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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1335 East-West Highway
Silver Spring, MD 20910
THE DIRECTOR

APR 18 1994

Mr. Roy B. Fox
Coordination and Review Manager
Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

Dear Mr. Fox:

Enclosed is the biological opinion prepared by the National Marine Fisheries Service (NMFS) under section 7 of the Endangered Species Act on the Columbia River Northern Squawfish Management Program in 1994.

As stated in the biological opinion, NMFS has determined that the proposed activity is not likely to jeopardize the continued existence of endangered or threatened Snake River salmon species.

Consultation on the activity considered in this opinion must be reinitiated if: 1) There is a modification to the proposed project; 2) a new species is listed; 3) critical habitat is designated in the area covered by the project; or 4) new information reveals impacts of identified activities that may affect listed species.

Sincerely,

Herbert W. Kaufman

for Rolland A. Schmitten

Enclosure

bc: F/NWO3 - ESB File Copy, GCNW - M. Bancroft
F/PR8 - P. Williams
PR8:Ziobro:4/12/94:bj:C:\DOCS\BOB\SQUAWZ.94

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

Endangered Species Act
Section 7 Consultation

BIOLOGICAL OPINION

Columbia River Northern Squawfish
Management Program for 1994

Agency: Bonneville Power Administration

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: 4/18/94

TABLE OF CONTENTS

TABLES

I. BACKGROUND

On December 2, 1993, the National Marine Fisheries Service (NMFS) received a request for consultation on the 1994 through 1998 operation of the Federal Columbia River Power System (FCRPS) and a biological assessment (FCRPS BA) discussing the impacts of this action on three species of Snake River salmon listed as endangered or threatened under the Endangered Species Act (ESA) from the Bonneville Power Administration (BPA), Corps of Engineers (COE), and Bureau of Reclamation (BOR). Included in the BA was a partial description of the Squawfish Management Program. Because 1) details of the proposed squawfish management program were incomplete at the time the biological opinion on 1994 - 1998 operation of the FCRPS was prepared, and 2) funding of the proposed Squawfish Management Program beyond 1994 is uncertain, impacts of this activity in 1994 are analyzed separately.

The BA proposes a fourth consecutive year of a study to remove northern squawfish (*Ptychocheilus oregonensis*) from reservoirs within the FCRPS and evaluate the effectiveness of this action in reducing juvenile salmonid mortality in reservoirs. Research is also continuing to develop prey-protective measures to reduce the vulnerability of juvenile salmonids to predators. The squawfish removal program is conducted by various agencies under contract, and is funded by the BPA. The BPA will coordinate the preparation of weekly reports and an annual progress report to be submitted to NMFS.

II. PROPOSED ACTIONS

Details of the proposed action are included in the 1994 program documentation for the Columbia River Northern Squawfish Management Program and are summarized as follows:

A. Dam Angling (Hook and Line Angling)

Columbia River Inter-Tribal Fish Commission (CRITFC), CRITFC-member tribes, or a CRITFC subcontractor will hire and station dam anglers at the eight COE dams on the lower Columbia and Snake rivers. Dam angling targeting squawfish 11 inches in length or greater will take place from late May through mid-September.

B. Sport-Reward Fishery (Hook and Line Angling)

The sport-reward fishery will continue in the Columbia River below Priest Rapids Dam and in the Snake River below Hells Canyon Dam in 1994. The Washington Department of Wildlife (WDW) will issue vouchers to registered anglers returning predator-size (11 inches or greater) northern squawfish of acceptable quality to registration sites. The 1994 program will begin in early May and close in mid-September.

C. **Site-Specific Fishery**

Three crews of technicians will deploy small-meshed (3½ - 4 inch stretched mesh) gill nets at night to locate and capture northern squawfish in the mainstem Columbia and Snake rivers. In locations where squawfish catches are high, salmonid presence is low, and physical conditions allow, floating Merwin trap nets will be deployed at night to capture squawfish. Up to five Merwin traps will be operated in the Columbia River from the tailrace of Bonneville Dam to McNary Dam, and in the Snake River as far upriver as the confluence with the Grande Ronde River. Trapping will take place from the date of this opinion through May 31, 1994.

Measures that will be taken to minimize the incidental catch of salmonids and reduce the possibility of stress or injury during the deployment of both gill nets and Merwin traps include: 1) all sampling will take place one hour after sunset and cease one hour before sunrise; 2) sampling will not take place when water temperatures exceed 68°F, and 3) sampling gear will not be deployed within 500 feet of any hydroelectric project fishway entrance. In addition, conditions that will prompt the cessation of sampling activities in order to minimize the possibility of taking listed Snake River salmon include: 1) sampling will cease in the Bonneville tailrace after one adult sockeye salmon passes Bonneville Dam; 2) sampling will cease in the Snake River after one adult sockeye salmon passes Ice Harbor Dam; 3) sampling will cease in a Columbia River reservoir when 10 or more adult sockeye salmon pass the nearest downstream dam in any one day; 4) sampling will cease in any Columbia River reservoir as well as in the Snake River if one adult sockeye salmon is incidentally taken, and 5) sampling will cease in all reservoirs if the incidental catch of salmon or steelhead is three percent or more of the cumulative number of adults of each species, respectively, passing the dam; calculation of the cumulative number will begin with the day preceding the deployment of sampling gear; sampling will resume when sufficient adults have passed to reduce the incidental take to 2.5 percent or less of the cumulative count.

Measures specific to gillnetting that will be taken to minimize the incidental catch and injury of salmonids include: 1) cessation of effort for that night at a particular site (a reach of the river 400 meters or less in length) if two or more adult salmonids or 100 or more juvenile salmonids are caught; 2) cessation of effort at a location (a reach of the river three kilometers or less in length) for that night if five or more adult salmonids or 250 or more juvenile salmonids are caught, and 3) cessation of effort at a particular site if the number of juvenile salmonids recorded as dead or in fair condition, i.e. injured, comprise 50 percent or more of the total number of squawfish greater than 271 mm in length that are caught.

Measures specific to Merwin trapping that will be taken to minimize the incidental catch and injury of salmonids include: 1) traps will be checked and any incidentally caught salmonids released at least once every three hours; 2) cessation of effort at a site for the night if the number of adult salmonids caught exceeds the number of squawfish 275 mm or greater in length that are caught in any three hour period; 3) cessation of effort at a site for the night if the catch rate of adult salmonids is five per hour or greater; 4) cessation of effort at a site for the night if the catch rate of juvenile salmonids is 25 or more per northern squawfish 275 mm or greater in length during any three hour period; and 5) when adult salmonids are captured, the density of fish held in Merwin traps will be calculated; if, for a water temperature of 50°F, the density is greater than 1.0 lb/cubic foot, the period for checking and emptying the trap will be shortened by one hour until the density criterion is met; for each degree of water temperature below or above 50°F, the poundage will be increased or decreased by five percent respectively.

D. Biological Evaluation

Squawfish will be collected by means of electrofishing and gillnetting to evaluate size structure, population dynamics, and consumption rates of juvenile salmonids. Sampling will take place in the Columbia River from river kilometer 71 to the tailrace of Priest Rapids Dam, and in the Snake River from its confluence with the Columbia River upstream to Lewiston, Idaho. Sampling is scheduled to occur from March through August, 1994.

III. LISTED SPECIES AND CRITICAL HABITAT

A. Species Status

Snake River sockeye salmon (*Oncorhynchus nerka*) are listed as endangered (November 20, 1991, 57 FR 58619). Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*) and Snake River fall chinook salmon (*Oncorhynchus tshawytscha*) are listed as threatened (April 22, 1992, 57 FR 14653). All three listed species may be affected by this action.

Critical habitat was designated for Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon on December 28, 1993 (58 FR 68543), effective on January 27, 1994. The proposed actions are within critical habitat for all three listed species.

B. Biological Information

1. Snake River Sockeye Salmon

For detailed information on the Snake River sockeye salmon, see Waples, et al. (1991a), and 56 FR 58619 (November 20, 1991). Snake River sockeye salmon adults enter the Columbia River primarily during June and July. Arrival to Redfish Lake, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs primarily in October (Bjornn et al. 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for 3 to 5 weeks, emerging April through May and moving immediately into the lake, where juveniles feed on plankton for 1 to 3 years before migrating to the ocean (Bell 1986). Migrants leave Redfish Lake from late April through May (Bjornn et al. 1968), and smolts migrate almost 900 miles (1440 kilometers) to the Pacific Ocean.

Passage at Lower Granite Dam (the first Snake River Dam in the juveniles' migration route) ranges from late April to July, with peak passage from May to late June (Fish Passage Center 1992a). During the early summer months, smolts remain inshore or within the Columbia River influence. Later, they migrate through the northeast Pacific Ocean (Hart 1973, Hart and Dell 1986). Snake River sockeye salmon usually spend two to three years in the Pacific Ocean and return to spawn in their fourth or fifth year of life.

Escapement of Snake River sockeye salmon to the Snake River has declined dramatically in recent years. Counts made at Lower Granite Dam since 1975 have ranged from 531 in 1976 to 0 in 1990. In 1988, the Idaho Department of Fish and Game (IDFG) conducted spawning ground surveys that identified four adults and two redds (gravel nests in which the eggs are deposited). In 1989, one adult reached Redfish Lake and one redd and a second potential redd were identified. No redds or adults were identified in 1990. In 1991, three males and one female returned to Redfish Lake. One male Snake River sockeye salmon returned to Redfish Lake in 1992. Six males and two females returned to Redfish Lake in 1993.

Over the last year scientific evidence has mounted that there is a residual population of sockeye salmon in Redfish Lake that is part of the Evolutionarily Significant Unit (ESU) listed by NMFS as an endangered species. NMFS considers this residual sockeye salmon population in Redfish Lake to be part of the Snake River sockeye salmon population listed as an endangered species, and therefore it is subject to all the protection, prohibitions, and requirements of the Endangered Species Act that apply to Snake River sockeye salmon (March 19, 1993, letter from N. Foster [NMFS] to Federal agencies).

2. Snake River Spring/Summer Chinook Salmon

For detailed information on the Snake River spring/summer chinook salmon, see Matthews and Waples (1991), NMFS (1991b), and 56 FR 29542 (June 27, 1991). In the Columbia River Basin, adult Snake River spring/summer chinook salmon migrate past Bonneville Dam from March through July (Burner 1951). The present range of naturally produced Snake River spring/summer chinook salmon is primarily limited to the Salmon, Grand Ronde, Imnaha, and Tucannon subbasins. Most Snake River spring/summer chinook salmon enter individual subbasins from May through September. Juvenile Snake River spring/summer chinook salmon begin emerging from the gravel from February through June (Perry and Bjornn 1991). Typically, after rearing in their nursery streams for about one year, smolts begin their seaward migration in April through May (Bugert et al. 1990, Cannamela 1992).

The timing of the different components of the spring/summer chinook salmon smolt migration varies greatly at Lower Granite Dam and encompasses virtually the entire spring and early summer migration period. Wild summer chinook salmon are present early and peak with hatchery-reared spring chinook salmon in late April. Hatchery-reared summer chinook salmon typically peak during the mid-migration period in early May. The latest and most protracted outmigrations are of wild spring chinook salmon. Although they are present in small numbers throughout the entire outmigration, most were detected from mid-May to mid-June (Matthews et al. 1990). Run timing can be expected to vary somewhat each year due to differing environmental conditions. After reaching the mouth of the Columbia River, it is believed that spring/summer chinook salmon inhabit nearshore areas before beginning their northeast Pacific Ocean migration which lasts two to three years.

The estimated annual number of wild adult Snake River spring/summer chinook salmon passing over Lower Granite Dam averaged 9,674 fish from 1980 through 1990, with a low count of 3,343 fish in 1980 and a high count of 21,870 fish in 1988 (Matthews and Waples 1991). The estimated numbers of wild adult Snake River spring/summer chinook salmon passing over Lower Granite Dam in 1991 and 1992 were 5,520 and 9,344 fish, respectively (FCRPS BA). In 1993, an estimated 7,803 wild spring/summer chinook salmon passed over Lower Granite Dam (COE Juvenile Fish Transportation Program ESA section 10 permit application, November 15, 1993).

3. Snake River Fall Chinook Salmon

For detailed information on the Snake River fall chinook salmon, see Waples, et al. (1991b), NMFS (1991c) and 56 FR 29542 (June 27, 1991). Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from

August through October. Fall chinook salmon production is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon and Tucannon rivers. Fall chinook salmon generally spawn from October through November and fry emerge from March through April. Downstream migration generally begins within several weeks of emergence (Becker 1970, Allen and Meekin 1973) with juveniles rearing in backwaters and shallow water areas through mid-summer prior to smolting and migration.

