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EFFECTS OF HANDLING AND TRUCKING ON CHINOOK SALMON, STRIPED BASS, AMERICAN SHAD, STEELHEAD TROUT, THREADFIN SHAD, AND WHITE CATFISH SALVAGED AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY

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ABSTRACT

Tests were conducted to determine the mortality associated with handling and trucking fish salvaged at the John E. Skinner Delta Fish Protective Facility during the period September 1984 through October 1985. Six species of fish were used in the analysis:

Chinook salmon *(Oncorhynchus tshawytscha)*
Striped bass *(Morone saxatilis)*
American shad *(Alosa sapidissima)*
Steelhead trout *(Oncorhynchus mykiss)*
Threadfin shad *(Dorosoma petenense)*
White catfish *(Ictalurus catus)*

Mortality varied widely depending on species, size of fish, and water temperature. The greatest mortalities were observed in the trucking tests during periods of higher water temperatures and holding tank flows. Striped bass, American shad, threadfin shad, and white catfish consistently exhibited high handling and trucking mortalities. Holding tank temperature and dissolved oxygen were the most common parameters significantly correlated with handling mortality. Trucking water temperature and dissolved oxygen and holding tank flow and holding tank water temperature were the most common parameters significantly correlated with trucking mortality.

INTRODUCTION

The effects of handling and trucking on fish salvaged at the John E. Skinner Delta Fish Protective Facility (Skinner facility) are an important factor in successful operation of the facility. The Skinner facility is part of the State Water Project (SWP) and is located on the intake channel to the Harvey O. Banks Delta Pumping Plant, in Contra Costa County. Annual salvage at the facility between 1980 and 1985 averaged 4.8 million fish, composed of some 55 species.

The sole purpose of the Skinner facility is to help preserve the fishery resources of the Sacramento-San Joaquin Delta. To help maximize the salvage efficiency of the facility (i.e., maximize the number of fish released alive back into the Delta), losses associated with the handling and trucking operations at the facility were evaluated during 1984 and 1985. No evaluations of this type had been done at the Skinner facility prior to this study.

The California Department of Fish and Game conducted a study (1973 through 1979) at the Federal Central Valley Project's (CVP) Tracy Fish Collecting Facility (Tracy facility) to determine the effects of handling and trucking on juvenile chinook salmon (Menchen 1980). They reported that a substantial handling and trucking mortality was occurring during those operations. No other studies have been conducted with any other species at the Tracy facility.

Presently, fish at both facilities are being trucked as dictated by tables that specify the percent of a load for a given size hauling truck determined by fish sizes, number for each size group, and water temperature (Bates et al. 1960).

The process of handling and/or trucking various species of fish has been shown to cause stress that creates a blood electrolyte and/or osmotic disturbances that may result in mortality (Lewis 1971, Wedemeyer 1972, Wydoski and Wedemeyer 1976). Barton et al. (1980) reported that rainbow trout *(Oncorhynchus mykiss)* subjected to handling, confinement, transport, and stocking showed signs of being stressed as indicated by elevated plasma cortisol levels.

Chinook salmon *(Oncorhynchus tshawytscha)* were shown to be stressed, apparently in a cumulative manner, by elements of the collection system at McNary Dam on the Columbia River (Schreck et al. 1985). Schreck et al. (1985) also reported that loading fish into either a barge or truck was the most stressful event in the transportation procedure.

Largemouth bass *(Micropterus salmonides)* were shown to be stressed during hauling (Carmichael 1984). Specker and Schreck (1980) concluded that transportation caused stress in coho salmon *(Oncorhynchus kisutch)* regardless of hauling density (12 and 120 g/L) and duration (4 and 12 h).

The stresses associated with the salvage of fish at the facility are numerous and accumulative. These stresses may begin accumulating as soon as fish encounter the radial gates and the high velocities associated with the intake to the SWP. As fish are drawn across the forebay toward the fish facility, they may be subjected to possible predation. After crossing the forebay, fish encounter the trash rack and may hesitate before negotiating the 2-inch space opening between bars. The hesitation expends extra energy and subjects fish to predation for a longer period. Mechanical damage or abrasion may occur as fish pass through the trash rack.

Next, the fish encounter the primary louvers, which divert the fish into bypass pipes that lead to a smaller, secondary louver or perforated plate system. Again, fish may exert extra energy to avoid the screen and may hesitate before entering the primary bypass, which increases exposure to predation. Once inside the primary bypass pipe, fish are subjected to higher velocities and, at times, a partially closed butterfly valve. Either of these conditions may cause mechanical damage or abrasions.

Exiting the primary bypass, the fish encounter the secondary screens, which divert the fish into another set of bypass pipes that lead into four adjacent holding tanks. Again, fish may exert extra energy to avoid the screen and may hesitate before entering the secondary bypass, which increases exposure to predation and may cause mechanical abrasion. Once inside the primary bypass pipe, fish are subjected to higher velocities and, at times, two separate butterfly valves, which may be partially closed. Either of these conditions may cause mechanical damage or abrasions.

Finally, fish reach the collection tanks and are held there until enough fish have been collected to warrant a fish haul run. Collection times vary from 1 to 24 hours. While in the collection tank, fish must swim continuously against holding tank velocities that may be as high as 2 feet per second. Also, fish are probably subjected to predation while in the holding tanks.

In preparing the collected fish for transporting, the holding tank is drawn down and fish are washed into the 500 gallon collecting bucket by a surge of water from the influent line of the holding tank. During the drawdown and washing process, fish are subjected to some strong turbulence.

Fish, at times numbering tens of thousands, are confined to the 500-gallon collecting bucket. During this time, fish may be over-crowded and may lower the dissolved oxygen level within the bucket to below an adequate level. The collecting bucket may be transferred to the next holding tank, which has been draining, and fish may go through the washing-down process again. Fish are loaded into the bucket and transferred to the next holding tank, which also has been draining.

During months when fish are abundant and water temperatures are higher and dissolved oxygen levels are low, this process of collecting and loading fish may be very stressful. Also, during certain times of the year, heavy loads of debris and/or algae will hamper the collection and prolong the time fish spend in the collection bucket. Once the collection of fish has been completed, fish are transferred and dumped into the appropriate size transport truck. When loading fish into the 600 gallon truck, there is very little water in the truck to cushion the drop and force from the collection bucket.

Finally, the fish are transported to the release site, which takes about 60 minutes. During transport, sloshing may cause fish to exert extra energy to maintain their position and equilibrium in the tank. The fish are released into the release pipe, which leads back to the Delta beyond the influence of the SWP and CVP pumps. Fish that remain in the truck are washed down with a low pressure hose and/or pushed out with a brush. By this time, the surviving fish are probably very stressed and very vulnerable to predation.

The purpose of this study was to determine if the procedures for collection, handling, and trucking are causing significant mortality to the successfully screened fish and to develop procedures and/or revise the hauling tables to minimize losses.

DWR/DFG AGREEMENT FOR MITIGATING DIRECT LOSSES AT THE SWP

In 1986, the Department of Water Resources (DWR) entered into an agreement with the Department of Fish and Game to offset direct losses of striped bass, chinook salmon, and steelhead trout caused by the diversion of water by the Harvey O. Banks Delta Pumping Plant. DWR and DFG intend this agreement to offset direct losses of all fish caused by the diversions of water by the pumping plant. At present, sufficient information exists to deal only with the three species mentioned above. However, impacts on other species of fish will be addressed if impacts are identified and measures can be developed that would offset such impacts.

The direct impact of the SWP on the fishery resources of the Delta begins when fish are drawn into Clifton Court Forebay along with the water the project diverts from the Delta.

Direct losses of fish entrained into the SWP system comprise several sources. These include:

- *Pre-screening losses,* primarily believed to result from predation before the fish encounter the screens.
- *Screening losses,* fish passing through the primary louver screens and lost to the Delta.
- *Handling losses,* mortalities resulting from the handling required to transfer fish from the collecting tanks to a fish hauling truck.
- *Trucking losses,* mortalities resulting from transporting and releasing fish back to the Delta beyond the influence of the SWP and CVP pumps.
- *Delayed losses,* mortalities resulting from stress imposed upon fish from the time they are entrained until they are released alive back into the Delta.

To comply with the 2-agency agreement mentioned above, DFG needs to assign system loss estimates each year. The handling and trucking losses dealt with in this paper are just a segment of the total system loss.

Mortality rates were analyzed in bimonthly periods to conform to the methodology used to calculate system losses for the 2-agency agreement.

MATERIALS AND METHODS

Handling and trucking evaluations were conducted on a weekly basis from September 1984 through October 1985, except during periods of facility shutdowns or when other facility evaluations were being conducted.

Fish used for the evaluations were collected under normal facility operating procedures; facility flows, bypass ratios, and velocities are set according to specifications outlined in Decision 1485. Prior to each test, the following operational parameters were recorded: primary and secondary flows, velocities, depths, bypass ratios, and collection tank flow. The number of collection tanks in use was recorded, and the depth, velocity, water temperature, and dissolved oxygen level in each tank were measured. The estimated total number of fish for all collection tanks and total time of collection were also recorded.

