortality of chinook caught by trolling is lower in the sport fishery and about 30 percent in the commercial fishery. Use of the ad mark in a selective fishery could adversely impact the CV CWT program. This is because the tag detection rate, using currently available hand-held detection equipment, is much lower than it is for coho, stemming from the much larger head size of chinook.

Final Remarks and Recommendations

California ocean fisheries are regulated under a Plan developed by the Council and approved by the Secretary pursuant to the Magnuson-Steven Act. The process provides for thorough discussion of Council and State management objectives along with extensive scientific stakeholder input. The Plan amendment process is flexible and requires that proposed Plan amendment proposals are consistent with the National Standards of the Magnuson-Steven Act. The amendment process may take a year or longer to complete, but can be done in less than a year if the change is agreeable to the affected interest groups.

The Council's escapement goal for Sacramento River fall chinook has been met in all but five years since 1970. The goal does not differentiate between hatchery and natural production. Attainment of the winter chinook escapement goal is evaluated based on the adopted regulation structure and is not linked to the actual escapement.

NMFS has expressed concern that natural production in the CV is depressed and that hatchery production is masking the situation. NMFS has also concluded that CV chinook are subjected to excess fishing mortality in the ocean fisheries (NMFS 1998).

In my view, the major problem with current CV salmon fishery management is two fold: (1) the lack of river return estimates for CWT releases and (2) the lack of a comprehensive CWT program to estimate fishery and spawning escapement returns for all hatchery releases. To remedy this situation, I recommend using the Klamath River salmon management program as a model for developing a counterpart CV program. In addition to a comprehensive hatchery CWT and river spawning escapement estimation program; government, tribal, and stakeholder input is provided through a basin management advisory council (Klamath Fishery Management Council, KFMC). The KFMC has a scientific team that evaluates and analyzes biological data and fishery management options (Klamath River Technical Advisory Team). The opportunity is at hand to develop a comprehensive CV fishery management program as a main element of the fishery program to be developed under the Central Valley Project Improvement Act.

Thanks, Nat Bingham

In closing, I would like to recognize and pay tribute to former Council member and friend of many years Nathaniel (Nat) S. Bingham. Nat and I had agreed to prepare this report, but he passed away before we could actually begin work on the manuscript. Had he been around to help write the report, more would have been written about the importance of habitat protection and restoration to the sustainability of CV salmon populations. Nat was an important contributor to the management of California salmon fisheries, and, in particular, to the protection and conservation of the State's rivers and streams upon which our salmon resources depend. Nat was the consummate statesman, but he will mostly be remembered as the tireless advocate for the fish. He was a driving force behind the creation of the Council's Habitat Steering Committee, and was active with the Committee right up to the end. California salmon are better off today in large part because of Nat Bingham's motivation and desire to do what was right for the fish.

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