Juvenile fall chinook salmon begin arriving at Lower Granite Dam in mid-May, but most pass this site in June and July (Fish Passage Center 1992a). Fall chinook salmon subyearlings are present in the Columbia River estuary from June to October (Rich 1920). Dawley et al. (1979) found that the majority of all juvenile fall chinook salmon enter the Columbia River estuary from April through September. They will spend one to four years in the Pacific Ocean before beginning their spawning migration. The estimated number of wild Snake River fall chinook salmon passing over Lower Granite Dam in 1992 was 549. The preliminary estimate of the number of adult wild fall chinook salmon passing over Lower Granite Dam in 1993 is 742 fish (February 16, 1994 telefax from Guy Norman, Washington Department of Fisheries [WDF]).

IV. PROGRAM EFFECTS

A. Evaluating Proposed Actions

1. Snake River Sockeye Salmon

Because of the extremely low abundance of Snake River sockeye salmon, the approach used for evaluating the impacts of an agency action on this species differs from the approach used for evaluating impacts on Snake River spring/summer chinook salmon and Snake River fall chinook salmon. Offspring of residual sockeye salmon are expected to migrate from Redfish Lake in 1994. Because so few fish remain, the human-induced mortality of even one adult sockeye salmon, or an equivalent impact, is a matter of grave concern to NMFS. Therefore, NMFS concludes that it is necessary to take measures to reduce adverse human impacts on Snake River sockeye salmon to minimal levels in order to insure that an agency action is not likely to jeopardize the continued existence of this species.

2. Snake River Spring/Summer Chinook Salmon and Snake River Fall Chinook Salmon

The effects of agency actions on Snake River spring/summer chinook salmon and Snake River fall chinook salmon are primarily evaluated by considering an action individually to determine whether the action includes measures or modifications to

adequately reduce the level of human-induced mortality compared with the 1986-90 base period (base period analysis). As one of the criteria for evaluating the quantitative and qualitative significance of reductions in human-induced mortality, NMFS considers the potential of the combined effects of all actions, using the Columbia/Snake River salmon life-cycle models and other available information (NMFS 1994b).

In evaluating proposed actions and alternatives for the base period analysis, NMFS will focus on whether there have been adequate reductions in mortality relative to a 1986 through 1990 base period. For actions with only minimal adverse effects on Snake River chinook salmon, such as the scientific research action addressed in this consultation, NMFS does not evaluate reductions in mortality from the base period. Rather, NMFS evaluates the proposed action's measures to fully minimize the adverse effects.

B. Effects of Proposed Actions

1. General Considerations

An increase in predator populations as a result of dams' creating artificial habitat and concentrating prey is discussed as a factor for the decline of each listed Snake River salmon species (NMFS 1991a,b,c). Ideal predator foraging environments have been created above and below the hydropower dams. Smolts that pass through the projects are subjected to turbines, bypasses, and spillways, resulting in disorientation and increased stress which may reduce their ability to avoid predators below the dams. Artificial lakes above the dams result in low water velocities which increase smolt travel time and increase predation opportunity. Increased water temperatures, also a result of the impoundment of the river, have been shown to increase predation rates (Vigg and Burley 1991).

The squawfish management program, therefore, has the potential to benefit migrating salmon by exploring methods to reduce the effects of squawfish predation. The program's goals are based on research indicating that a sustained, annual squawfish harvest rate of 10 to 20 percent will result in a reduction in losses of juvenile salmonids to predation by 50 percent or more within 10 years (Rieman and Beamesderfer 1990). Squawfish management program researchers estimate that the system-wide exploitation rate has been reduced by approximately 9 to 12 percent annually, averaging 11 percent, since the program's inception in 1991 (B. Maslen, fishery biologist, BPA, personal communication, March 22, 1994). The estimated benefits of the program involve many sources of uncertainty, including: 1) estimation of salmon mortality due to squawfish predation relative to total mortality of juvenile salmon in reservoirs; 2) determination of the year in which decreased mortality of salmon smolts begins to accrue; 3)

estimation of the total reduction in mortality expected and the time necessary for this reduction to accrue; (4) whether or not accrual of mortality reductions occurs linearly; (5) whether or not there will be compensatory effects of other predators following removal of squawfish; (6) whether or not reservoir mortality of all listed species will be reduced by the same proportion following predator removal; (7) whether squawfish are preying on salmon which would otherwise have survived dam and reservoir passage, or upon dead or moribund fish; and (8) whether results of studies and models developed for John Day Reservoir can be applied to the remainder of the Columbia/Snake River system without modification. Because the squawfish removal program is an experimental program and its effects on reducing reservoir mortality of listed species cannot be determined with certainty, a range of possible values was considered in the biological opinion on 1994-1988 operation of the Federal Columbia River power system and juvenile transportation program in 1994-1998. Low, mid-range and high estimates (0, 12 and 25 percent, respectively) of mortality reduction of juveniles due to predation as a result of the effects of the squawfish management program were applied in the passage model analyses (NMFS 1994b).

In addition to anticipated beneficial effects of the squawfish removal program, negative effects are expected as a result of incidental catch of listed Snake River salmon. These negative effects include stress from capture and handling, migration delays, and mortality.

2. Effects on Juveniles and Adults of all Listed Species

Migration delays resulting from incidental take in each of the program activities are anticipated for all three species of adult and juvenile Snake River salmon. Stress from hook and release during the Sport-Reward and Dam Angling activities may cause behavioral changes and migrational delays of unknown duration. Merwin traps will delay incidentally caught Snake River salmon due to confinement for a maximum of three hours. Gill nets will cause delays due to confinement of less than an hour. Stress due to entrapment or netting may cause behavioral changes, which could result in further delays, but the magnitude, if any, of such delays are unknown. Stress from electroshock and handling may also cause delays. Mesa and Schreck (1989) observed a recovery period of three to six hours for wild cutthroat trout (*Oncorhynchus clarki*) that were shocked and marked. Shocked fish exhibited behavioral changes including inactivity, cessation of feeding, and a reduction in wariness. Juvenile and adult Snake River salmon may react to electroshock in a similar manner as cutthroat trout.

Stress to incidentally caught juvenile salmonids may also result in increased vulnerability to predation. Inactivity and unwary

behavior, as noted by Mesa and Schreck, could put juvenile salmonids at greater risk to predation by squawfish, as well as other known Columbia River basin predators such as walleye (*Stizostedion vitreum*), smallmouth bass (*Micropterus dolomieu*), and channel catfish (*Ictalurus punctatus*) (Vigg et al. 1991).

3. Effects on Juveniles of all Listed Species

Incidental catches associated with this program in 1991-1993, which form the basis of estimates for 1994, were not always reported by species. In addition, estimates were not always summarized by area and date, further limiting the possibility of determining incidental take by species. For purposes of this consultation, therefore, application of collection count values at Lower Granite Dam are employed to reflect the proportion of listed juvenile salmon in the Snake River above Lower Granite Dam, and afford a conservative estimate of the percentage of listed juvenile Snake River salmon in the lower Snake River, because the diluting effects of spring and fall chinook salmon releases from Lyons Ferry Hatchery (spring chinook salmon reared at Lyons Ferry are transferred to the Tucannon River), the effects of the transportation program in relocating fish below Bonneville Dam, and reservoir and dam passage mortality are not incorporated. Because the effects of transport from McNary Dam have not been incorporated, and due to the influx of hatchery-reared fish and unlisted wild fish in the lower Columbia River, using collection count estimates for McNary Dam provides a conservative estimate of the percentage of listed juvenile Snake River salmon in the Columbia River between McNary Dam and Bonneville Dam.

Mortality estimates associated with each method of squawfish removal are derived from other research and data from the squawfish removal program collected from 1991 through 1993. Although cursory observations during electrofishing operations on the Columbia River indicate that most or all of stunned adult and juvenile salmon initially recover sufficiently to swim away, long-term effects or effects that do not result in immediate mortality are not well understood. During previous research in the Columbia River basin, an electroshocking injury level for incidentally shocked juvenile salmon has been estimated at 10 percent (M. Schuck, fishery biologist, Washington Department of Fisheries, pers. comm. *in* Scholz 1992). For purposes of this consultation, mortality of incidentally shocked juvenile salmon is taken to equal that 10 percent estimated injury level.

Mortality estimates for gillnetting incorporate Oregon Department of Fish and Wildlife (ODFW) data collected during the 1993 squawfish removal season, as well as other research studies. Mathews et al. (1992) indicates that all species suffer significant injury or mortality after capture in a gill net. 1993 research in Bonneville pool, identified in the detailed

operating plan for the squawfish management program, resulted in a juvenile salmonid:squawfish catch ratio of 0.016, with 39 percent of the juvenile salmonids incidentally captured recorded as dead or injured. For purposes of this consultation, the 39 percent value has been applied as a mortality rate for juvenile salmonids incidental to gillnetting in the site-specific and biological evaluation activities.

Merwin traps have exhibited a high incidental catch of salmonids when directed at squawfish in the Columbia River basin. Data provided in appendix A of the BA indicates that 566 salmonids were captured during 381 trap hours of effort, incidental to the capture of 170 northern squawfish. During 1994, Merwin traps will be operated differently than in previous years. Traps will be deployed in areas where squawfish concentrations are high and concentrations of salmonids are low. The BA states that, because of this change in operations, data from previous years are not likely to be representative of incidental catch rates that are anticipated in 1994. However, as no additional data are available, for purposes of this consultation the Merwin trap incidental salmonid catch rate experienced in previous years is considered indicative of the potential catch rate in 1994.

Mathews et al. (1992) note that Merwin traps capture and hold fish in good condition, but that mortalities due to handling and release will occur at a rate of about 0.27 percent for salmonids. ODFW reports that the mortality rate for salmonids incidentally caught in Merwin traps is less than one percent, but a specific value is not identified. For purposes of this consultation the 0.27 percent estimated incidental mortality value has been adopted.

a. Dam Angling

Between 1991 and 1993, 96 juvenile salmonids were taken in the dam angling fishery incidental to the capture of approximately 84,800 northern squawfish. Based on the incidental catch rate observed in the 1991-1993 time period, 32 juvenile salmonids are expected to be taken in the dam angling activities in 1994 (96/3 = 32), associated with the capture of approximately 28,267 northern squawfish (84,800/3 = 28,266.6).

The number of listed Snake River juvenile salmon that will be taken incidental to squawfish removal activities in 1994 is difficult to estimate. 12 percent of the dam angling effort is scheduled to occur on the Snake River, and the remainder on the Columbia River. Assuming a fish guidance efficiency (FGE) value of 74 percent for steelhead (Ledgerwood et al. 1988), and 56 percent for yearling chinook salmon (12/17/92 letter from M. Tuttle [NMFS] to J. Luce [BPA]), the average of daily collection counts at Lower Granite Dam from March 28 to October 31, 1991, and from April 2 to October 31, 1992, indicate that, based on

these two years, juvenile spring/summer chinook salmon comprise approximately 37 percent of the juvenile salmonid population in the Snake River annually (8,557,341 total juvenile spring/summer chinook salmon/23,068,616 total juvenile salmonids = 0.37) (Fish Passage Center 1991, Fish Passage Center 1992). Of the total spring/summer chinook salmon present, including hatchery fish and fish from the Clearwater River subbasin (which are not part of the listed species), approximately 11.6 percent are expected to be juvenile Snake River spring/summer chinook salmon (NMFS 1993a). Based on 1991 and 1992 collection counts, and assuming 35 percent FGE (12/17/92 letter from M. Tuttle [NMFS] to J. Luce [BPA]), the proportion of juvenile fall chinook salmon expected in collections at Lower Granite Dam during the proposed study is approximately 0.26 percent. Of these, approximately 75 percent are expected to be listed juvenile Snake River fall chinook salmon (NMFS 1992, Appendix A). As many as 2,414 juvenile Snake River sockeye salmon may be PIT-tagged and released into the Snake River system in 1994 (NMFS 1994a). This theoretical maximum value is adopted for purposes of this consultation. Assuming that natural mortality prior to entering Lower Granite pool is five percent or less, Snake River sockeye salmon are estimated to comprise about 0.02 percent of the total population of juvenile salmonids at Lower Granite Dam in 1994, based on dam counts in 1991 and 1992.

Based on scheduled fishing effort, it is estimated that approximately four juvenile salmonids will be taken incidental to dam angling on the Snake River in 1994 (0.12 [proportion of angling on Snake River] x 32 [expected total incidental catch] = 3.84). Of these, approximately 0.17 are expected to be Snake River spring/summer chinook salmon ([0.37 (proportion of juvenile spring/summer chinook salmon in total run) x 4 (expected total incidental catch)] x 0.116 [proportion of listed juvenile spring/summer chinook salmon] = 0.172), approximately 0.008 to be Snake River fall chinook salmon ([0.0026 (proportion of juvenile fall chinook salmon) x 4] x 0.75 [proportion of listed juvenile fall chinook salmon] = 0.0078), and approximately 0.0008 to be Snake River sockeye salmon (0.0002 [proportion of listed juvenile sockeye salmon] x 4 = 0.0008).