Test fish (i.e., fish removed from the holding tanks) were held for about 24 hours at the fish facility in circular fiberglass holding tanks (1577 liter capacity). Facility water was pumped directly into holding tanks during the holding period at about 19 liters per minute for once-through circulation.

The duration of fish collection times in the holding tanks varied, depending on the salvage rate (estimated number of fish entering the holding tanks per minute) and the densities that could be safely transported according to the hauling tables.

A test began by draining down a collection tank. Fish were removed from the tank with the large collecting bucket (1900 L). This procedure continued until all fish had been removed from each of the collection tanks (i.e., fish from all tanks make up one bucketful). This collection procedure was used because it is the standard operating procedure at the Skinner facility.

The collecting bucket (loaded with fish) was moved near the 24-hour holding area, at which time a control sample was taken by placing a rectangular dipnet (0.61 m by 0.91 m, with 3.18 mm square mesh) into the bottom of the bucket and then lifting it out. The control samples were intended to determine if the dipnet sampling procedure increased mortality. The fish in the dipnet were placed into the 24-hour holding tanks. Water temperature and dissolved oxygen levels in the holding tanks were monitored.

For a trucking test, the remaining fish were transferred to the transport truck equipped with only agitation aerators. Once loaded, fish were transported (simulated fish run) for about the same amount of time (40 minutes) and distance (25 miles) that would occur during a normal fish transport run. At the end of the simulated fish run, the fish were released into a partially filled circular swimming pool (9500 L, 0.91 m deep and 3.66 m diameter). A trucking sample was removed from the pool with the same rectangular dipnet described earlier. The sample was placed in the 24-hour holding area. Transport time, water temperature, and dissolved oxygen level in the transport truck were monitored before and at the end of the simulated fish run.

For a handling test, fish were removed from the collection tanks as described for the trucking test. A control sample was removed from the collecting bucket, as previously described. The remaining fish were then released directly into the partially filled swimming pool. A sample was removed with the same rectangular net and in the same manner as for the trucking sample. The sample was placed in the 24-hour holding area.

After each sample was placed in the 24-hour holding area, immediate mortalities were removed, measured, and counted by species. At the end of the 24-hour holding period, live fish and mortalities were separated, measured, and counted by species. Water temperature and dissolved oxygen levels were measured in the holding tanks at the end of the 24-hour period.

Handling and trucking tests were conducted during a wide variety of pumping conditions (375-6400 cfs), collection intervals (6-25 hours), fish collection (salvage) totals (500-100,000 fish), and water temperatures (41-77°F). Transport tank water temperatures ranged between 41 and 76°F, and dissolved oxygen levels ranged between 4.5 and 12.9 parts per million (see Appendixes 1a,b and 2a,b,c).

Analysis using six species of fish (chinook salmon, striped bass, American shad, steelhead trout, threadfin shad, and white catfish) indicated that mortality associated with the handling and trucking process varies with species and size of fish (Appendixes 3-13).

Bimonthly survival rates (control and handling combined or trucking) for chinook salmon were never less than 98 percent (based on sample sizes greater than 15 fish), and in most cases was 100 percent (Table 1). Mortality occurred when water temperatures were in the low 70s and with smaller fish.

Table 1
BIMONTHLY MEAN WATER TEMPERATURE, HANDLING, AND TRUCKING GRAND MEAN SURVIVAL RATES AND GRAND MEAN FORK LENGTHS FOR CHINOOK SALMON AND STRIPED BASS

1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

		Chinook Salmon				Striped Bass			
		Handling		Trucking		Handling		Trucking	
Period	Mean Water Temperature (°F)	Grand Mean Fork Length (mm)	Grand Mean Survival (%)	Grand Mean Fork Length (mm)	Grand Mean Survival (%)	Grand Mean Fork Length (mm)	Grand Mean Survival (%)	Grand Mean Fork Length (mm)	Grand Mean Survival (%)
JAN 1-15	43.6	204.00	100.00*			86.63	96.72	87.25	96.88
JAN 16-31	42.5	103.78	100.00*	190.00	100.00*	86.75	99.48	86.42	97.85
FEB 1-15	44.8	126.00	100.00*			83.39	96.08	81.71	96.87
FEB 16-28									
MAR 1-15									
MAR 16-31	52.9	122.92	100.00	94.18	100.00*	94.94	100.00*	89.00	100.00*
APR 1-15	63.5	84.42	100.00	83.89	98.72				
APR 16-30	61.9	89.51	99.64	90.46	100.00			98.00	100.00*
MAY 1-15	63.3	89.18	98.36	88.96	100.00	80.53	40.43**		0.00
MAY 16-31	65.6	87.47	99.41	87.44	100.00	16.67	79.43	17.54	34.15
JUN 1-15	74.6	55.10	44.44*	86.38	100.00*	26.01	58.30	24.36	54.86
JUN 16-30	74.1	79.00	0.00			37.90	50.96	41.32	22.94
JUL 1-15	73.4					47.32	79.59	46.26	62.11
JUL 16-31	75.6					52.01	90.54		
AUG 1-15	71.0					44.51	77.85	46.25	16.49
AUG 16-31	69.5					63.24	70.87	63.70	49.25
SEP 1-15	70.5					76.09	63.38	102.73	78.57*
SEP 16-30	69.4			104.00	100.00*	75.40	61.10	78.76	57.32*
OCT 1-15	66.3					78.32	77.55	78.12	96.42
OCT 16-31	60.2	178.13	100.00	176.16	100.00*	82.83	84.27	88.50	98.31
NOV 1-15	56.3	182.46	87.50*	176.60	100.00*	85.15	96.39	88.28	95.60
NOV 16-30	50.9	169.50	100.00			80.31	97.92	81.56	95.19
DEC 1-15	50.0	169.69	100.00*	175.50	100.00*	86.99	98.74	89.53	89.77
DEC 16-31	44.6	160.00	100.00*			89.75	99.17		

* Test with sample size of less than 15 fish and/or mean fork lengths with a wide range of variation. (See Appendixes 3-6 for standard deviations.)

** Data were excluded from the handling regression in Figure 1 because two different year classes were represented.

Bimonthly survival rates (control and handling combined or trucking) for striped bass ranged from 16 percent to 99 percent (Table 1 and Figure 1). Regression lines were fitted for handling and trucking survival rates versus striped bass mean fork lengths, in 10 mm groupings. The coefficients of determination for handling and trucking tests were $r^2 = 0.51$ and $r^2 = 0.68$, respectively.

The high survival rate (79.43 percent) for striped bass in the 10-19 mm group (which was omitted from the regression) may be attributed to the lower water temperatures (less than 65°F) and the lower truckload densities (less than 25,000 fish) during the test period May 16-31, 1985, as compared to the testing periods between June 1 through August 15, when mean water temperatures were above 71°F and mean truckload densities were greater than 30,000 fish.

The lowest survival rate occurred when water temperatures were above 70°F and with smaller fish. In both handling and trucking tests, a correlation between fish length and survival was observed for the periods May through December, in which an increase in survival was associated with size of fish (Table 1 and Figures 2 and 3).

Survival rates for handling tests were consistently higher than for trucking tests. Survival rates for both handling and trucking tests were highest after fish had attained a fork length of about 80 mm, which occurred during October.