Based on average collection counts from 1988 through 1990, and applying assumptions of FGE, bypass/turbine/sluiceway and reservoir survival, and no spill at collector dams, estimates of the number of listed Snake River salmon at McNary Dam in 1991 indicate that juvenile Snake River spring/summer chinook salmon comprise as much as 0.15 percent of the total population of migrating juvenile salmonids at that point in the Columbia River, and juvenile Snake River fall chinook salmon comprise as much as 0.006 percent of the total population (NMFS 1992, Appendix A; Ceballos et al. 1992 ; Ceballos et al. 1993). Snake River sockeye salmon may comprise up to 0.006 percent of the total population of migrating juvenile salmonids (NMFS 1992, Appendix

A; Ceballos et al. 1992 ; Ceballos et al. 1993). However, the estimate for sockeye salmon was based on 1991 trapping in Redfish Lake Creek. A total population estimate of 4,500 juvenile sockeye salmon from Redfish Lake was made, based on the number of fish trapped and trapping efficiency (Fox 1991). The estimated maximum theoretical population of migrating juvenile Snake River sockeye salmon in 1994 is 54 percent of the 1991 estimate (2,414/4,500 = 0.536). Therefore, Snake River sockeye salmon may comprise as much as approximately 0.003 percent of the total population of migrating juvenile salmonids passing McNary Dam in 1994 (0.54 x 0.006 = 0.00324).

Based on scheduled fishing effort, approximately 28 juvenile salmonids will be taken incidental to dam angling in the Columbia River in 1994 (0.88 [proportion of angling on Columbia River] x 32 [expected total incidental catch] = 28.16). Of these, approximately 0.04 will be Snake River spring/summer chinook salmon (0.0015 [proportion of listed juvenile spring/summer chinook salmon in run] x 28 [expected incidental catch on Columbia River] = 0.042), approximately 0.002 will be Snake River fall chinook salmon (0.00006 [proportion of listed juvenile fall chinook salmon] x 28 = 0.00168), and approximately 0.0008 will be Snake River sockeye salmon (0.00003 [proportion of listed juvenile sockeye salmon] x 28 = 0.00084).

The total estimated take of listed Snake River juvenile salmon incidental to the dam angling activity is 0.21 Snake River spring/summer chinook salmon (0.17 on Snake River + 0.04 on Columbia River = 0.21), 0.01 Snake River fall chinook salmon (0.008 on Snake River + 0.002 on Columbia River = 0.01), and 0.0016 Snake River sockeye salmon (0.0008 on Snake River + 0.0008 on Columbia River = 0.0016). Because 1) hooking mortality has been shown to be greater for smaller salmon handled entirely in water (Bendock and Alexandersdottir 1993), and 2) hook-and-line squawfish removal efforts are not conducted in a closely controlled atmosphere where consistent, in-water, gentle hook removal efforts are employed, for the purposes of this consultation it is assumed that all juvenile salmon incidentally taken during the dam angling activity will die.

b. Sport-Reward Fishery

No juvenile salmonids were reportedly taken incidental to the sport-reward fishery. However, due to the unstructured nature of the sport-reward activity, it is likely that juvenile salmonids were incidentally taken, but not reported. Therefore, for purposes of this consultation, it is assumed that the incidental catch ratio of juvenile salmonids to northern squawfish is equal to that experienced in the dam angling fishery.

In the 1991-1993 time period, approximately 448,376 northern squawfish 11 inches in length or greater were taken in the sport-

reward fishery. The total number of squawfish under 11 inches in length and the bycatch of juvenile salmonids that were taken incidental to their capture in the sport-reward fishery is not known. However, in 1992, 13,898 northern squawfish less than 11 inches in length were reported taken in the sport reward fishery, compared to the capture of 186,604 squawfish greater than or equal to 11 inches in length (Burley et al. 1992). Assuming that only half of the undersized squawfish taken in 1992 were reported, approximately 15 percent of the total catch was of undersized fish ([13,898 x 2]/186,604 = 0.148). This value has been incorporated in estimating the incidental take of juvenile salmonids by the sport-reward activity in 1994.

Based on the average catch from 1991 through 1993, approximately 149,459 northern squawfish 11 inches or greater will be captured in the sport-reward fishery in 1994 (448,376/3 = 149,458.6). Applying the 15 percent value for undersized fish, approximately 22,419 squawfish under 11 inches in length are expected to be taken in 1994 (0.15 x 149,459 = 22,418.85).

Based on dam angling catch data from 1991 through 1993, at least 169 juvenile salmonids will be taken incidental to the capture of squawfish 11 inches of length or greater in the sport-reward fishery in 1994 ([96 (total incidental take of juvenile salmonids, 1991-1993, incidental to dam angling)/84,800 (total take of northern squawfish, 1991-1993, incidental to dam angling)] x 149,459 [estimated annual take of northern squawfish 11 inches or greater in length] = 169.19). An additional 25 juvenile salmonids are likely to be taken incidental to the capture of undersized squawfish in the sport-reward fishery in 1994 ([96/84,800] x 22,419 [estimated annual take of undersized northern squawfish] = 25.38), for a total estimated incidental take of 194 juvenile salmonids (169 + 25 = 194).

Because participation in the sport-reward fishery is unstructured, it is not possible to describe effort patterns with certainty. However, based on 1992 effort data, approximately 22 percent of the sport-reward angling effort is likely to occur on the Snake River (Burley et al. 1992). Assuming that incidental catch rates are equal throughout the Snake and Columbia rivers, approximately 43 juvenile salmonids are likely to be taken incidental to the sport-reward fishery on the Snake River in 1994 (0.22 [estimated proportion of effort on Snake River] x 194 [estimated total incidental take of juvenile salmonids] = 42.68). Of these, approximately 1.9 are expected to be Snake River spring/summer chinook salmon ([0.37 (proportion of juvenile spring/summer chinook salmon in total run) x 43 (proportion of incidental take of juvenile salmonids on Snake River)] x 0.116 [proportion of listed juvenile spring/summer chinook salmon] = 1.85), approximately 0.084 to be Snake River fall chinook salmon ([0.0026 (proportion of juvenile fall chinook salmon in total run) x 43] x 0.75 [proportion of listed juvenile fall chinook

salmon] = 0.084), and approximately 0.009 to be Snake River sockeye salmon (0.0002 [proportion of listed juvenile sockeye salmon] x 43 = 0.0086).

Based on 1992 effort data, approximately 151 juvenile salmonids are likely to be taken incidental to the sport-reward fishery on the Columbia River in 1994 (0.78 [proportion of incidental take of juvenile salmonids on Columbia River] x 194 [estimated total incidental take of juvenile salmonids] = 151.32). Of these, approximately 0.23 are expected to be Snake River spring/summer chinook salmon (0.0015 [proportion of listed juvenile spring/summer chinook salmon] x 151 [proportion of incidental take of juvenile salmonids on Columbia River] = 0.226), approximately 0.01 to be Snake River fall chinook salmon (0.00006 [proportion of listed juvenile fall chinook salmon] x 151 = 0.009), and approximately 0.0045 to be Snake River sockeye salmon (0.00003 [proportion of listed juvenile sockeye salmon] x 151 = 0.00453).

The total estimated take of listed Snake River juvenile salmon incidental to the sport-reward fishery activity is 2.13 Snake River spring/summer chinook salmon (1.9 [Snake River] + 0.23 [Columbia River] = 2.13), 0.094 Snake River fall chinook salmon (0.084 [Snake River] + 0.01 [Columbia River] = 0.094), and 0.0054 Snake River sockeye salmon (0.0009 [Snake River] + 0.0045 [Columbia River] = 0.0054). Because 1) hooking mortality has been shown to be greater for smaller salmon handled entirely in water (Bendock and Alexandersdottir 1993), and 2) hook-and-line squawfish removal efforts are not conducted in a closely controlled atmosphere where consistent, in-water, gentle hook removal efforts are employed, for the purposes of this consultation it is assumed that all juvenile salmon incidentally taken during the sport-reward activity will die.

c. Site-Specific Fishery

Researchers will use 3½ - 4 inch stretched mesh gill nets to locate areas of squawfish concentrations. Approximately 1,932 net hours (soak time) are scheduled in 1994. 28 juvenile salmonids were captured in 410 hours of gill net soak time in the Bonneville pool in 1993, resulting in an incidental catch rate of approximately 0.07 juvenile salmonids per hour (28/410 = 0.068). Based on this experience, and assuming that similar incidental catch rates will be experienced in other areas of the Columbia and Snake rivers, approximately 135 juvenile salmonids are expected to be caught incidental to gillnetting in the site-specific fishery activity in 1994 (1932 x 0.07 = 135.24). Applying the incidental mortality rate of 39 percent, approximately 53 juvenile salmonid mortalities are anticipated as a result of gillnetting for squawfish in 1994 (0.39 x 135 = 52.65).

It is likely that the number of juvenile salmonids present during this activity will range from very few in March, to a large number during the height of the spring/summer chinook salmon migration in late April through early June. Because of annual variations in migration timing, the assumption that spring migrants will be equally vulnerable to gill net operations during the entire activity period is applied in this consultation. Juvenile fall chinook salmon migration generally occurs during summer months. In 1991 and 1992, 90 percent of the migration passed Lower Granite Dam after June 11 and June 6 respectively (Fish Passage Center 1993a). However, little information is available that indicates the extent to which Snake River fall chinook salmon rear in the lower Snake River. Additionally, surveys coordinated by the COE in 1993 identified several fall chinook salmon redds in the Snake River below Little Goose and Lower Granite dams (D. Kenney, fishery biologist, COE, pers. comm., December 3, 1993). Because the degree to which juvenile Snake River fall chinook salmon are present in the lower Snake River in the spring is uncertain, for the purposes of this consultation the entire population of juvenile Snake River fall chinook salmon are assumed to be equally vulnerable to early-season squawfish removal activities.

512 hours of gillnetting effort are scheduled on the Snake River, March through May, in 1994. Applying the incidental juvenile salmonid catch rate experienced in 1993 yields an estimate of approximately 36 juvenile salmonids projected to be caught during Snake River gill net activities in 1994 (0.07 juvenile salmonids/hour x 512 hours of effort = 35.84). Approximately 13.3 of these fish will be spring/summer chinook salmon (0.37 [proportion of juvenile spring/summer chinook salmon in Snake River] x 36 [estimated incidental take of juvenile salmonids on Snake River] = 13.32), and about 1.54 will be listed Snake River spring/summer chinook salmon (0.116 [proportion of listed juvenile spring/summer chinook salmon] x 13.3 = 1.542). 0.6 Snake River spring/summer chinook are likely to die as a result of being caught in gill nets (0.39 [incidental mortality rate] x 1.54 = 0.601). Approximately 0.094 fall chinook salmon are likely to be captured incidental to gillnetting on the Snake River in 1994 (0.0026 [proportion of juvenile fall chinook salmon in total run] x 36 = 0.0936), and 0.07 will be Snake River fall chinook salmon (0.75 [proportion of listed juvenile fall chinook salmon] x 0.094 = 0.0705). About 0.03 Snake River fall chinook salmon are likely to die (0.39 x = 0.07 = 0.0273). Approximately 0.007 juvenile Snake River sockeye salmon are likely to be caught (0.0002 [proportion of listed juvenile sockeye salmon] x 36 = 0.0072), with a mortality of 0.003 fish (0.39 x 0.007 = 0.00273).

1,420 hours of gillnetting effort are scheduled to be conducted in the Columbia River in conjunction with the site-specific activity, April through June, in 1994. Approximately 99 juvenile salmonids are projected to be caught during Columbia River gill

net activities in 1994 (0.07 juvenile salmonids/hour x 1420 hours of soak time = 99.4). Approximately 0.2 of these fish will be Snake River spring/summer chinook salmon (0.0015 [proportion of listed juvenile spring/summer chinook salmon] x 99 = 0.148), with a mortality of 0.08 fish (0.39 [incidental mortality rate] x 0.2 = 0.078). Approximately 0.006 Snake River fall chinook salmon are likely to be captured incidental to gillnetting in the Columbia River in 1994 (0.00006 [proportion of listed juvenile fall chinook salmon] x 99 = 0.0059), and about 0.002 Snake River fall chinook salmon are likely to die (0.39 x 0.006 = 0.0023). Approximately 0.003 juvenile Snake River sockeye salmon are likely to be caught (0.00003 [proportion of listed juvenile sockeye salmon] x 99 = 0.00297), with a mortality of 0.001 fish (0.39 x 0.003 = 0.00117).

Approximately 700 hours of Merwin trap effort are scheduled for 1994. In 1993, 381 trap hours of effort resulted in the incidental catch of 342 juvenile salmonids. Applying the ratio of effort to incidental juvenile salmonid catch from 1993 (342/381 = 0.897), it is likely that approximately 630 juvenile salmonids will be incidentally taken during Merwin trap operation in 1994 (0.9 salmonids/hour x 700 hours of effort = 630). Merwin traps were not used in the Snake River in 1993. Although the incidental catch rate of salmonids is likely to be lower in the Snake River than in the Columbia River, in the absence of data the incidental catch ratio experienced in 1993 is applied equally to all sites in this consultation.

161 hours of Merwin trap effort are scheduled on the Snake River, March through May, in 1994, which will result in the incidental catch of an estimated 145 juvenile salmonids (0.9 salmonids/hour x 161 hours of effort = 144.9). Approximately 6.2 of these fish are likely to be Snake River spring/summer chinook salmon ([0.37 (proportion of juvenile spring/summer chinook salmon in run) x 145 (estimated incidental catch of juvenile salmonids)] x 0.116 [proportion of listed juvenile spring/summer chinook salmon] = 6.22), about 0.28 will be Snake River fall chinook salmon ([0.0026 (proportion of juvenile fall chinook salmon in run) x 145] x 0.75 [proportion of listed juvenile fall chinook salmon] = 0.283), and approximately 0.03 will be Snake River sockeye salmon (0.0002 [proportion of listed juvenile sockeye salmon] x 145 = 0.029). Mortality estimates are 0.017 for listed juvenile spring/summer chinook salmon (0.0027 [estimated mortality rate] x 6.2 [estimated incidental take] = 0.0167), 0.0008 for listed fall chinook salmon (0.0027 x 0.28 [estimated incidental take] = 0.00076), and 0.00008 for listed sockeye salmon (0.0027 x 0.03 [estimated incidental take] = 0.000081).

539 hours of Merwin trapping effort are scheduled for the Columbia River, April through June, which will result in the incidental catch of approximately 485 juvenile salmonids (0.9 salmonids/hour x 539 hours of effort = 485.1). Approximately

0.73 of these fish are likely to be Snake River spring/summer chinook salmon (0.0015 [estimated proportion of listed juvenile spring/summer chinook salmon] x 485 = 0.727), 0.03 are likely to be Snake River fall chinook salmon (0.00006 [estimated proportion of listed juvenile fall chinook salmon] x 485 = 0.029), and 0.015 are likely to be Snake River sockeye salmon (0.00003 [estimated proportion of listed juvenile sockeye salmon] x 485 = 0.0146). Mortality estimates are 0.002 listed juvenile spring/summer chinook salmon (0.0027 [estimated mortality rate] x 0.73 = 0.0019), 0.00008 for listed juvenile fall chinook salmon (0.0027 x 0.03 = 0.00008), and 0.00004 for listed juvenile sockeye salmon (0.0027 x 0.015 = 0.00004).

The total estimated take of listed Snake River juvenile salmon incidental to the site-specific fishery activity is indicated in tables 1-3, below.

Table 1. Estimated incidental catch (take) and mortality of listed juvenile Snake River spring/summer chinook salmon due to site-specific fishery activity.

ACTION	TAKE	MORTALITY
Snake River gillnetting	1.54	0.6
Columbia River gillnetting	0.2	0.08
Snake River Merwin trapping	6.2	0.017
Columbia River Merwin trapping	0.73	0.002
TOTALS	8.67	0.699

Table 2. Estimated catch (take) and mortality of listed juvenile Snake River fall chinook salmon due to site-specific fishery activity.

ACTION	TAKE	MORTALITY
Snake River gillnetting	0.07	0.03
Columbia River gillnetting	0.006	0.002
Snake River Merwin trapping	0.28	0.0008
Columbia River Merwin trapping	0.03	0.00008
TOTALS	0.386	0.03288

Table 3. Estimated catch (take) and mortality of listed juvenile Snake River sockeye salmon due to site-specific

fishery activity.

ACTION	TAKE	MORTALITY
Snake River gillnetting	0.007	0.003
Columbia River gillnetting	0.003	0.001
Snake River Merwin trapping	0.03	0.00008
Columbia River Merwin trapping	0.015	0.00004
TOTALS	0.055	0.00412

d. Biological Evaluation

Approximately 403 hours of electrofishing effort were conducted on the Snake and Columbia rivers in association with this activity in 1993. Of these, 268 hours of effort during the mark and release portion of the activity were conducted throughout the study area, and 135 hours of effort during the size structure, population dynamics, and consumption study efforts were concentrated in Columbia River reservoirs. Assuming equivalent effort between the reservoirs/river reaches during each activity, approximately 134 hours of electrofishing effort occurred in Snake River reservoirs (268/2 = 134), and 269 hours of effort occurred in Columbia River reservoirs (268/2 + 135 = 269).

Approximately 4,557 juvenile salmonids were observed to be incidentally stunned during electrofishing activities in 1993, 1,035 in Snake River reservoirs and 3,522 in Columbia River reservoirs. On average, therefore, 7.72 juvenile salmonids were observed to be affected per hour of electrofishing in the Snake River in 1993 (1,035/134 = 7.72), and 13.1 juvenile salmonids were observed to be affected per hour in the Columbia River (3,522/269 = 13.09).

The degree of effort between the Snake and Columbia rivers in 1994 will be similar to 1993 for the mark and release portion of the biological evaluation project. Mark and release efforts will involve both electrofishing and gillnetting, and will take place from river kilometer 71 in the Columbia River to just below Priest Rapids Dam, and in the Snake River from its confluence with the Columbia River upstream to Lewiston, Idaho. The mark and release activity is scheduled from March through May. Because the amount of effort that is scheduled for the Columbia River above its confluence with the Snake River, where listed Snake River salmon are not likely to occur, is not indicated in the BA for 1993 or 1994 efforts, for purposes of this consultation it is assumed that all mark and release activity has the potential to take listed fish. The examination of size structure, population dynamics, and evaluation of northern squawfish consumption activities are proposed to occur in John

Day, Ice Harbor, Lower Monumental, Little Goose and Lower Granite reservoirs from May through August.

The degree of effort that will be made in each of the reservoirs/river reaches during electrofishing in 1994 will depend on the level of squawfish catch. For purposes of this consultation, effort is assumed to be equal for each reservoir/river reach. Approximately 268 hours of mark and release electrofishing efforts will be evenly distributed between the Snake and Columbia rivers (268 hours/2 = 134 hours). 80 percent of the scheduled total of approximately 135 hours of electrofishing during the size structure, population dynamics, and consumption study activity will occur in the Snake River (0.8 x 135 hours = 108 hours).

A total of 242 (134 + 108 = 242) hours of electrofishing effort in the Snake River will result in an estimated incidental catch of 1,868 juvenile salmonids (7.72 juvenile salmonids affected/hour x 242 hours = 1,868.24). Of these, approximately 80.17 are likely to be Snake River spring/summer chinook salmon ([0.37 (proportion of juvenile spring/summer chinook salmon in Snake River run) x 1,868] x 0.116 [proportion of listed juvenile spring/summer chinook salmon] = 80.17), approximately 3.64 are likely to be Snake River fall chinook salmon ([0.0026 (proportion of juvenile fall chinook salmon in Snake River run) x 1,868] x 0.75 [proportion of listed juvenile fall chinook salmon] = 3.64), and approximately 0.37 are likely to be Snake River sockeye salmon (0.0002 [proportion of listed juvenile sockeye salmon] x 1,868 = 0.374). Application of the 10 percent incidental mortality value yields estimated mortalities incidental to proposed electrofishing operations in the Snake River in 1994 of 8.02 juvenile Snake River spring/summer chinook salmon (0.10 x 80.17 = 8.017), 0.36 juvenile Snake River fall chinook salmon (0.10 x 3.6 = 0.36), and 0.037 juvenile Snake River sockeye salmon (0.10 x 0.37 = 0.037).

A total of 161 hours (134 hours in Snake River + [0.2 (proportion of effort in Columbia River) x 135 total hours of effort] = 161) of electrofishing effort in the Columbia River will result in an incidental catch of approximately 2,109 juvenile salmonids (13.1 juvenile salmonids affected/hour x 161 hours = 2,109.1). Of these, approximately 3.16 are likely to be juvenile Snake River spring/summer chinook salmon (0.0015 [proportion of listed juvenile spring/summer chinook salmon] x 2,109 = 3.163), approximately 0.13 are likely to be juvenile Snake River fall chinook salmon (0.00006 [proportion of listed juvenile fall chinook salmon] x 2,109 = 0.126), and approximately 0.06 are likely to be juvenile Snake River sockeye salmon (0.00003 [proportion of listed juvenile sockeye salmon x 2,109 = 0.063). Application of the 10 percent incidental mortality value yields estimated mortalities incidental to proposed electrofishing operations in the Columbia River in 1994 of 0.32 juvenile Snake

River spring/summer chinook salmon (0.10 x 3.16 = 0.316), 0.01 juvenile Snake River fall chinook salmon (0.10 x 0.13 = 0.013), and 0.006 juvenile Snake River sockeye salmon (0.10 x 0.06 = 0.006.

Approximately 880 hours of gillnetting effort were conducted on the Snake and Columbia rivers in association with this activity in 1993. Of these, 829 hours of effort during the mark and release portion of the activity were conducted throughout the study area, and 51 hours of effort during the size structure, population dynamics, and consumption efforts were concentrated in Columbia River reservoirs. Assuming equivalent effort between the rivers during the mark and release activity, approximately 414.5 hours of gillnetting effort occurred in Snake River reservoirs (829/2 = 414.5), and 465.5 hours of effort occurred in Columbia River reservoirs (414.5 + 51 = 465.5).

The BA states that no juvenile salmonids were taken during gill net efforts by the biological evaluation activity in 1993. However, the site-specific fishery's gill net efforts, using gear of the same mesh size, resulted in an incidental catch rate of 0.07 juvenile salmonids per hour of soak time, with a mortality rate of 39 percent. Because 1) most of the gillnetting effort occurs at night when conditions are not ideal for sighting juvenile salmonids that may be incidentally taken; 2) small juvenile salmonids may be caught by their mouths and fall out of gill nets as they are being retrieved before they are observed, and 3) the primary task of research staff is to retrieve the gill nets and secure the captured squawfish, with observation and recording of incidental catch as a secondary concern, to more accurately estimate the potential incidental take of listed juvenile salmonids during gillnetting by the biological evaluation activity the incidental take and mortality rate of the site-specific fishery's gillnetting efforts have been applied.

In 1994, approximately 829 hours of gillnetting effort are proposed to occur incidental to the mark and release activity and 51 hours of gillnetting effort are proposed to occur incidental to the size structure, population dynamics and consumption activities. The degree of effort that will be made in each of the reservoirs/river reaches during gillnetting will depend on the level of squawfish catch. For purposes of this consultation, effort is assumed to be equal for each reservoir/river reach within each activity. Mark and release gillnetting efforts will be evenly distributed between the Snake and Columbia rivers (829 hours/2 = 414.5 hours), while 80 percent of the effort for the size structure, population dynamics, and consumption studies will occur in the Snake River (0.8 x 51 hours = 40.8 hours).

A total of approximately 456 (414.5 hours during mark and release + 41 hours during size structure, population dynamics, and consumption studies = 455.5) hours of gill net soak time in the

Snake River may result in the incidental take of as many as 32 juvenile salmonids (0.07 juveniles salmonids affected/hour soak time x 456 = 31.92). Approximately 1.37 of these fish are likely to be juvenile Snake River spring/summer chinook salmon ([0.37 (proportion of juvenile spring/summer chinook salmon in Snake River run) x 32] x 0.116 [proportion of listed juvenile spring/summer chinook salmon] = 1.373), of which 0.53 are likely to die as a result of being caught in gill nets (0.39 [proportion of incidentally caught juvenile salmonids that will die] x 1.37 = 0.534). Approximately 0.06 of the incidentally caught salmonids are likely to be juvenile Snake River fall chinook salmon ([0.0026 (proportion of juvenile fall chinook salmon in Snake River run) x 32] x 0.75 [proportion of listed juvenile fall chinook salmon] = 0.0624), of which about 0.02 are likely to die (0.39 x = 0.06 = 0.0234). Approximately 0.006 juvenile Snake River sockeye salmon are likely to be caught (0.0002 [proportion of listed juvenile sockeye salmon in Snake River run] x 32 = 0.0064), with a mortality of about 0.002 fish (0.39 x 0.006 = 0.00234).

Approximately 425 (414.5 hours during mark and release + [0.2 (proportion of activity occurring in Columbia River) x 51] = 424.7) hours of gillnetting effort in the Columbia River will result in an incidental catch of approximately 30 juvenile salmonids (0.07 juvenile salmonids/hour x 425 = 29.75). Of these, approximately 0.045 are likely to be Snake River spring/summer chinook salmon (0.0015 [proportion of listed juvenile spring/summer chinook salmon in Columbia River run] x 30 = 0.045), approximately 0.002 are likely to be Snake River fall chinook salmon (0.00006 [proportion of listed juvenile fall chinook salmon] x 30 = 0.0018), and approximately 0.0009 are likely to be Snake River sockeye salmon (0.00003 [proportion of listed juvenile sockeye salmon] x 30 = 0.0009). Application of the 39 percent incidental mortality value yields estimated mortalities incidental to proposed biological evaluation gillnetting operations in the Columbia River in 1994 of 0.018 juvenile Snake River spring/summer chinook salmon (0.39 x 0.045 = 0.0175), 0.0008 juvenile Snake River fall chinook salmon (0.39 x 0.002 = 0.00078), and 0.0004 juvenile Snake River sockeye salmon (0.39 x 0.0009 = 0.00035).