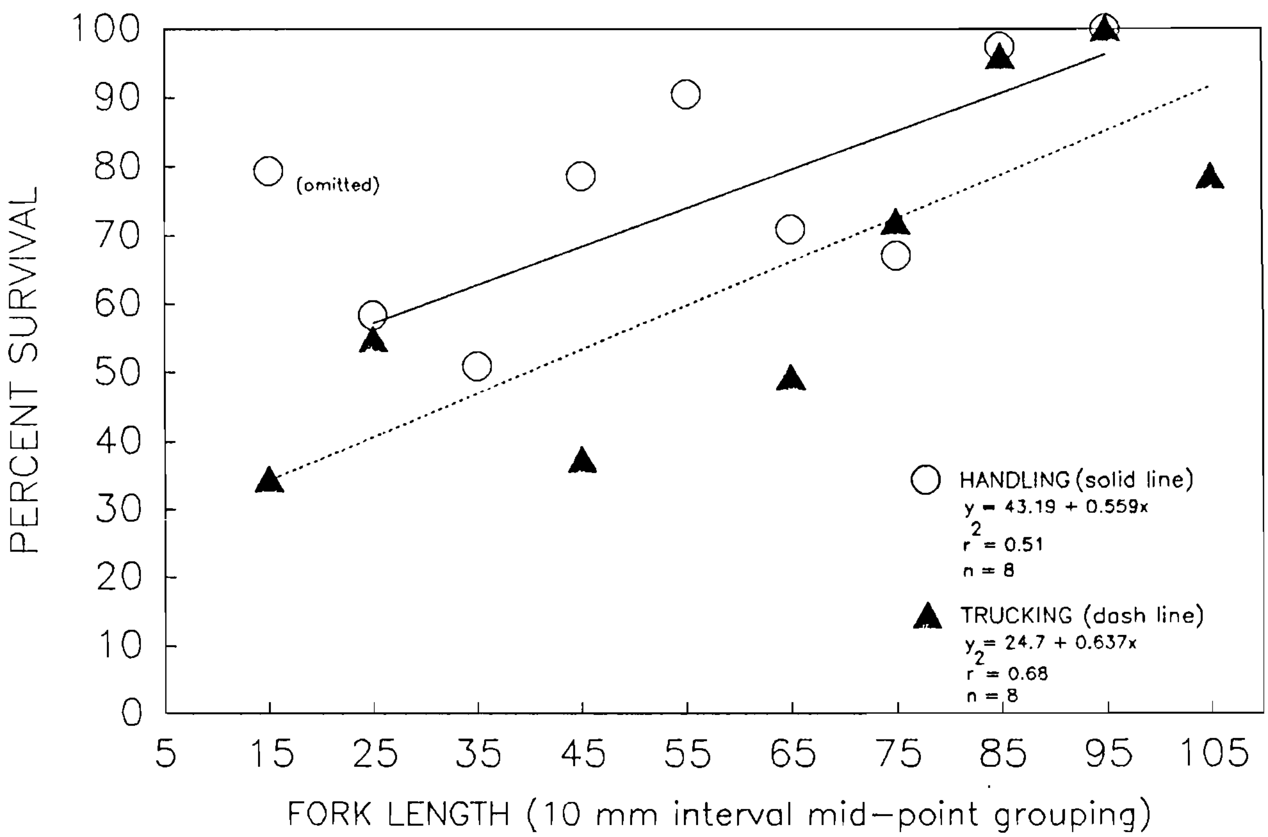

Figure 1
HANDLING AND TRUCKING SURVIVAL RATES FOR STRIPED BASS OF VARIOUS LENGTH GROUPS
1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

Immediate mortality associated with handling for striped bass (based on sample sizes greater than 15 fish) ranged from zero to 58 percent (Appendix 5). The highest immediate mortality occurred during the spring months with the smaller fish (< 20 mm FL). Handling mortality at the end of 24 hours ranged from 0.26 to 38.6 percent.

The highest 24-hour mortalities occurred during the period mid-May through October. The high mortality during the first part of this period was probably due to the smaller size fish (< 30 mm FL), while later in the period when fish were larger (> 50 mm FL), higher water temperatures were more of a detrimental factor.

Immediate mortality associated with trucking (based on sample sizes greater than 15 fish), which includes the handling mortality, ranged from zero to 97.79 percent (Appendix 6). The highest immediate mortalities occurred during the spring months with the smaller fish (< 30 mm FL). Trucking mortality at the end of 24 hours ranged from 1.41 to 83.51 percent.

The highest 24-hour mortalities occurred during the period mid-May through September. The high mortality during the first part of the period was probably due to the smaller size fish

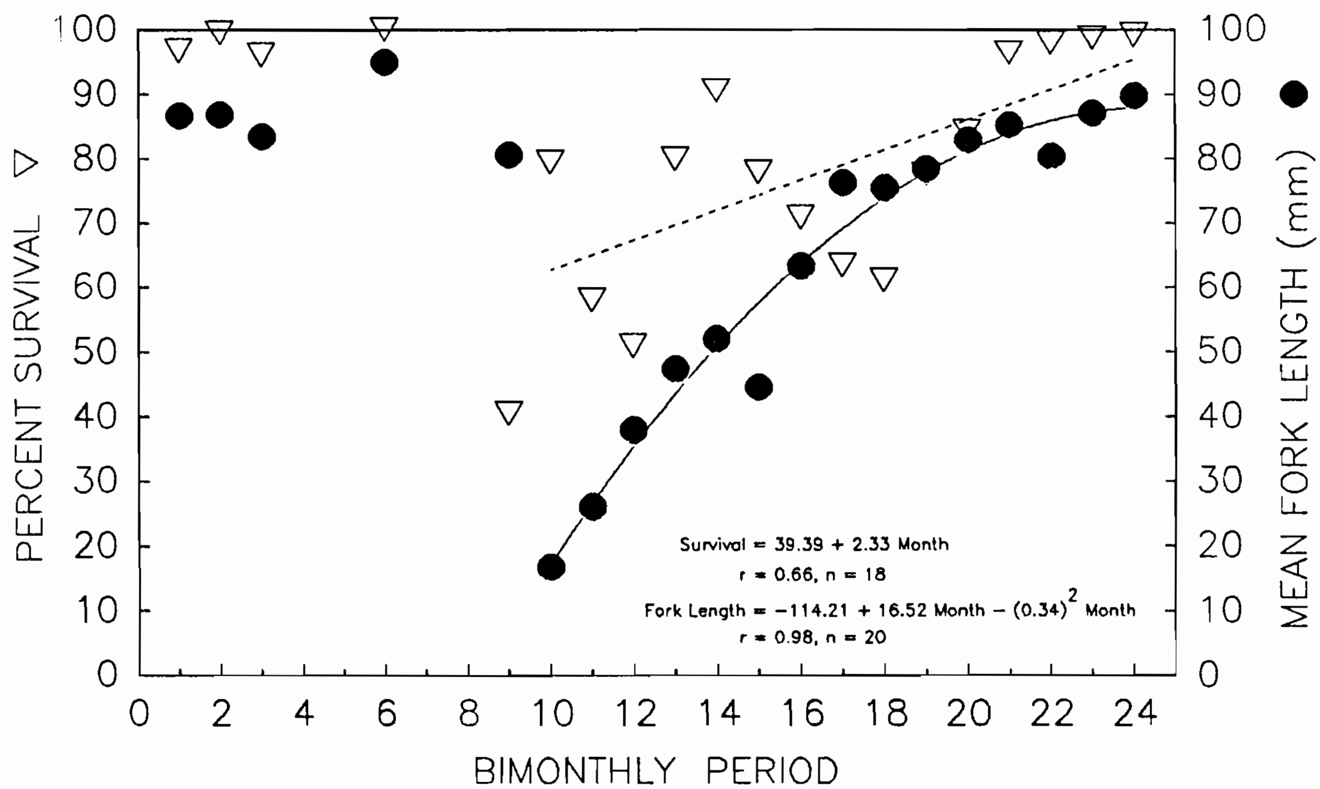

Figure 2
MEAN HANDLING SURVIVAL RATES AND MEAN FORK LENGTHS OF STRIPED BASS FOR BIMONTHLY PERIODS
1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

NOTE: Lines fitted for bimonthly periods 10 through 24 for survival (broken line) and fork length (solid line) data where Jan 1-15 = 1 and Dec 16-31 = 24.

(<30 mm FL), while later in the period when fish were larger, higher water temperatures were more of a detrimental factor.

Handling and trucking mortalities for American shad (based on sample sizes greater than 15 fish) were consistently higher than for the other five species analyzed. Mortality was independent of fish size and water temperature. Immediate handling mortality was low, ranging from 0.43 to 5.56 percent (Appendix 7). However, handling mortality at the end of 24 hours was considerably higher, ranging from 11.04 to 40.65 percent.

Immediate mortality associated with trucking (based on sample sizes greater than 15 fish) ranged from zero to 100 percent, but was frequently less than 5 percent (Appendix 8). However, trucking mortality at the end of 24 hours was considerably higher, ranging from zero to 100 percent but frequently higher than 25 percent.

Very few steelhead trout (10 total fish) were observed during the handling and trucking evaluations. There was no mortality observed in the few fish that were tested (Appendix 9).

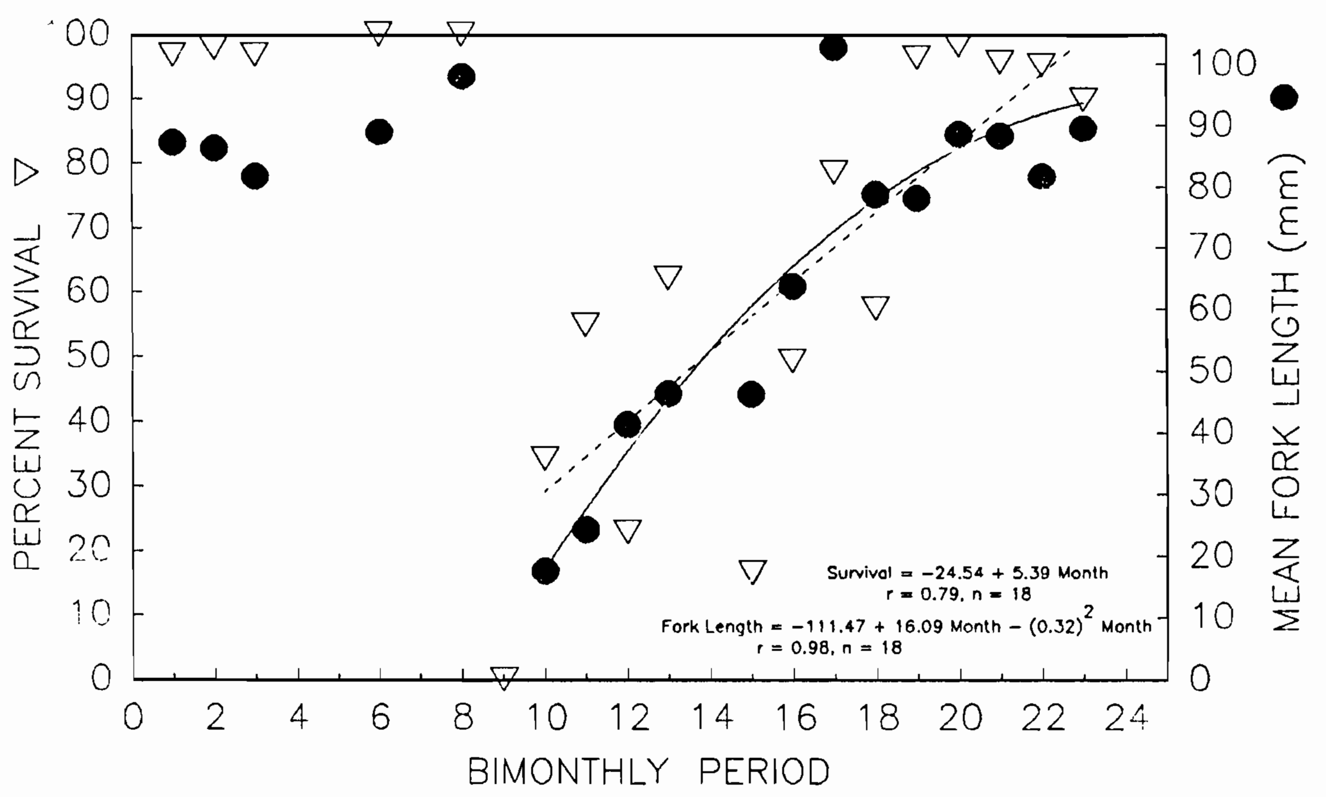

Figure 3
MEAN TRUCKING SURVIVAL RATES AND MEAN FORK LENGTHS OF STRIPED BASS FOR BIMONTHLY PERIODS
1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

NOTE: Lines fitted for bimonthly periods 10 through 24 for survival (broken line) and fork length (solid line) data where Jan 1-15 = 1 and Dec 16-31 = 24.

Immediate mortality associated with handling for threadfin shad (based on sample size greater than 15 fish) ranged from zero to 37.36 percent, but was frequently less than 5 percent (Appendix 10). Handling mortality at the end of 24 hours ranged from zero to 54.35 percent, but was frequently higher than 10 percent. The highest handling mortalities occurred during the winter and summer months, when water temperatures were the lowest and the highest.

Immediate mortality associated with trucking (based on sample sizes greater than 15 fish) ranged from zero to 60.11 percent, but was frequently less than 5 percent (Appendix 11). Trucking mortality at the end of 24 hours ranged from zero to 65.91 percent. The highest trucking mortality occurred during the winter and summer months, when water temperatures were the lowest and the highest.

Immediate mortality associated with handling for white catfish (based on sample size greater than 15 fish, of which there were only seven) ranged from 2.2 to 33.86 percent (Appendix 12). Handling mortality at the end of 24 hours ranged from 17.86 to 69.91 percent.

Immediate mortality associated with trucking (based on sample size greater than 15 fish, of which there were only six) ranged from zero to 32.69 percent (Appendix 13). Trucking mortality at the end of 24 hours ranged from zero to 74.6 percent.

Correlation coefficients between handling and trucking mortalities and the operational and environmental parameters were computed. Results for significant correlation coefficients are presented in Tables 2 and 3 for striped bass, American shad, threadfin shad, and white catfish.

Table 2
SIGNIFICANT CORRELATION COEFFICIENT VALUES FOR IMMEDIATE (imm) AND 24-HOUR (24h) MORTALITIES FOR HANDLING TEST, BY ENVIRONMENTAL PARAMETERS AND SPECIES
1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

Parameter	Parameter Range	Period	Mortality Range(%)	r Value	
Striped Bass					
Old Primary Velocity (f/s)	2.37 - 4.1	Nov-Feb	0.26 - 3.45	-0.463*	(24h)
Old Secondary Velocity (f/s)	2.11 - 4.17	Oct-Feb	< 2	-0.549*	(imm)
New Secondary Velocity (f/s)	0.89 - 1.07	Oct-Feb	< 2	-0.653*	(imm)
New Secondary Bypass Ratio	1.65 - 1.94	Oct-Feb	< 2	-0.671*	(imm)
Holding Tank Temperature (°F)	69 - 70	Jun-Sep	8.2 - 38.6	0.757**	(24h)
Holding Tank Dissolved Oxygen (ppt)	6.17 - 8.03	Jun-Sep	8.2 - 38.6	0.757**	(24h)
American Shad					
Total Salvage	747 - 95,544	Jan-Dec	< 6	0.497*	(imm)
New Primary Velocity (f/s)	1.48 - 2.37	Jul-Oct	11 - 40.7	0.666*	(24h)
Threadfin Shad					
Period	Jan - Feb	Jan-Feb	13 - 45	-0.582**	(imm)
Period	Jan - Mar	Jan-Mar	15 - 55	-0.472*	(24h)
Pumping Rate (cfs)	3484 - 5270	Jan-Feb	13 - 45	-0.432*	(imm)
Old Secondary Bypass Ratio	1.65 - 1.94	Jan-Feb	13 - 45	0.543**	(imm)
Holding Tank 1 Velocity (f/s)	1.95 - 2.03	Jan-Feb	13 - 45	0.612**	(imm)
Holding Tank 3 Velocity (f/s)	0.94 - 1.03	Jan-Feb	13 - 45	0.633*	(imm)
Holding Tank Temperature (°F)	42 - 53	Jan-Feb	13 - 45	-0.522*	(imm)
Holding Tank Dissolved Oxygen (ppt)	9.6 - 10.7	Jan-Feb	13 - 45	0.444*	(imm)
Collection Time	9.25 - 18.33	Jan-Feb	13 - 45	-0.439*	(imm)
White Catfish					
Old Primary Velocity (f/s)	1.48 - 3.02	May-Oct	17.86 - 69.91	-0.576**	(24h)
New Primary Velocity (f/s)	1.48 - 2.37	May-Oct	2.2 - 33.86	0.691**	(imm)
Holding Tank Flow (cfs)	12.95 - 33.17	May-Oct	17.86 - 69.91	0.587**	(24h)
Holding Tank Temperature (°F)	60.2 - 75.6	May-Oct	17.86 - 69.91	-0.67**	(24h)
Holding Tank Dissolved Oxygen (ppt)	6.2 - 9.0	May-Oct	17.86 - 69.91	0.565*	(24h)

* $p < 0.05$

** $p < 0.01$

For handling tests, two parameters (holding tank temperatures and holding tank dissolved oxygen) were significantly correlated with mortality for three of the four species used (Table 2). For trucking tests, one parameter (trucking temperature) was significantly correlated with mortality in all of the four species used in the analysis (Table 3). Also, three parameters (holding tank flow, holding tank temperature, and trucking dissolved oxygen) were significantly correlated with mortality in three of the four species used in the analysis.

Striped bass handling mortality was significantly correlated with six parameters (two positive and four negative). Of these parameters, the new secondary bypass ratio was positively correlated with immediate mortality. Holding tank temperature was positively correlated with 24-hour mortality. The other four parameters (primary channel velocity for the louvered [old] secondary, both secondary velocities, and holding tank dissolved oxygen) were negatively correlated with handling mortality (immediate and 24-hour).