The total estimated take of listed Snake River juvenile salmon incidental to the biological evaluation activity is indicated in tables 4-6, below.

Table 4. Estimated catch (take) and mortality of listed juvenile Snake River spring/summer chinook salmon due to biological evaluation activity.

ACTION	TAKE	MORTALITY
Snake River electrofishing	80.17	8.02
Columbia River electrofishing	3.16	0.32
Snake River gillnetting	1.37	0.53
Columbia River gillnetting	0.045	0.018
TOTALS	84.75	8.89

Table 5. Estimated catch (take) and mortality of listed juvenile Snake River fall chinook salmon due to biological evaluation activity.

ACTION	TAKE	MORTALITY
Snake River electrofishing	3.64	0.36
Columbia River electrofishing	0.13	0.01
Snake River gillnetting	0.06	0.02
Columbia River gillnetting	0.002	0.0008
TOTALS	3.832	0.391

Table 6. Estimated catch (take) and mortality of listed juvenile Snake River sockeye salmon due to biological evaluation activity.

ACTION	TAKE	MORTALITY
Snake River electrofishing	0.37	0.037
Columbia River electrofishing	0.06	0.006
Snake River gillnetting	0.0006	0.0002
Columbia River gillnetting	0.0009	0.0004
TOTALS	0.4315	0.0436

e. Juvenile Summary

The total direct take of listed juvenile salmon resulting from all squawfish management program activities in 1994 is indicated in tables 7-9, below.

Table 7. Estimated catch (take) and mortality of listed juvenile Snake River spring/summer chinook salmon due to

squawfish management program activity.

ACTION	TAKE	MORTALITY
Dam Angling	0.21	0.21
Sport-Reward Fishery	2.13	2.13
Site-Specific Fishery	8.67	0.70
Biological Evaluation	84.75	8.89
TOTALS	95.76	11.93

Table 8. Estimated catch (take) and mortality of listed juvenile Snake River fall chinook salmon due to squawfish management program activity.

ACTION	TAKE	MORTALITY
Dam Angling	0.01	0.01
Sport-Reward Fishery	0.09	0.09
Site-Specific Fishery	0.39	0.03
Biological Evaluation	3.79	0.39
TOTALS	4.28	0.52

Table 9. Estimated catch (take) and mortality of listed juvenile Snake River sockeye salmon due to squawfish management program activity.

ACTION	TAKE	MORTALITY
Dam Angling	0.002	0.002
Sport-Reward Fishery	0.014	0.014
Site-Specific Fishery	0.055	0.004
Biological Evaluation	0.432	0.044
TOTALS	0.503	0.064

4. Effects on Adults of All Species

Each component of the squawfish management program has the potential to affect migrating adult Snake River salmon. Electroshocking and gillnetting have the greatest potential to cause mortalities among all three listed species of adult Snake River salmon.

As with juveniles, species of adults incidentally captured from 1991 through 1993 were not always recorded. In addition, estimates were not always summarized by area and date, further

limiting the possibility of determining incidental take by species. For purposes of this consultation, the assumption is made that all incidentally captured salmon could have been listed species, unless information to the contrary was provided. Mortality estimates associated with each method of squawfish removal are derived from relevant research and squawfish removal program data from 1991 through 1993.

Injuries resulting from forced muscular contractions in adult rainbow trout (*Oncorhynchus mykiss*) caused by electroshock have been documented, with significant spinal injuries occurring in 32 to 67 percent of the fish studied (Sharber and Carothers 1988; Holmes et al. 1990). Although chinook and sockeye salmon were not included in these studies, for purposes of this consultation it is assumed that the effects of electroshock on adult salmon are similar to those identified in the referenced studies on adult trout. Therefore, 32 to 67 percent of the adult salmon incidentally affected by electrofishing efforts are assumed to die.

Based on 1991 and 1992 gillnetting efforts, ODFW has estimated that approximately 85% of adult salmonids incidentally caught in gill nets targeting squawfish would be released in good condition, 10% would be mortalities, and 5 percent would be in an unknown condition (March 29, 1993, letter from D. Ward, ODFW to W. Maslen, BPA). The assumption that the 5 percent unknown condition represents additional mortality results in a total estimated mortality rate of 15 percent of incidentally caught salmonids as a result of gillnetting. Research utilizing gill nets in Lower Granite reservoir in 1991 resulted in a known mortality rate for adult spring/summer and fall chinook salmon of 20 percent, although the sample size was small (Bennett 1992). 37 adult salmonids were captured in 410 hours of gill net soak time in the Bonneville pool in 1993 associated with the squawfish removal program, resulting in an incidental catch rate of 0.09 adult salmonids caught per hour (37/410 = 0.090). Of these, four were identified as dead or injured, resulting in an incidental mortality and injury rate of 11 percent of captured fish (4/37 = 0.108). An incidental catch rate of 0.09 adult salmonids per hour and a 15 percent mortality rate for adult salmonids incidentally netted are considered to be representative values and they are applied in this consultation.

The estimated mortality associated with Merwin trapping, 0.27 percent, is based on observations by the University of Washington during the 1991-1992 trapping season (Mathews et al. 1992). This is considered a maximum value, as fish were held longer (up to 12 hours) in the cited study than the maximum of four hours proposed in the BA.

a. Dam Angling

Dam angling has been conducted at all eight of the mainstem Columbia and Snake River dams. The reported catch for the 1991 through 1993 time period was 45 adult salmonids. None of the adults were landed. Based on the average annual incidental catch of adult salmonids, 15 adults are likely to be taken incidental to the dam angling activity in 1994 (45/3 = 15). Although adults incidentally hooked are released without handling and no mortalities have been reported, stress from being hooked and, in many cases, from carrying the hook and a length of line after release is likely. The BA proposes an incidental mortality rate of 33 percent for fish that are hooked and released. Bendock and Alexandersdottir (1993) reported short-term (five day) mortality rates of 4.1 percent to 10.6 percent for chinook salmon caught and released in the Kenai River of Alaska, with little additional mortality expected beyond the five-day period. All fish were held in water continuously during hook removal and tagging. No conclusions were made as to whether the rigors of tagging had an effect on the mortality rate during this study. Because hook-and-line squawfish removal efforts are not conducted in a closely controlled atmosphere where consistent, in-water, gentle hook removal efforts are employed, for the purposes of this consultation the 33 percent mortality value has been applied. No data were provided in the BA indicating the location where incidentally caught adult salmonids were taken. Although adult salmonids are more numerous in the Columbia River, in the absence of data it is assumed that adult salmonids are equally vulnerable to capture throughout the Snake and Columbia rivers.

Twelve percent of the dam angling effort is scheduled to occur on the Snake River, and the remainder on the Columbia River. Assuming that the vulnerability of individual salmonids to capture by hook and line is similar in the Snake and Columbia rivers, it is likely that the degree of effort will reflect the composition of the incidental catch. Therefore, two adult salmonids are likely to be taken incidental to the dam angling activity on the Snake River (0.12 x 15 = 1.8), and 13 adult salmonids are likely to be taken on the Columbia River (0.88 x 15 = 13.2).

For purposes of this consultation population estimates for McNary and Lower Granite dams are applied to all Columbia River and Snake River research activities respectively in order to provide a conservative estimate of the number of listed adult salmon that may be incidentally affected. These values reflect the maximum potential contribution of listed Snake River salmon for the reach of the river below the respective dams because unlisted adults that return to hatcheries or tributaries downstream are not included in the calculation of the proportion of listed Snake River salmon present. Although listed spring/ summer and fall chinook salmon that return to the Tucannon River and listed fall

chinook salmon that may spawn in the Snake River below Lower Granite Dam are excluded by employing Lower Granite Dam counts, the majority of adults that return to Lyons Ferry Hatchery are also excluded. In 1993 the total number of Lyons Ferry Hatchery fall chinook salmon returning was 458 fish (February 28, 1994 letter from W. Shake [United States Fish and Wildlife Service] to M. Tuttle [NMFS]). Surveys of the Palouse River in 1989, 1990, and 1991 revealed the presence of two redds and four adults, one redd and three adults, and no redds or fish, respectively. Surveys of the Tucannon River in 1989, 1990, and 1991 revealed the presence of 48 redds, 61 redds and 50 redds, respectively (February 25, 1992, memorandum from G. Mendel [WDF] to G. Griffin [NMFS]). Surveys in the fall of 1993 identified seven fall chinook salmon redds in the Lower Granite tailrace and four fall chinook salmon redds in the Snake River below Little Goose Dam (D. Kenney, fishery biologist, COE, personal communication, December 27, 1993). Although it is not known with certainty whether the spawning fall chinook salmon below Lower Granite and Little Goose dams were Snake River fall chinook salmon, in the absence of conflicting evidence NMFS considers them to be so. Because the number of Lyons Ferry Hatchery salmon below Lower Granite Dam are likely greater than the combined total number of listed salmon spawning in the Snake River, the Palouse River, and the Tucannon River, discounting all four groups by applying Lower Granite Dam counts does not unfavorably skew the estimated ratio of listed to unlisted salmon in the lower Snake River.

The ten year annual average (1982-91) for all adult salmonids passing Lower Granite Dam during spring, summer and fall is 122,185 fish (COE, Portland and Walla Walla Districts, 10-year fish count summary). The 10-year (1982-91) average annual estimate of Snake River spring/summer chinook salmon at Lower Granite Dam is 9,176 fish (Columbia River Technical Staffs 1993a). Applying these average values, approximately 7.5 percent of adult salmonids in the Snake River in 1994 are likely to be Snake River spring/summer chinook salmon (9,176/122,185 = 0.075). Therefore, 0.15 Snake River spring/summer chinook salmon are likely to be taken incidental to the dam angling activity on the Snake River in 1994 (0.075 x 2 adult salmonids incidentally taken on Snake River = 0.15), and 0.05 are estimated to die (0.33 incidental mortality rate x 0.15 = 0.05). The seven-year (1986-92) average annual estimate of Snake River fall chinook salmon at Lower Granite Dam is 328 fish (Columbia River Technical Staffs 1993b). Applying this value, approximately 0.3 percent of adult salmonids in the Snake River in 1994 are likely to be Snake River fall chinook salmon (328/122,185 = 0.00268). Therefore, approximately 0.006 Snake River fall chinook salmon are likely to be taken incidental to dam angling on the Snake River in 1994 (0.003 x 2 = 0.006), resulting in the mortality of 0.002 fish (0.33 x 0.006 = 0.0019). The seven-year (1986-92) average annual estimate of Snake River sockeye salmon migrating past Lower Granite Dam is 7.1 fish (Columbia River Technical Staffs 1993a).

Therefore, approximately 0.006 percent of adult salmonids in the Snake River in 1994 are likely to be Snake River sockeye salmon (7.1/122,185 = 0.000058), and approximately 0.00012 Snake River sockeye salmon are likely to be taken incidental to dam angling on the Snake River in 1994 (0.00006 x 2 = 0.00012), resulting in the mortality of 0.00004 fish (0.33 x 0.00012 = 0.0000396).

The ten year annual average (1982-91) for all adult salmonids passing McNary Dam during spring, summer, and fall is 359,300 fish (Fish Passage Center 1992). The 10-year (1982-91) average annual estimate of Snake River spring/summer chinook salmon at the mouth of the Columbia River, minus the estimated number of fish harvested in the Columbia River below McNary Dam, is 14,424 fish (Columbia River Technical Staffs 1993a). Applying the estimated conversion rate to provide for unaccountable losses between Bonneville Dam and McNary Dam (Ross 1994), 13,256 Snake River spring/summer chinook salmon are likely to pass McNary Dam in 1994 (14,424 x 0.919 = 13,255.66). Applying these average values, approximately 3.7 percent of adult salmonids in the Columbia River in 1994 are likely to be Snake River spring/summer chinook salmon (13,256/359,300 = 0.037). Therefore, 0.48 Snake River spring/summer chinook salmon are likely to be taken incidental to the dam angling activity on the Columbia River in 1994 (0.037 x 13 adult salmonids incidentally taken on Columbia River = 0.481), and 0.16 are likely to die (0.33 incidental mortality rate x 0.48 = 0.158).