Striped bass trucking mortality was significantly correlated with seven parameters (three positive and four negative). Holding tank flow, holding tank temperature, and trucking temperature were positively correlated with 24-hour mortality. The other four parameters (primary channel velocity for louvered secondary, secondary channel velocity for louvered secondary, holding tank dissolved oxygen, and trucking dissolved oxygen) were negatively

Table 3
SIGNIFICANT CORRELATION COEFFICIENT VALUES FOR
IMMEDIATE (imm) AND 24-HOUR (24h) MORTALITIES FOR
TRUCKING TEST, BY ENVIRONMENTAL PARAMETERS AND SPECIES
1984-1985 Handling and Trucking Evaluations
John E. Skinner Delta Fish Protective Facility
Byron, California

Parameter	Parameter Range	Period	Mortality Range(%)	r Value	
Striped Bass					
Old Primary Velocity (f/s)	2.75 - 4.13	Oct-Feb	0 - 6.9	-0.658**	(24h)
Old Secondary Velocity (f/s)	2.16 - 3.70	Oct-Feb	0 - 6.9	-0.547*	(imm)
Holding Tank Flow (cfs)	9.87 - 32.9	Jun-Oct	21 - 84	0.677**	(24h)
Holding Tank Temperature (°F)	67.2 - 74.3	Jun-Oct	21 - 84	0.712**	(24h)
Holding Tank Dissolved Oxygen (ppt)	7.5 - 10.8	Oct-Feb	0 - 6.9	-0.614**	(24h)
Trucking Temperature (°F)	67.6 - 68.3	Jun-Oct	21-84	0.678**	(24h)
Trucking Dissolved Oxygen (ppt)	7.3 - 12.6	Oct-Feb	0 - 6.9	-0.678**	(24h)
American Shad					
Pumping Rate (cfs)	4818 - 6400	Jun-Sep	25 - 100	0.513**	(24h)
Old Primary Bypass Ratio	1.10 - 1.69	Aug-Mar	<4	-0.545*	(imm)
Old Secondary Bypass Ratio	1.55 - 3.70	Aug-Mar	<4	-0.545*	(imm)
Holding Tank Flow (cfs)	16.1 - 32.9	Jun-Sep	25 - 100	0.485*	(24h)
Trucking Temperature (°F)	43.7 - 74.8	Jan-Dec	0 - 100	0.470*	(imm)
Threadfin Shad					
Holding Tank 1 Velocity (f/s)	1.37 - 1.96	Jan-Sep	13 - 66	0.617*	(24h)
Holding Tank Temperature (°F)	42.8 - 43.7	Jan-Feb	10 - 60	-0.497*	(imm)
Trucking Temperature (°F)	43.7 - 44.6	Jan-Feb	10 - 60	-0.568*	(imm)
Trucking Dissolved Oxygen (ppt)	9.5 - 12.6	Jan-Feb	10 - 60	0.564*	(imm)
White Catfish					
Old Primary Velocity (f/s)	1.45 - 4.13	May-Sep	0 - 82	-0.613**	(24h)
Holding Tank Flow (cfs)	13.12 - 32.9	May-Sep	0 - 82	0.638**	(24h)
Holding Tank Temperature (°F)	61.3 - 74.3	May-Sep	0 - 82	0.593*	(24h)
Holding Tank Dissolved Oxygen (ppt)	6.1 - 9.4	May-Sep	0 - 82	-0.551*	(24h)
Trucking Temperature (°F)	61.3 - 74.8	May-Sep	0 - 82	0.587*	(24h)
Trucking Temperature Change (°F)	-1.8 - 3.9	May-Sep	0 - 82	-0.673**	(24h)
Trucking Dissolved Oxygen (ppt)	5.7 - 9.05	May-Sep	0 - 82	-0.698**	(24h)
Trucking Dissolved Oxygen Change (ppt)	-2.5 - 1.1	May-Sep	0 - 82	0.581*	(24h)

* $p < 0.05$

** $p < 0.01$

correlated with trucking mortality (immediate and 24-hour).

American shad handling mortality was significantly correlated with two parameters (both positive). Of these parameters, total salvage was correlated with immediate mortality.

American shad trucking mortality was significantly correlated with five parameters (three positive and two negative). Of these parameters, old primary bypass ratio and old secondary bypass ratio were negatively correlated with immediate trucking mortality. Trucking temperature was positively correlated with immediate mortality ranging from zero to 100 percent. Pumping rate and holding tank flow were positively correlated with 24-hour mortality.

Threadfin shad handling mortality was significantly correlated with nine parameters. All of these parameters were correlated with immediate mortality except one. The parameter "period" was negatively correlated with 24-hour mortality.

Threadfin shad trucking mortality was significantly correlated with four parameters (two positive and two negative). Of these parameters, holding tank temperature and trucking temperature were negatively correlated with immediate mortality. Trucking dissolved oxygen was positively correlated with immediate mortality.

Velocity in holding tank one was positively correlated with 24-hour mortality. Some of the threadfin shad trucking mortality observed during January and February could be a result of the winter die-off, which was occurring during the same period.

White catfish handling mortality was significantly correlated with five parameters (three positive and two negative). Primary channel velocity for the new secondary screen was positively correlated with immediate mortality. Sample sizes were very small during the period when primary channel velocity for the new secondary screen were highest.

Primary channel velocity for the old secondary screen was negatively correlated with 24-hour mortality. Again, sample sizes were very small during the period when primary channel velocity for the old secondary screen were lowest. Holding tank flow and holding tank temperature were positively correlated with 24-hour mortality, while holding tank dissolved oxygen was negatively correlated with 24-hour mortality.

White catfish trucking mortality was significantly correlated with eight parameters. All of these parameters were correlated with 24-hour mortality (four positive and four negative). Holding tank flow, holding tank temperature, trucking temperature, and trucking dissolved oxygen change were positively correlated with 24-hour mortality. Primary channel velocity for the old secondary, holding tank dissolved oxygen, trucking temperature change, and trucking dissolved oxygen were negatively correlated with 24-hour mortality.

Some qualitative observations were noted during handling and trucking tests:

- Some fish (particularly striped bass, American shad, and threadfin shad) showed signs of mechanical abrasions and/or some tailfin erosion.
- At times, large quantities of fish scales (mostly from American shad and threadfin shad) were observed suspended in the collection bucket and laying on the bottom of the hauling truck.
- Numerous white catfish had sores and/or fin rot.
- During periods of warmer water temperature and higher fish densities, fish were observed gasping for air near the surface of the collection bucket and hauling truck.
- During various times of the year, large amounts of debris and vegetative material accumulated in the collection bucket and clogged the release outlet on the hauling truck.
- When more than one aerator in the hauling truck was in use, the turbulence created tended to disorient the fish.
- During spring, when larval fish were present, fairly high numbers were observed impinged on the uptake of the aerators on the hauling truck.

DISCUSSION

The effects of handling and trucking fish that have been successfully screened from the SWP pumping at the Skinner Fish Facility were quite variable. Chinook salmon showed very little immediate detrimental effect to the handling and trucking process. However, a tagging study conducted during the mid-1970s by the California Department of Fish and Game at the Tracy facility showed a handling and trucking mortality of 57 percent for juvenile chinook salmon. Steelhead trout showed no immediate detrimental effect by the handling and trucking process. Striped bass, American shad, threadfin shad, and white catfish did not handle the stresses associated with handling and trucking very well, which resulted in high mortality rates.

The mortality associated with the present method of handling and trucking was probably biased low, because there is an uncertain amount of mortality occurring days later as a result of the stresses. Carmichael et al. (1984) reported largemouth bass mortalities up to 4 days after trucking. Barton et al. (1980) reported that rainbow trout showed signs of stress up to 8 days after stocking. This probably holds true for most other species.

Handling and trucking mortality and related stresses on fish salvaged at the Skinner facility could probably be reduced by some simple modifications.

- Avoid overloading and reduce the amount of time in the collecting bucket and/or increase the holding capacity of the collecting bucket and increase the diameter of the drain hole in the bucket to facilitate the release of fish, especially when debris loads are heavy. The present method of draining the collection tanks one at a time and putting an entire truckload of fish in the collection bucket, which has less than half the capacity of the truck, is probably very stressful. At times there appeared to be more fish than water in the truck.
- Modifying the collecting bucket brace from horizontal to angular would reduce some of the mechanical damage caused by banging into the horizontal brace when fish are drained into the collecting bucket.
- Reduce holding tank flows to below 10 cfs per tank, and keep holding tank velocities below 1 fps in each tank.
- Adding common salt (0.5% NaCl concentration) and/or a mild anesthetic to the transport truck water might reduce mortalities. The use of salt solutions (NaCl) alone or with an anesthetic (MS-222, diazepam, or etomidate) during handling and/or trucking have been tested widely, with positive results (Collins and Hulsey 1963, Wedemeyer 1972, Hattingh 1975, Strange and Schreck 1978, Murai et al. 1979, Tomasso et al. 1980, Carmichael et al. 1984). The detrimental effects of scale, skin, and mucous losses were reduced by the addition of 2 ppt sodium chloride (Johnson 1979). Striped bass were generally hauled in 10 ppt sodium chloride (McCraren and Millard 1978). From both osmotic and acid-base standpoint, a 10 ppt salinity (brackish) recovery environment appeared to be less stressful to exercised striped bass than were fresh water or salt water recovery environments (Cech et al. unpub MS). Carmichael et al. (1984) also suggest using bacteriostats and reduced temperatures in conjunction with saline solutions and a mild anesthetic to reduce stress and mortality.
- Use compressed oxygen to maintain proper O_2 concentration levels, especially during higher water temperatures. Carmichael et al. (1984) found that largemouth bass subjected to reduced O_2 were stressed and that the super-saturation levels of O_2 sometimes encountered during fish hauling did not have a serious detrimental effect.
- Eliminate or reduce the use of agitator aerators. The force and turbulence created by the aerators were observed to cause disorientation and physical damage to some of the fish, especially larvae and smaller fish. The aerator should not be used during the presence of larval striped bass or American shad, and should be used only in a limited capacity to

create a directional flow for orientation purposes.