The seven-year (1986-92) average annual estimate of Snake River fall chinook salmon at McNary Dam is 992 fish (Columbia River Technical Staffs 1993b). Applying this value, approximately 0.28 percent of adult salmonids in the Columbia River in 1994 are likely to be Snake River fall chinook salmon (992/359,300 = 0.00276). Therefore, approximately 0.036 Snake River fall chinook salmon will be taken incidental to dam angling on the Snake River in 1994 (0.0028 x 13 adult salmonids incidentally taken on Columbia River = 0.0364), resulting in the mortality of 0.012 fish (0.33 incidental mortality rate x 0.036 = 0.0119).

The seven-year (1986-92) average annual estimate of Snake River sockeye salmon migrating past Ice Harbor Dam is 11.14 fish (Columbia River Technical Staffs 1993a). The average survival past each lower Columbia River Dam for sockeye salmon has been estimated to be 96.8 percent (Ross 1993). Therefore, the seven-year (1986-92) average annual estimate of Snake River sockeye salmon at McNary Dam is 11.51 fish (11.14/0.968 = 11.508). Based on these average values, approximately 0.003 percent of adult salmonids in the Columbia River in 1994 are likely to be Snake River sockeye salmon (11.51/359,300 = 0.000032). Approximately 0.0004 Snake River sockeye salmon will be taken incidental to dam angling on the Columbia River in 1994 (0.00003 x 13 adult salmonids incidentally taken on Columbia River = 0.00039), resulting in the mortality of 0.00013 fish (0.33 x 0.0004 =

0.00013).

The total estimated take of listed Snake River adult salmon incidental to the dam angling activity is indicated in table 10.

Table 10. Estimated catch (take) and mortality of listed adult Snake River salmon due to dam angling activity.

SPECIES	TAKE	MORTALITY
Snake River spring/summer chinook salmon	0.63	0.21
Snake River fall chinook salmon	0.05	0.014
Snake River sockeye salmon	0.0005	0.00017

b. Sport-Reward Fishery

The reported catch of all adult salmonids incidental to the sport-reward fishery for the 1991 through 1993 time period was 130 fish. Only those fish landed were reported; there is no provision in the sport-reward fishery for reporting fish that are released. However, only those fish that were voluntarily returned to the squawfish voucher stations were recorded as incidental catch. It is likely, therefore, that additional, unreported instances of incidental catch occurred. The ratio of reported incidental adult salmonid:squawfish catch in the sport-reward fishery from 1991-93 was 0.00026 (incorporating preliminary data for 1993). The ratio of incidental adult salmonid:squawfish catch in the dam angling activity for 1991-93 was 0.00053, about twice the rate of the sport-reward fishery. Because, except for the data collection methods, the two activities are similar, for purposes of this consultation it is assumed that the rate of incidental salmonid catches for the sport-reward fishery is considered the same as for the dam angling activity. Therefore, based on the number of squawfish estimated to be caught during the sport-reward fishery in 1994, approximately 79 adult salmonids are expected to be incidentally taken (0.00053 x 149,459 = 79.21). Because participants in the sport-reward fishery are not involved in a structured activity with close direction provided by the resource agency, as is the case for the dam angling activity, it is likely that all incidentally-caught salmonids will die.

Approximately 22 percent of the sport-reward fishery effort occurred on the Snake River in 1992. Applying this value, and, in the absence of data, assuming that incidental catch rates are equal throughout the Snake and Columbia rivers, approximately 17 adult salmonids are likely to be taken incidental to the sport-reward fishery on the Snake River in 1994 (0.22 x 79 total adult salmonids incidentally taken = 17.38). Of these, it is expected that approximately 1.28 will be Snake River spring/summer chinook salmon (0.075 [proportion of listed adult spring/summer chinook

salmon in Snake River] x 17 = 1.275), approximately 0.05 will be Snake River fall chinook salmon (0.003 [proportion of listed adult fall chinook salmon in Snake River] x 17 = 0.051), and approximately 0.001 will be Snake River sockeye salmon (0.00006 [proportion of listed adult sockeye salmon in Snake River] x 17 = 0.00102).

Approximately 62 adult salmonids are likely to be taken incidental to the sport-reward fishery on the Columbia River in 1994 (0.78 [proportion of activity expected to occur on Columbia River] x 79 total adult salmonids expected to be incidentally taken = 61.62). Of these, it is expected that approximately 2.36 will be Snake River spring/summer chinook salmon (0.038 [proportion of listed adult spring/summer chinook salmon in Columbia River run] x 62 = 2.356), approximately 0.17 will be Snake River fall chinook salmon (0.0028 [proportion of listed adult fall chinook salmon in Columbia River run] x 62 = 0.173), and approximately 0.002 will be Snake River sockeye salmon (0.00003 [proportion of listed adult sockeye salmon in Columbia River run] x 62 = 0.00186).

The total estimated take of listed adult Snake River salmon incidental to the sport-reward fishery in 1994 is 3.64 spring/summer chinook salmon (1.28 in Snake River + 2.36 in Columbia River = 3.64), 0.22 fall chinook salmon (0.05 in Snake River + 0.17 in Columbia River = 0.22), and 0.003 sockeye salmon (0.001 in Snake River + 0.002 in Columbia River = 0.003).

c. Site-Specific Fishery

A total of 1,835 hours of gill net effort that will affect adult salmon is proposed. Thirty-seven adult salmonids were captured in 410 hours of gill net soak time in the Bonneville pool in 1993, resulting in an incidental catch rate of 0.09 adult salmonids per hour (37/410 = 0.09). Based on this experience, and, in the absence of other data, assuming that similar incidental catch rates will be experienced in other areas of the Columbia and Snake rivers, approximately 165 adult salmonids are expected to be caught incidental to gillnetting in the site-specific fishery activity in 1994 (1835 x 0.09 = 165.15). Applying an incidental mortality rate of 15 percent, approximately 25 adult salmonid mortalities are anticipated as a result of gillnetting for squawfish during site-specific fishery activities in 1994 (0.15 x 165 = 24.75).

Approximately 512 hours of gillnetting effort are scheduled on the Snake River, March through May, 1994, during the site-specific fishery. Approximately 46 adult salmonids are likely to be caught incidental to the 512 hours of gill net soak time (0.09 adult salmonids incidentally taken/hour x 512 = 46.08). Of these, about 3.45 are expected to be Snake River spring/summer chinook salmon (.075 [proportion of listed adult spring/summer

chinook salmon in Snake River run] x 46 = 3.45), and 0.52 are estimated to die (0.15 incidental mortality rate x 3.45 = 0.517). Approximately 0.14 Snake River fall chinook salmon are likely to be taken incidental to gillnetting on the Snake River in 1994 (0.003 [proportion of listed adult fall chinook salmon in Snake River run] x 46 = 0.138), resulting in the mortality of 0.02 fish (0.15 x 0.14 = 0.021). About 0.003 Snake River sockeye salmon are likely to be taken incidental to gillnetting on the Snake River in 1994 (0.00006 [proportion of listed adult sockeye salmon in Snake River run] x 46 = 0.00276), resulting in the mortality of about 0.0005 fish (0.15 x 0.003 = 0.00045).

Approximately 1,323 hours of gill net soak time are scheduled in the Columbia River during the site-specific fishery activity in 1994. Approximately 119 adult salmonids are likely to be caught incidental to this activity (0.09 adult salmonids incidentally taken/hour x 1,323 = 119.07). Of these, about 4.52 Snake River spring/summer chinook salmon are likely to be taken (0.038 [proportion of listed adult spring/summer chinook salmon in Columbia River run] x 119 = 4.52), and 0.68 are estimated to die (0.15 incidental mortality rate x 4.5 = 0.675). Approximately 0.33 Snake River fall chinook salmon are likely to be taken incidental to gillnetting (0.0028 [proportion of listed adult fall chinook salmon in Columbia River run] x 119 = 0.33), resulting in the mortality of 0.05 fish (0.15 x 0.33= 0.049). A total of 0.004 adult Snake River sockeye salmon are likely to be incidentally caught during the gillnetting activity (0.00003 [proportion of listed adult sockeye salmon in Columbia River run] x 119 = 0.00357), resulting in the mortality of 0.0006 fish (0.15 x 0.004 = 0.0006).

The total estimated take of listed adult salmon incidental to gillnetting operations proposed for 1994 is approximately: 7.97 Snake River spring/summer chinook salmon (3.45 in the Snake River + 4.52 in the Columbia River = 7.97), with a mortality of 1.2 fish (0.52 in the Snake River + 0.68 in the Columbia River = 1.2), 0.47 Snake River fall chinook salmon (0.14 in the Snake River + 0.33 in the Columbia River = 0.47), with a mortality of 0.07 fish (0.02 in the Snake River + 0.05 in the Columbia River = 0.07), and 0.007 Snake River sockeye salmon (0.003 in the Snake River + 0.004 in the Columbia River = 0.007), with an associated mortality of 0.001 fish (0.0005 in the Snake River + 0.0006 in the Columbia River = 0.0011).

Data provided in the BA indicates that 224 adult salmonids were captured during 381 hours of Merwin trap effort in 1993, incidental to the capture of 170 northern squawfish. Merwin traps were not used in the Snake River in 1993. Although the incidental catch rate of salmonids is likely to be lower in the Snake River than in the Columbia River, in the absence of data the incidental catch ratio experienced in 1993 is applied equally

to all sites in this consultation. Applying the ratio of incidental adult salmonid catch to effort (224/381 = 0.58), it is likely that approximately 406 adult salmonids will be incidentally taken during 700 hours of Merwin trap operations in 1994 (0.58 x 700 = 406).

Approximately 161 hours of Merwin trap effort are scheduled in the Snake River, March through May, 1994, which will result in the incidental catch of about 93 adult salmonids. (0.58 adult salmonids incidentally taken/hour x 161 = 93.38). Of these, about 6.98 adult Snake River spring/summer chinook salmon are likely to be taken (.075 [proportion of listed adult spring/summer chinook salmon in Snake River run] x 93 = 6.975), and 0.02 are estimated to die (0.0027 incidental mortality rate x 6.98 = 0.0189). Approximately 0.28 Snake River fall chinook salmon are likely to be taken incidental to Merwin trapping on the Snake River in 1994 (0.003 [proportion of listed adult fall chinook salmon in Snake River run] x 93 = 0.279), resulting in the mortality of 0.0008 fish (0.0027 x 0.28 = 0.00076). About 0.006 Snake River sockeye salmon are likely to be taken incidental to trapping on the Snake River in 1994 (0.00006 [proportion of listed adult sockeye salmon in Snake River run] x 93 = 0.00558), resulting in the mortality of about 0.00002 fish (0.0027 x 0.006 = 0.000016.

Approximately 539 hours of Merwin trapping effort are scheduled for the Columbia River, April through June, 1994, which will result in the incidental catch of approximately 313 adult salmonids (0.58 adult salmonids incidentally taken/hour x 539 = 312.62). Of these, about 11.89 Snake River spring/summer chinook salmon are likely to be taken (0.038 [proportion of listed adult spring/summer chinook salmon in Columbia River run] x 313 = 11.894), and 0.03 are likely to die (0.0027 incidental mortality rate x 11.9 = 0.032). Approximately 0.88 Snake River fall chinook salmon are likely to be taken incidental to gillnetting (0.0028 [proportion of listed adult fall chinook salmon in Columbia River run] x 313 = 0.876), resulting in the mortality of 0.002 fish (0.0027 x 0.88 = 0.0024), and about 0.009 adult Snake River sockeye salmon are likely to be incidentally caught during the gillnetting activity (0.00003 [proportion of listed adult sockeye salmon in Columbia River run] x 313 = 0.0094), resulting in the mortality of 0.00002 fish (0.0027 x 0.009 = 0.000024).

The total estimated take of listed Snake River adult salmon incidental to the site-specific fishery activity is indicated in table 11.

Table 11. Estimated catch (take) and mortality of listed adult Snake River salmon due to site-specific fishery activity.

SPECIES	TAKE	MORTALITY
Snake River spring/summer chinook salmon	26.84	1.25
Snake River fall chinook salmon	1.63	0.073
Snake River sockeye salmon	0.022	0.001

d. Biological Evaluation

1). 1993 Effort

Approximately 880 hours of gillnetting effort were conducted on the Snake and Columbia rivers in association with this activity in 1993. Of these, 829 hours of effort during the mark and release portion of the activity were conducted throughout the study area, and 51 hours of effort during the size structure, population dynamics, and consumption efforts were concentrated in Columbia River reservoirs. Assuming equivalent effort between the rivers during the mark and release activity, approximately 414.5 hours of gillnetting effort occurred in Snake River reservoirs (829/2 = 414.5), and 465.5 hours of effort occurred in Columbia River reservoirs (414.5 + 51 = 465.5).

2). 1993 Collections

A total of 503 adult salmonids were caught incidental to the biological evaluation activity in 1993, including 289 steelhead, 89 chinook salmon, 54 sockeye salmon, and 71 unidentified salmonids. Spring/summer and fall chinook salmon were not distinguished. Sixty-seven percent of the identified fish were steelhead, 21 percent were chinook salmon, and 12 percent were sockeye salmon (289 + 89 + 54 = 432; 289/432 = 0.67; 89/432 = 0.21; 54/432 = 0.12). Assuming that the species composition of the unidentified fish was the same as those identified, the unidentified fish would be composed of 47.6 steelhead, 14.9 chinook salmon, and 8.5 sockeye salmon (0.67 x 71 = 47.57; 0.21 x 71 = 14.91; 0.12 x 71 = 8.52). Therefore, the estimated composition of the total incidental catch of adult salmonids in 1993 was 337 steelhead (289 + 47.6 = 336.6), 104 chinook salmon (89 + 14.9 = 103.9), and 62.5 sockeye salmon (54 + 8.5 = 62.5). A similar level of effort is expected to result in a similar incidental catch of adult salmonids in 1994.

In 1993, 37 percent of the adult chinook salmon incidentally captured during biological evaluation activities were taken in the Snake River (33/89 = 0.37). A total of 12 adult chinook salmon in both rivers were caught by gill nets during approximately 880 hours of soak time, constituting 13.5 percent

of the total take of chinook salmon (12/89 = 0.135), but the number of fish taken by gill net in each river was not specified in the BA. Although the incidental catch rate of salmonids was likely lower in the Snake River than in the Columbia River, in the absence of data a similar catch rate for each method in each river is assumed in this consultation. Therefore, about 4.44 adult chinook salmon were likely taken by gill net in the Snake River (0.37 [proportion of catch in Snake River] x 12 adult salmonids incidentally captured by gill net = 4.44). The method of catch for unidentified fish was not specified in the BA. Of the 5.5 unidentified fish (14.9 total unidentified fish projected to be adult chinook salmon x 0.37 = 5.513) ascribed to the chinook salmon incidental catch on the Snake River, an estimated 0.74 were taken incidental to gillnetting (0.135 [proportion of total chinook salmon incidental take attributable to biological evaluation gillnetting] x 5.5 = 0.743), for a total of approximately 5.18 chinook salmon taken incidental to gillnetting (4.44 + 0.74 = 5.18) on the Snake River. No sockeye salmon were taken incidental to the biological evaluation activity on the Snake River in 1993.

63 percent of the chinook salmon incidentally captured during biological evaluation activities in 1993 were taken in the Columbia River (56/89 = 0.629). Therefore, about 7.56 chinook salmon were likely taken by gill net in the Columbia River (0.63 x 12 total adult chinook salmon incidentally taken = 7.56). Of the 9.4 unidentified fish ascribed to the chinook salmon incidental catch on the Columbia River (14.9 total unidentified fish projected to be adult chinook salmon x 0.63 = 9.38), an estimated 1.3 were taken incidental to gillnetting (0.135 [proportion of total chinook salmon incidental take attributable to biological evaluation gillnetting] x 9.4 = 1.269), for a total of 8.86 adult chinook salmon taken incidental to gillnetting (7.56 + 1.3 = 8.86).

Of 54 adult sockeye salmon taken on the Columbia River in 1993, only one was taken incidental to gillnetting. Of the 8.5 unidentified fish ascribed to the sockeye salmon incidental catch on the Columbia River, an estimated 0.16 sockeye salmon are attributable to gillnetting operations ([1/54] x 8.5 = 0.157), for a total of 1.16 fish (1 + 0.16 = 1.16).

The estimated catch-per-hour of adult chinook salmon in the Snake River incidental to the gillnetting portion of the biological evaluation activity in 1993 was 0.011 fish (5.18 adult chinook salmon taken on Snake River/414.5 hours of effort on Snake River = 0.011). The estimated catch-per-hour of adult chinook salmon in the Columbia River was approximately 0.02 fish (9.3 adult chinook salmon incidentally taken on the Columbia River/465.5 hours of effort on Columbia River = 0.0199). For sockeye salmon the estimated incidental catch-per-hour in the Columbia River was

0.0025 fish (1.16 adult sockeye salmon incidentally taken on Columbia River/465.5 = 0.00249). No sockeye salmon were taken incidental to gillnetting on the Snake River in 1993. Multiplying the ratio of the maximum number of adult sockeye salmon expected to be in the Snake River in 1994 to the seven-year (1986-92) average annual estimate of Columbia River sockeye salmon runsize (Columbia River Technical Staffs 1993a) by the estimated gill net catch-per-hour of sockeye salmon in the Columbia River yields an estimated catch-per-hour value of approximately 0.0000002 Snake River sockeye salmon anticipated during 1994 biological evaluation gillnetting operations on the Snake River ([7.1/80,443] x 0.0025 = 0.0000002).

A total of 77 chinook salmon in both rivers were taken incidental to electrofishing, comprising 86.5 percent of the total take (77/89 total adult chinook salmon incidentally taken = 0.865). Assuming an incidental take rate for electrofishing in each river similar to the overall incidental take rate in each river, about 28.5 chinook salmon were likely taken in the Snake River in 1993 (0.37 [proportion of incidental take on Snake River] x 77 hours = 28.49). Of the 14.9 unidentified fish ascribed to the chinook salmon incidental catch, an estimated 4.77 were taken incidental to electrofishing on the Snake River ([0.865 x 14.9] x 0.37 = 4.77), for a total of 33.27 chinook salmon (28.5 + 4.77 = 33.27). The rate of incidental take on the Snake River, therefore, was 0.25 adult chinook salmon/hour of electrofishing effort (33.27/134 hours = 0.248). No sockeye salmon were captured incidental to electrofishing efforts on the Snake River in 1993.

About 48.5 adult chinook salmon were taken incidental to electrofishing in the Columbia River in 1993 (0.63 [proportion of incidental take of adult chinook salmon on Columbia River] x 77 total adult chinook salmon taken incidental to electrofishing = 48.51). Of the 9.39 unidentified fish ascribed to the chinook salmon incidental catch on the Columbia River, an estimated 8.12 were taken incidental to electrofishing (0.865 [proportion of incidental take of adult chinook salmon attributable to electrofishing] x 9.39 = 8.12), for a total of 56.62 chinook salmon taken incidental to electrofishing (48.5 + 8.12 = 56.62). The incidental catch rate/hour of adult chinook salmon, therefore, was 0.21 fish (56.62/269 hours = 0.21). Over 98 percent of sockeye salmon incidentally captured in the Columbia River were a result of electrofishing (53 adult sockeye salmon taken incidental to electrofishing/54 total adult sockeye salmon incidentally taken = 0.982). Of the 8.5 unidentified fish ascribed to the sockeye salmon incidental catch on the Columbia River, an estimated 8.35 sockeye salmon are attributable to electrofishing operations (0.982 x 8.5 = 8.347), for a total of 61.35 fish (53 + 8.35 = 61.35). The incidental take rate/hour of adult sockeye salmon, therefore, was 0.23 fish (61.35/269 = 0.228).

3). Proposed 1994 Operations

Approximately 829 hours of gillnetting effort are proposed to occur incidental to the mark and release activity and 51 hours of gillnetting effort are proposed to occur incidental to the size structure, population dynamics and consumption study activities in 1994. The degree of effort that will be made in each of the reservoirs/river reaches during gillnetting will depend on the level of squawfish catch. For purposes of this consultation, effort is assumed to be equal for each reservoir/river reach. Mark and release gillnetting efforts will be evenly distributed between the Snake and Columbia rivers (829 hours/2 = 414.5 hours), while 80 percent of the effort for the size structure, population dynamics, and consumption study activities will occur in the Snake River (0.8 x 51 hours = 40.8 hours in the Snake River; 0.2 x 51 hours = 10.2 hours in the Columbia River).

A total of approximately 456 (414.5 hours of mark and release effort + 41 hours of size structure, population dynamics, and consumption study efforts = 455.5) hours of gill net soak time in the Snake River may result in the incidental take of as many as 5 adult chinook salmon (0.011 incidentally caught adult chinook salmon/hour x 456 hours = 5.016). Approximately 0.38 of these fish are likely to be Snake River spring/summer chinook salmon (0.075 [proportion of listed adult spring/summer chinook salmon in Snake River run] x 5 = 0.375), of which 0.06 are likely to die as a result of being caught in gill nets (0.15 incidental mortality rate x 0.38 = 0.057). Approximately 0.015 of the incidentally caught salmonids are likely to be Snake River fall chinook salmon (0.003 [proportion of listed adult fall chinook salmon in Snake River run] x 5 = 0.015), of which about 0.002 are likely to die (0.15 x = 0.015 = 0.0023). Approximately 456 hours of soak time may result in the incidental take of about 0.00009 Snake River sockeye salmon (0.0000002 [estimated incidental catch/hour of sockeye salmon on Snake River] x 456 = 0.00009), with an associated mortality of 0.000014 fish (0.15 x 0.00009 = 0.0000135).

Approximately 425 hours (414.5 hours of mark and release effort + 10.2 hours of size structure, population dynamics, and consumption study efforts = 424.7) of gillnetting effort in the Columbia River will result in an estimated incidental catch of approximately 8.5 adult chinook salmon (0.02 incidentally caught adult chinook salmon/hour x 425 hours = 8.5) and 1.06 adult sockeye salmon (0.0025 incidentally caught adult sockeye salmon/hour x 425 = 1.063). Of these, approximately 0.32 are likely to be Snake River spring/summer chinook salmon (0.038 [proportion of listed adult spring/summer chinook salmon in Columbia River run] x 8.5 = 0.323), approximately 0.02 are likely to be Snake River fall chinook salmon (0.0028 [proportion of listed adult fall chinook salmon in Columbia River run] x 8.5 = 0.024), and approximately 0.00003 are likely to be Snake River

sockeye salmon (0.00003 [proportion of listed adult sockeye salmon in Columbia River run] x 1.06 = 0.000032). Application of the 15 percent incidental mortality value yields estimated mortalities incidental to proposed biological evaluation gillnetting operations in the Columbia River in 1994 of 0.05 Snake River spring/summer chinook salmon (0.15 x 0.32 = 0.048), 0.003 Snake River fall chinook salmon (0.15 x 0.02 = 0.003), and 0.000005 Snake River sockeye salmon (0.15 x 0.00003 = 0.0000045).

Approximately 242 hours of electrofishing effort in the Snake River in 1994 will result in an estimated incidental catch of 60.5 adult salmonids (0.25 adult chinook salmon incidentally taken/hour x 242 = 60.5). Of these, approximately 4.54 are likely to be Snake River spring/summer chinook salmon (0.075 [proportion of listed adult spring/summer chinook salmon in Snake River run] x 60.5 = 4.537), and approximately 0.18 are likely to be Snake River fall chinook salmon (0.003 [proportion of listed adult fall chinook salmon in Snake River run] x 60.5 = 0.182). Snake River electrofishing efforts will result in an estimated incidental catch of approximately 0.008 Snake River sockeye salmon (0.000034 listed adult sockeye salmon incidentally taken/hour x 242 hours = 0.0082). Application of the upper end of the 32 to 67 percent incidental mortality range yields estimated mortalities resulting from the proposed electrofishing operations in the Snake River in 1994 of 1.7 adult Snake River spring/summer chinook salmon (0.67 x 4.54 = 3.04), 0.12 adult Snake River fall chinook salmon (0.67 x 0.18 = 0.1206), and 0.005 Snake River sockeye salmon (0.67 x 0.008 = 0.005). Because of the uncertainty of long-term, indirect effects of electroshock on behavior and reproduction, in addition to the direct observable effects referenced above, the higher mortality value has been applied in this consultation.

161 hours of electrofishing effort in the Columbia River will result in an estimated incidental catch of approximately 55 adult chinook salmon (0.21 adult chinook salmon incidentally taken/hour x 161 hours = 33.81). Of these, approximately 1.29 are likely to be Snake River spring/summer chinook salmon (0.038 [proportion of listed adult spring/summer chinook salmon in Columbia River run] x 33.81 = 1.285), and approximately 0.1 are likely to be Snake River fall chinook salmon (0.0028 [proportion of listed adult fall chinook salmon in Columbia River run] x 33.81 = 0.095). Columbia River electrofishing efforts are likely to result in the incidental catch of 61 sockeye salmon (0.23 adult sockeye salmon incidentally taken/hour x 161 hours = 37.03), of which approximately 0.001 are estimated to be Snake River sockeye salmon (0.00003 [proportion of listed adult sockeye salmon in Columbia River run] x 37 = 0.0011). Application of the upper end of the 32 to 67 percent incidental mortality value yields estimated mortalities incidental to proposed electrofishing operations in the Columbia River in 1994 of 0.86 Snake River spring/summer chinook salmon (0.67 x 1.29 = 0.864), 0.07 Snake

River fall chinook salmon (0.67 x 0.1 = 0.067), and 0.0007 Snake River sockeye salmon (0.67 x 0.001 = 0.0067).

The total estimated take of listed Snake River adult salmon incidental to the biological evaluation activity is indicated in table 12.

Table 12. Estimated catch (take) and mortality of listed adult Snake River salmon due to biological evaluation activity.