- A minimum level of light may be advantageous in the transport tank for those species of fish (i.e., American shad) that rely on visual cues to maintain their orientation (Fisher 1976, 1981). However, this may lead to an increase in predation during the hauling process.

In conclusion, this analysis of the handling and trucking data indicates immediate adverse effects on striped bass, American shad, threadfin shad, and white catfish. Although chinook salmon and steelhead trout showed no immediate adverse effects, a delayed effect may occur as suggested by the literature.

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APPENDIXES

APPENDIX 1a. MEAN BIMONTHLY OPERATIONAL DATA DURING CONTROL AND HANDLING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY.

			PRIMARY CHANNEL			
			VELOCITY (fps)		BYPASS RATIO	
DATES	TOTAL SALVAGE	PUMPING RATE (cfs)	BAYS 1-3	BAYS 4-5	BAYS 1-3	BAYS 4-5
JAN 1-15	2081	4613	3.01		1.26	
JAN 16-31	747	3484	2.61		1.32	
FEB 1-15	1158	5270	3.31		1.33	
MAR 16-31	1315	6400	2.51	2.27	1.28	1.34
APR 1-15	1542	6400	2.52	2.70	1.25	1.20
APR 16-30	1597	5272	3.01	3.00	1.26	1.36
MAY 1-15	6248	4520	2.37	2.37	1.42	1.48
MAY 16-31	25862	4520	1.48	1.48	1.49	1.60
JUN 1-15	95544	6400	2.09	2.09	1.49	1.45
JUN 16-30	71834	6400	2.27	2.27	1.30	1.40
JUL 1-15	33729	6400	2.21	2.21	1.11	1.56
JUL 16-31	33000	6400	2.25	2.25	1.50	1.35
AUG 1-15	7209	6400	2.23	2.23	1.41	1.25
AUG 16-31	9010	6400	2.15	2.15	1.54	1.37
SEP 1-15	2528	5339	2.21	2.19	1.46	1.33
SEP 16-30	3121	4962	2.57	1.72	1.39	1.45
OCT 1-15	877	4643	2.42	2.11	1.37	1.39
OCT 16-31	5290	5539	3.02	1.95	1.34	1.41
NOV 1-15	7031	5270	3.14		1.38	
NOV 16-30	8599	4705	2.37		1.27	
DEC 1-15	11334	6400	3.82		1.32	
DEC 16-31	13093	6400	4.10		1.24	

APPENDIX 1a. MEAN BIMONTHLY OPERATIONAL DATA DURING CONTROL AND HANDLING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY. (Continued)

	SECONDARY CHANNEL			
	VELOCITY (fps)		BYPASS RATIO	
DATES	OLD	NEW	OLD	NEW
JAN 1-15	2.41		1.65	
JAN 16-31	2.13		1.94	
FEB 1-15	2.73		1.75	
MAR 16-31	1.82	0.78	1.13	1.20
APR 1-15	1.62	0.82	1.50	1.22
APR 16-30	1.19	0.64	1.23	1.36
MAY 1-15	1.12	0.60	1.35	1.40
MAY 16-31	1.19	0.76	2.13	1.14
JUN 1-15	1.65	0.81	1.41	1.28
JUN 16-30	2.02	0.97	1.50	1.20
JUL 1-15	1.83	1.11	1.37	1.18
JUL 16-31	2.83	1.04	1.07	1.29
AUG 1-15	1.92	1.28	1.48	1.22
AUG 16-31	2.42	1.05	1.32	1.21
SEP 1-15	2.11	1.10	1.29	1.21
SEP 16-30	2.37	0.89	1.30	1.23
OCT 1-15	2.20	1.07	1.19	1.25
OCT 16-31	2.53	1.01	0.99	1.25
NOV 1-15	2.82		1.23	
NOV 16-30	2.53		1.22	
DEC 1-15	3.45		1.23	
DEC 16-31	4.17		1.26	

APPENDIX 1b. MEAN BIMONTHLY HOLDING TANK DATA DURING CONTROL AND HANDLING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY.

		HOLDING TANK				
			VELOCITY			
DATES	PUMPING RATE (cfs)	FLOW (cfs)	TANK 1 (fps)	TANK 2 (fps)	TANK 3 (fps)	TEMPERATURE (°F)
JAN 1-15	4613	13.45	2.03			43.60
JAN 16-31	3484	14.98	1.95			42.35
FEB 1-15	5270	15.23	2.03			44.78
MAR 16-31	6400	28.70	1.67	1.18	0.95	52.93
APR 1-15	6400	29.45	1.75	1.33	1.00	63.50
APR 16-30	5272	17.80				61.88
MAY 1-15	4520	14.32				63.34
MAY 16-31	4520	23.68	1.61	1.48		65.62
JUN 1-15	6400	33.17	1.41	1.06	0.98	74.63
JUN 16-30	6400	24.58				74.05
JUL 1-15	6400	30.35				73.35
JUL 16-31	6400	30.10	1.67	1.19	1.03	75.60
AUG 1-15	6400	29.94	1.71	1.14	0.95	71.00
AUG 16-31	6400	29.62	1.71	1.24	0.99	69.52
SEP 1-15	5339	20.59	1.49	1.08	0.95	70.49
SEP 16-30	4962	12.95	1.43	1.02	0.94	69.37
OCT 1-15	4643	13.56	1.09	0.89	1.02	66.28
OCT 16-31	5539	16.40	1.27	1.04	0.94	60.17
NOV 1-15	5270	11.10	1.69			56.30
NOV 16-30	4705	10.75	1.51			50.90
DEC 1-15	6400	12.97	0.99	1.02		50.00
DEC 16-31	6400	13.10	0.99	1.12		44.63

APPENDIX 1b. MEAN BIMONTHLY HOLDING TANK DATA DURING CONTROL AND HANDLING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY. (Continued)

	HOLDING TANK	
DATES	DISSOLVED OXYGEN (ppm)	COLLECTION TIME (hrs)
JAN 1-15	10.30	18.33
JAN 16-31	10.30	9.25
FEB 1-15	10.70	11.67
MAR 16-31	9.60	22.88
APR 1-15	8.40	16.25
APR 16-30	8.58	13.80
MAY 1-15	8.86	13.15
MAY 16-31	8.30	14.68
JUN 1-15	6.17	12.03
JUN 16-30	6.73	14.27
JUL 1-15	7.52	14.58
JUL 16-31	6.70	15.50
AUG 1-15	7.57	12.64
AUG 16-31	8.03	16.25
SEP 1-15	7.46	17.02
SEP 16-30	7.80	15.09
OCT 1-15	8.00	12.17
OCT 16-31	9.00	1[illegible].50
NOV 1-15	9.45	16.25
NOV 16-30	9.40	17.25
DEC 1-15	10.17	20.00
DEC 16-31	10.70	22.31

APPENDIX 2a. MEAN BIMONTHLY OPERATIONAL DATA DURING TRUCKING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY.

			PRIMARY CHANNEL			
			VELOCITY (fps)		BYPASS RATIO	
DATES	TOTAL SALVAGE	PUMPING RATE (cfs)	BAYS 1-3	BAYS 4-5	BAYS 1-3	BAYS 4-5
JAN 1-15	2104	6400	3.88		1.25	
JAN 16-31	947	3390	3.25		1.10	
FEB 1-15	1749	5270	3.26		1.32	
MAR 16-31	1229	6400	2.23	2.23	1.53	1.30
APR 1-15	1772	6400	3.12	2.33	1.19	1.25
APR 16-30	1819	4520	3.10	3.10	1.22	1.19
MAY 1-15	5718	4520	2.54	2.54	1.45	1.54
MAY 16-31	26250	4330	1.45	1.45	1.48	1.55
JUN 1-15	85692	6400	2.16	2.16	1.38	1.44
JUN 16-30	48749	6400	2.20	2.20	1.25	1.50
JUL 1-15	30261	6400	2.26	2.26	0.88	1.49
AUG 1-15	8016	6400	2.06	2.05	1.46	1.35
AUG 16-31	8998	6400	2.02	2.02	1.69	1.48
SEP 1-15	3306	6400	2.17	2.17	1.47	1.40
SEP 16-30	3442	4818	2.34	1.73	1.40	1.52
OCT 1-15	1535	4643	2.75		1.39	
OCT 16-31	10591	5648	4.13		1.19	
NOV 1-15	6240	5270	3.59		1.23	
NOV 16-30	9156	5270	3.31		1.30	
DEC 1-15	12351	6400	3.35		1.17	

	SECONDARY CHANNEL			
	VELOCITY (fps)		BYPASS RATIO	
DATES	OLD	NEW	OLD	NEW
JAN 1-15	3.29		1.25	
JAN 16-31	2.16		1.10	
FEB 1-15	2.69		1.32	
MAR 16-31	1.98	0.82	1.53	1.30
APR 1-15	2.80	0.87	1.19	1.25
APR 16-30	1.17	0.59	1.22	1.19
MAY 1-15	1.00	0.55	1.45	1.54
MAY 16-31	0.86	1.17	1.48	1.55
JUN 1-15	1.65	0.86	1.38	1.44
JUN 16-30	1.72	1.00	1.25	1.50
JUL 1-15	1.48	1.02	0.88	1.49
AUG 1-15	1.55	0.75	1.46	1.35
AUG 16-31	2.79	1.06	1.69	1.48
SEP 1-15	2.68	1.13	1.47	1.40
SEP 16-30	2.15	1.01	1.40	1.52
OCT 1-15	2.24		1.39	
OCT 16-31	3.70		1.19	
NOV 1-15	2.55		1.23	
NOV 16-30	2.39		1.30	
DEC 1-15	2.76		1.17	

APPENDIX 2b. MEAN BIMONTHLY HOLDING TANK DATA DURING TRUCKING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY.

		HOLDING TANK				
			VELOCITY			
DATES	PUMPING RATE (cfs)	FLOW (cfs)	TANK 1 (fps)	TANK 2 (fps)	TANK 3 (fps)	TEMPERATURE (°F)
JAN 1-15	6400	14.10	1.44			43.70
JAN 16-31	3390	15.40	1.96			42.80
FEB 1-15	5270	14.60	1.87			43.70
MAR 16-31	6400	29.35	1.79	1.25	1.00	53.15
APR 1-15	6400	20.00	1.82	1.37	1.02	64.40
APR 16-30	4520	12.50				60.35
MAY 1-15	4520	13.10				61.25
MAY 16-31	4330	20.70	1.39	1.36		66.10
JUN 1-15	6400	32.90	1.41	1.06	0.98	74.30
JUN 16-30	6400	26.25				74.30
JUL 1-15	6400	30.95				74.15
AUG 1-15	6400	30.60	1.63	1.01	0.75	72.00
AUG 16-31	6400	29.95	1.80	1.24	1.01	69.55
SEP 1-15	6400	30.15	1.82	1.18	0.96	67.80
SEP 16-30	4818	16.12	1.37	1.01	0.83	68.74
OCT 1-15	4643	9.87	1.07	0.65		67.23
OCT 16-31	5648	10.65	0.93			59.45
NOV 1-15	5270	10.50	1.35			56.30
NOV 16-30	5270	9.60	1.35			52.70
DEC 1-15	6400	14.25	1.11	1.02		49.55

	HOLDING TANK	
DATES	DISSOLVED OXYGEN (ppm)	COLLECTION TIME (hrs)
JAN 1-15	10.20	16.00
JAN 16-31	10.80	21.00
FEB 1-15	9.75	21.88
MAR 16-31	9.25	22.58
APR 1-15	8.50	15.38
APR 16-30	8.80	14.63
MAY 1-15	9.40	16.38
MAY 16-31	8.10	10.75
JUN 1-15	6.10	17.75
JUN 16-30	6.85	13.04
JUL 1-15	7.55	12.25
AUG 1-15	8.20	15.00
AUG 16-31	7.70	12.25
SEP 1-15	7.95	15.25
SEP 16-30	7.84	16.83
OCT 1-15	7.53	11.33
OCT 16-31	9.20	8.50
NOV 1-15	9.00	5.00
NOV 16-30	8.80	24.00
DEC 1-15	9.90	22.50

APPENDIX 2c. MEAN BIMONTHLY HAULING TRUCK DATA DURING TRUCKING TESTS (1984-85) AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY.

DATES	PUMPING RATE (cfs)	TRUCKING TIME (hrs)	TRUCK TEMP. (^{o}F)	CHANGE TEMP. (^{o}F)	TRUCK D.O. (ppm)	CHANGE D.O. (ppm)
JAN 1-15	6400	0.83	44.60	1.80	9.50	-2.50
JAN 16-31	3390	0.75	43.70	0.90	12.60	-1.80
FEB 1-15	5270	0.83	43.90	2.05	11.20	-0.10
MAR 16-31	6400	0.92	53.95	0.00	8.55	0.50
APR 1-15	6400	1.08	63.95	1.30	7.10	0.30
APR 16-30	4520	0.92	59.05	0.40	7.85	0.50
MAY 1-15	4520	0.83	61.25	1.25	8.75	-1.95
MAY 16-31	4330	0.79	64.40	1.70	9.05	-1.45
JUN 1-15	6400	0.75	71.30	3.90	7.10	-2.50
JUN 16-30	6400	0.79	73.60	-1.55	6.00	-0.70
JUL 1-15	6400	0.79	74.75	-0.70	6.05	0.00
AUG 1-15	6400	0.75	69.80	-1.80	5.70	1.10
AUG 16-31	6400	0.75	68.20	-0.20	7.15	0.85
SEP 1-15	6400	0.75	67.55	-1.70	7.25	0.60
SEP 16-30	4818	0.93	68.98	0.02	7.50	0.50
OCT 1-15	4643	0.92	68.30	-1.93	7.30	1.07
OCT 16-31	5648	0.75	60.60	0.55	9.20	-1.20
NOV 1-15	5270	1.00	53.60	1.80	8.60	1.60
NOV 16-30	5270	1.33	56.70	0.00	9.00	-0.20
DEC 1-15	6400	0.83	52.35	0.95	9.35	-0.80

APPENDIX 3. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	100.00	0.00	204.00	0.00
JAN 16-31*	1	100.00	0.00	103.78	0.00
FEB 1-15*	1	100.00	0.00	126.00	0.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	100.00	0.00	122.92	20.77
APR 1-15	2	100.00	0.00	84.42	3.01
APR 16-30	4	99.64	0.64	89.51	2.01
MAY 1-15	5	98.36	3.37	89.18	1.16
MAY 16-31	5	99.41	1.20	87.47	1.18
JUN 1-15*	2	44.44	42.78	55.10	3.75
JUN 16-30	1	0.00	0.00		
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30	0				
OCT 1-15	0				
OCT 16-31	7	100.00	0.00	178.13	11.01
NOV 1-15*	2	87.50	12.86	182.46	8.46
NOV 16-30	2	100.00	0.00	169.50	8.32
DEC 1-15*	4	100.00	0.00	169.69	30.68
DEC 16-31*	4	100.00	0.00	160.00	27.77

* = TOTAL SAMPLE SIZE < 15

APPENDIX 3. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	0.00	0.00		
JAN 16-31*	1	0.00	0.00		
FEB 1-15*	1	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	0.00	0.00		
APR 1-15	2	0.00	0.00		
APR 16-30	4	0.00	0.00		
MAY 1-15	5	0.00	0.00		
MAY 16-31	5	0.00	0.00		
JUN 1-15*	2	0.00	0.00		
JUN 16-30	1	100.00	0.00	79.00	0.00
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30	0				
OCT 1-15	0				
OCT 16-31	7	0.00	0.00		
NOV 1-15*	2	0.00	0.00		
NOV 16-30	2	0.00	0.00		
DEC 1-15*	4	0.00	0.00		
DEC 16-31*	4	0.00	0.00		

APPENDIX 3. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	0.00	0.00		
JAN 16-31*	1	0.00	0.00		
FEB 1-15*	1	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	0.00	0.00		
APR 1-15	2	0.00	0.00		
APR 16-30	4	0.36	0.00	93.00	0.00
MAY 1-15	5	1.64	3.37	16.49	0.00
MAY 16-31	5	0.59	0.00	71.00	0.00
JUN 1-15*	2	55.56	42.78	58.97	6.24
JUN 16-30	1	0.00	0.00		
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30	0				
OCT 1-15	0				
OCT 16-31	7	0.00	0.00		
NOV 1-15*	2	12.50	12.86	89.00	0.00
NOV 16-30	2	0.00	0.86		
DEC 1-15*	4	0.00	0.00		
DEC 16-31*	4	0.00	1.31		

APPENDIX 4. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	0				
JAN 16-31*	1	100.00	0.00	190.00	0.00
FEB 1-15	0				
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	100.00	0.00	94.18	19.31
APR 1-15	2	98.72	1.37	83.89	0.59
APR 16-30	2	100.00	0.00	90.46	0.98
MAY 1-15	2	100.00	0.00	88.96	0.76
MAY 16-31	2	100.00	0.00	87.44	0.20
JUN 1-15*	1	100.00	0.00	86.38	0.00
JUN 16-30	0				
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30*	1	100.00	0.00	104.00	0.00
OCT 1-15	0				
OCT 16-31*	1	100.00	0.00	176.16	0.43
NOV 1-15*	1	100.00	0.00	176.00	0.00
NOV 16-30	0				
DEC 1-15*	1	100.00	0.00	175.50	9.62
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 4. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	0				
JAN 16-31*	1	0.00	0.00		
FEB 1-15	0				
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	2	0.00	0.00		
APR 16-30	2	0.00	0.00		
MAY 1-15	2	0.00	0.00		
MAY 16-31	2	0.00	0.00		
JUN 1-15*	1	0.00	0.00		
JUN 16-30	0	0.00	0.00		
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30*	1	0.00	0.00		
OCT 1-15	0				
OCT 16-31*	1	0.00	0.00		
NOV 1-15*	1	0.00	0.00		
NOV 16-30	0				
DEC 1-15*	1	0.00	0.00		
DEC 16-31	0				