SPECIES	TAKE	MORTALITY
Snake River spring/summer chinook salmon	6.53	4.01
Snake River fall chinook salmon	0.315	0.195
Snake River sockeye salmon	0.009	0.006

e. Adult Summary

The total direct take of listed adult salmon resulting from all predator control and monitoring activities in 1994 is described in table 13.

Table 13. Estimated catch (take) and mortality of listed adult Snake River salmon due to all squawfish management program activities.

TOTAL TAKE BY SPECIES	TAKE	MORTALITY
Snake River spring/summer chinook salmon	37.64	6.75
Snake River fall chinook salmon	2.22	0.5
Snake River sockeye salmon	0.04	0.01

V. CUMULATIVE EFFECTS

Cumulative effects are those impacts of future non-Federal, state and local government, and private actions that are reasonably certain to occur within the area of Federal actions under review. Future Federal actions, including ongoing research operations involving the incidental and direct take of listed Snake River salmon during gillnetting and electrofishing activities, are being or have been reviewed through separate section 7 and section 10 consultation processes. In addition, non-Federal actions that require authorization under section 10 of the ESA will be evaluated under section 7 consultations. Therefore, these actions are not considered cumulative to the proposed action.

VI. CRITICAL HABITAT

As described in previous sections of this biological opinion, activities of the Squawfish Management Program may affect essential features of the migration corridors of listed Snake River salmon by modifying passage conditions due to the temporary delay of migrants incidentally captured. However, because of the low level of take and the brief nature of potential delays, administration of the Squawfish Management Program is not likely to appreciably diminish the value of critical habitat for the survival and recovery of the listed species.

VII. CONCLUSION

Based on results from 1991-1993 research efforts, as many as 94.09 juvenile and 36.09 adult Snake River spring/summer chinook salmon will be taken incidentally to activities conducted by the squawfish management program in 1994. Of these, the mortality of approximately 11.76 juveniles and 8.2 adults is anticipated. As many as 4.28 juvenile and 2.17 adult Snake River fall chinook salmon will be taken. Of these, the mortality of approximately 0.53 juveniles and 0.48 adults is anticipated. As many as 0.5 juvenile and 0.035 adult Snake River sockeye salmon will be taken. Of these, the mortality of approximately 0.06 juveniles and 0.01 adults is anticipated.

Migration delays are anticipated for all three species of adult and juvenile Snake River salmon that are taken but not killed incidentally to each of the program activities. Merwin traps will delay incidentally caught Snake River salmon due to confinement for a maximum of three hours. Gill nets will cause delays due to confinement of less than an hour. Stress due to entrapment or netting may cause behavioral changes, which could result in further delays, but the magnitude, if any, of such delays are unknown. Stress from electroshock and handling may cause delays of 6 to 24 hours. Stress from hook and release may cause behavioral changes and migrational delays of unknown duration. Because of: 1) the low total number of listed Snake River salmon that are likely to be incidentally taken; 2) the short duration of the delays that are anticipated; and 3) the low number of listed Snake River salmon that are likely to be taken incidentally to dam angling and the sport reward activities, where the effects of catch and release on migratory behavior is unknown, the effects of the proposed activities on the migration of listed Snake River salmon are likely negligible.

The take of listed Snake River salmon incidentally to the activities of the Squawfish Management Program is likely to be equal to or less than operation of the program in 1993. The site-specific activity has re-structured the operation of Merwin traps to maximize the catch of northern squawfish and minimize the incidental take of salmonids. Although not a certainty,

selective targeting of trapping sites has the potential to reduce the incidental take of listed Snake River salmon. The catch rate criterion for adult salmonids caught in Merwin traps has been reduced from 6.3 per hour in 1993 to 5 per hour in 1994, which could reduce stress in captured fish. Merwin traps will be checked and emptied at least every three hours for the entire 1994 season. Fish were held for a maximum of four hours prior to May 31 and after September 30 in 1993. Reduced holding time is likely to reduce stress in captured fish. The mortality of salmonids incidentally taken in gill nets should be less than in 1993, because gill net soak times have been reduced, as indicated in the Incidental Take Statement.

Based on the available information, NMFS concludes that operation of the Squawfish Management Program in 1994 is not likely to jeopardize the continued existence of listed Snake River salmon or result in the destruction or adverse modification of critical habitat. Additionally, conduct of the program may have the beneficial effect of reducing predation on migrating juvenile Snake River salmon.

VIII. REINITIATION OF CONSULTATION

Reinitiation of formal consultation is required if discretionary Federal involvement or control over the action has been retained or is authorized by law and if: 1) the amount or extent of taking specified in any incidental take statement is exceeded; 2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; 3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action.

IX. CONSERVATION RECOMMENDATIONS

1. Given the degree of electrofishing effort in the Columbia and Snake River basins in the course of research operations, and the uncertainty of effects on both listed and non-listed non-target fish, NMFS considers directed research to elucidate this problem to be of critical importance. The BPA should fund a research program specifically directed at the effects of electrofishing on adult and juvenile salmonids. The research should include investigation of the direct physiological effects, possible migrational delays and increased susceptibility to predation, and possible effects on spawning behavior and success.

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XI. INCIDENTAL TAKE STATEMENT

Section 9 and regulations implementing Section 4 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. When a proposed Federal action is found to be consistent with Section 7(a)(2) of the ESA (i.e., the action is found not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat) and that action may incidentally take individuals of listed species, NMFS will issue an incidental take statement specifying the impact of any incidental taking of endangered or threatened species.

The incidental take statement also provides reasonable and prudent measures that are necessary to minimize impacts, and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures. Incidental takings resulting from the agency action, including incidental takings caused by activities authorized by the agency, are exempted from the taking prohibition by section 7(o) of the ESA, but only if those takings are in compliance with the specified terms and conditions.

A. Anticipated Incidental Take

Tables 14 and 15 indicate the estimated incidental take and mortality of juvenile and adult salmonids during squawfish management program activities. Because the structure and degree of supervision and monitoring is variable among the activities, and the work often takes place at night when identification to species is difficult, the incidental take is estimated and to be monitored in terms of the total number of juvenile salmonids and adult salmonids taken by each activity, rather than a prescribed level for each species by activity.

Table 14. Estimated catch (take) and mortality of juvenile salmonids due to all squawfish management program activities.

TOTAL TAKE OF JUVENILE SALMONIDS	TAKE	MORTALITY
DAM ANGLING - SNAKE RIVER	4	4
DAM ANGLING - COLUMBIA RIVER	28	28
SPORT REWARD FISHERY - SNAKE RIVER	43	43
SPORT REWARD FISHERY - COLUMBIA RIVER	151	151
SITE-SPECIFIC FISHERY - SNAKE RIVER (GILLNETTING)	36	14
SITE-SPECIFIC FISHERY - COLUMBIA RIVER (GILLNETTING)	99	39
SITE-SPECIFIC FISHERY - SNAKE RIVER (MERWIN TRAPPING)	145	0.39
SITE-SPECIFIC FISHERY - COLUMBIA RIVER (MERWIN TRAPPING)	485	1.31
BIOLOGICAL EVALUATION - SNAKE RIVER (ELECTROFISHING)	1,868	187
BIOLOGICAL EVALUATION - COLUMBIA RIVER (ELECTROFISHING)	2,109	211
BIOLOGICAL EVALUATION - SNAKE RIVER (GILLNETTING)	32	13
BIOLOGICAL EVALUATION - COLUMBIA RIVER (GILLNETTING)	30	12

Table 15. Estimated catch (take) and mortality of adult salmonids due to all squawfish management program activities.

TOTAL TAKE OF ADULT SALMONIDS	TAKE	MORTALITY
DAM ANGLING - SNAKE RIVER	2	0.78
DAM ANGLING - COLUMBIA RIVER	13	5
SPORT REWARD FISHERY - SNAKE RIVER	17	17
SPORT REWARD FISHERY - COLUMBIA RIVER	62	62
SITE-SPECIFIC FISHERY - SNAKE RIVER (GILLNETTING)	46	7
SITE-SPECIFIC FISHERY - COLUMBIA RIVER (GILLNETTING)	119	18
SITE-SPECIFIC FISHERY - SNAKE RIVER (MERWIN TRAPPING)	93	0.25
SITE-SPECIFIC FISHERY - COLUMBIA RIVER (MERWIN TRAPPING)	313	0.84
BIOLOGICAL EVALUATION - SNAKE RIVER (ELECTROFISHING)	60.5	41
BIOLOGICAL EVALUATION - COLUMBIA RIVER (ELECTROFISHING)	55	37
BIOLOGICAL EVALUATION - SNAKE RIVER (GILLNETTING)	5	0.75
BIOLOGICAL EVALUATION - COLUMBIA RIVER (GILLNETTING)	9.5	1.4

The total allowable take of juvenile and adult salmonids indicated above reflects an estimated maximum of approximately 94 juvenile and 36 adult Snake River spring/summer chinook salmon that will be taken incidental to activities conducted by the squawfish management program in 1994. Of these, the mortality of approximately 12 juveniles and 8 adults is anticipated. As many as 4 juvenile and 2 adult Snake River fall chinook salmon are expected to be taken. Of these, the mortality of approximately one juvenile and one adult is anticipated. As many as one juvenile and no adult Snake River sockeye salmon are expected to be taken, and no juveniles or adults are expected to be killed.

B. Reasonable and Prudent Measures and Conditions for Implementation

1. Gill nets shall be checked at least once every 45 minutes to minimize potential mortalities associated with the incidental catch of listed salmon.

2. As field conditions permit, the BPA shall assure that all Squawfish Management Program activities make every effort to record the species, life stage, location and time of incidental take of adult and juvenile salmonids. Recording of incidental take data shall not interfere with the return of incidentally caught salmonids to the river in as quick and efficient a manner as possible.

3. Measures that will be taken to minimize the incidental catch of salmonids and reduce the possibility of stress or injury when gill nets are deployed or electrofishing is conducted during the biological evaluation activity shall include: 1) all sampling shall take place one hour after sunset and cease one hour before sunrise; 2) sampling shall not take place when water temperatures exceed 68°F; and 3) sampling gear shall not be employed within 500 feet of any hydroelectric project fishway entrance. In addition, conditions that will prompt the cessation of sampling activities in order to minimize the possibility of taking listed Snake River salmon shall include: 1) sampling shall cease in the Bonneville tailrace after one adult sockeye salmon passes Bonneville Dam; 2) sampling shall cease in the Snake River after one adult sockeye salmon passes Ice Harbor Dam; 3) sampling shall cease in a Columbia River reservoir when 10 or more adult sockeye salmon pass the nearest downstream dam in any one day; 4) sampling shall cease in any Columbia River reservoir as well as in the Snake River if one adult sockeye salmon is incidentally taken; and 5) sampling shall cease in all reservoirs if the incidental catch of salmon or steelhead is three percent or more of the cumulative number of adults of each species, respectively, passing the dam; calculation of the cumulative number shall begin with the day preceding the deployment of sampling gear; sampling shall resume when sufficient adults have passed to reduce the incidental take to 2.5 percent or less of the cumulative count. Additional measures that shall be taken to minimize the incidental catch and injury of salmonids include: 1) cessation of effort for that night at a particular site (a reach of the river 400 meters or less in length) if two or more adult salmonids or 100 or more juvenile salmonids are caught; 2) cessation of effort at a location (a reach of the

river three kilometers or less in length) for that night if five or more adult salmonids or 250 or more juvenile salmonids are caught; and 3) cessation of effort at a particular site if the number of juvenile salmonids recorded as dead or in fair condition, i.e. injured, comprise 50 percent or more of the total number of squawfish greater than 271 mm in length that are caught.

4. All squawfish management program activities shall cease in the Snake River after one adult sockeye salmon passes Ice Harbor Dam.

5. For each activity and each activity area, Squawfish Management Program operations shall cease when the incidental take of juvenile or adult salmonids meets or exceeds the estimated incidental take indicated in tables 14 and 15.

File: BPA I C.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
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MAY - 5 1994

F/NW

Mr. Roy Fox
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

Dear Mr. Fox:

Weekly field activity reports of the Squawfish Management Program indicate that the electrofishing component of the biological evaluation activity in the Columbia River has exceeded the allowable incidental take of both juvenile and adult salmonids, as identified in the April 22, 1994, Biological Opinion for the Columbia River Northern Squawfish Management Program for 1994. Accordingly, immediate reinitiation of consultation and cessation of biological evaluation electrofishing activities in the Columbia River is required.

As stipulated in the Biological Opinion, this action does not affect electrofishing activities in the Snake River, other components of the biological evaluation activity, or other activities encompassed by the Squawfish Management Program.

Your prompt attention to this matter is appreciated.

Sincerely,

J. Gary Smith
Acting Regional Director

bc: F/NW - D. Darm
GCNW - M. Bancroft
F/NW03 - B. Brown/G. Griffin
C. Toole/J. Young