APPENDIX 4. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR CHINOOK SALMON DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	0				
JAN 16-31*	1	0.00	0.00		
FEB 1-15	0				
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	2	1.28	1.37	72.50	0.00
APR 16-30	2	0.00	0.00		
MAY 1-15	2	0.00	0.00		
MAY 16-31	2	0.00	0.00		
JUN 1-15	0				
JUN 16-30*	1	0.00	0.00		
JUL 1-15	0				
JUL 16-31	0				
AUG 1-15	0				
AUG 16-31	0				
SEP 1-15	0				
SEP 16-30*	1	0.00	0.00		
OCT 1-15	0				
OCT 16-31*	1	0.00	0.00		
NOV 1-15*	1	0.00	0.00		
NOV 16-30	0				
DEC 1-15*	1	0.00	0.00		
DEC 16-31	0				

APPENDIX 5. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	96.72	2.83	86.63	3.56
JAN 16-31	1	99.48	0.52	86.75	1.84
FEB 1-15	6	96.08	3.60	83.39	3.07
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	100.00	0.00	94.94	3.56
APR 1-15	0				
APR 16-30	0				
MAY 1-15	3	40.43	37.69	80.53	40.34
MAY 16-31	4	79.43	7.91	16.67	1.91
JUN 1-15	2	58.30	10.62	26.01	1.34
JUN 16-30	4	50.96	18.20	37.90	2.75
JUL 1-15	6	79.59	14.99	47.32	5.11
JUL 16-31	2	90.54	1.45	52.01	3.39
AUG 1-15	7	77.85	22.11	44.51	3.26
AUG 16-31	6	70.87	20.09	63.24	6.53
SEP 1-15	10	63.38	15.57	76.09	21.16
SEP 16-30	10	61.10	32.22	75.40	8.20
OCT 1-15	9	77.55	23.01	78.32	15.43
OCT 16-31	6	84.27	14.59	82.83	10.61
NOV 1-15	2	96.39	0.04	85.15	5.85
NOV 16-30	2	97.92	1.09	80.31	5.82
DEC 1-15	5	98.74	0.74	86.99	2.91
DEC 16-31	1	99.17	0.00	89.75	0.00

* = TOTAL SAMPLE SIZE < 15

APPENDIX 5. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	0.28	0.49	87.00	0.00
JAN 16-31	1	0.26	0.45	103.00	0.00
FEB 1-15	6	0.48	1.08	87.00	0.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	0				
APR 16-30	0				
MAY 1-15	3	58.02	36.23	13.00	0.33
MAY 16-31	4	10.60	5.97	15.41	0.65
JUN 1-15	2	15.43	6.04	17.52	0.88
JUN 16-30	4	18.48	12.20	17.59	1.80
JUL 1-15	6	4.55	4.57	21.13	5.61
JUL 16-31	2	1.26	0.53	23.86	1.40
AUG 1-15	7	0.97	0.68	26.83	7.09
AUG 16-31	6	0.23	0.47	67.50	0.00
SEP 1-15	10	6.53	14.75	77.87	9.22
SEP 16-30	10	0.27	0.68	57.00	2.05
OCT 1-15	9	0.34	0.65	74.00	1.02
OCT 16-31	6	0.18	0.33	84.25	7.96
NOV 1-15	2	1.10	0.73	69.75	7.39
NOV 16-30	2	0.73	0.33	77.50	1.03
DEC 1-15	5	0.20	0.26	67.25	2.80
DEC 16-31	1	0.00	0.00		

APPENDIX 5. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	3.00	2.50	75.13	4.50
JAN 16-31	1	0.26	0.46	70.00	0.00
FEB 1-15	6	3.45	2.61	67.20	7.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	0				
APR 16-30	0				
MAY 1-15	3	1.56	2.13	14.17	0.93
MAY 16-31	4	9.96	4.44	13.72	0.92
JUN 1-15	2	26.27	4.58	22.27	2.48
JUN 16-30	4	30.56	17.40	30.75	1.48
JUL 1-15	6	15.85	10.54	35.84	6.01
JUL 16-31	2	8.20	0.92	54.47	3.04
AUG 1-15	7	21.18	21.77	47.81	9.09
AUG 16-31	6	28.89	20.35	68.54	8.26
SEP 1-15	10	30.09	18.31	69.77	11.26
SEP 16-30	10	38.62	32.47	78.14	6.64
OCT 1-15	9	22.10	23.24	78.48	11.43
OCT 16-31	6	15.54	14.76	86.09	7.56
NOV 1-15	2	2.51	0.69	73.99	0.66
NOV 16-30	2	1.36	0.76	73.79	1.56
DEC 1-15	5	1.06	0.60	72.60	6.58
DEC 16-31	1	0.83	0.00	76.00	0.00

APPENDIX 6. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	96.88	0.05	87.25	0.72
JAN 16-31	1	97.85	0.00	86.42	0.00
FEB 1-15	2	96.87	0.05	81.71	1.28
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	100.00	0.00	89.00	0.00
APR 1-15	0				
APR 16-30*	2	100.00	0.00	98.00	3.60
MAY 1-15	1	0.00	0.00		
MAY 16-31	2	34.15	4.86	17.54	2.10
JUN 1-15	1	54.86	0.00	24.36	0.00
JUN 16-30	2	22.94	16.50	41.32	3.47
JUL 1-15	2	62.11	0.25	46.26	1.19
JUL 16-31	0				
AUG 1-15	1	16.49	0.00	46.25	0.00
AUG 16-31	2	49.25	25.76	63.70	8.41
SEP 1-15*	1	78.57	0.00	102.73	0.00
SEP 16-30	5	57.32	17.97	78.76	13.20
OCT 1-15	3	96.42	2.62	78.12	7.54
OCT 16-31	2	98.31	1.74	88.50	0.51
NOV 1-15	1	95.60	0.00	88.28	0.00
NOV 16-30	1	95.19	0.00	81.56	0.00
DEC 1-15	2	89.77	7.38	89.53	0.58
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 6. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

DATES	NUMBER OF TEST	IMMEDIATE MORTALITY GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	0.62	0.01	63.50	0.52
JAN 16-31	1	0.00	0.00		
FEB 1-15	2	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	0				
APR 16-30*	2	0.00	0.00		
MAY 1-15	1	97.79	0.07	12.75	0.68
MAY 16-31	2	36.38	0.07	16.26	0.10
JUN 1-15	1	11.73	0.00	20.11	0.00
JUN 16-30	2	25.60	18.62	27.67	9.75
JUL 1-15	2	9.22	7.04	23.63	2.37
JUL 16-31	0				
AUG 1-15	1	0.00	0.00		
AUG 16-31	2	1.07	1.10	57.33	0.00
SEP 1-15*	1	0.00	0.00		
SEP 16-30	5	3.78	5.03	76.86	14.84
OCT 1-15	3	0.19	0.27	88.00	0.00
OCT 16-31	2	0.28	0.29	80.00	0.00
NOV 1-15	1	0.29	0.00	68.00	0.00
NOV 16-30	1	0.96	0.00	66.00	0.00
DEC 1-15	2	6.90	6.33	75.78	0.23
DEC 16-31	0				

APPENDIX 6. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR STRIPED BASS DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	2.49	0.04	75.92	3.70
JAN 16-31	1	2.15	0.00	68.50	0.00
FEB 1-15	2	3.13	0.05	78.75	6.45
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	0				
APR 16-30*	2	0.00	0.00		
MAY 1-15	1	2.22	0.07	16.90	0.10
MAY 16-31	2	29.47	4.93	16.78	1.76
JUN 1-15	1	33.40	0.00	20.50	0.00
JUN 16-30	2	51.46	35.13	39.40	6.53
JUL 1-15	2	28.67	7.28	41.69	1.64
JUL 16-31	0				
AUG 1-15	1	83.51	0.00	45.44	0.00
AUG 16-31	2	49.68	26.87	59.20	2.07
SEP 1-15*	1	21.43	0.00	73.00	0.00
SEP 16-30	5	38.90	17.19	79.25	5.23
OCT 1-15	3	3.39	2.47	72.72	0.29
OCT 16-31	2	1.41	1.45	90.20	0.00
NOV 1-15	1	4.11	0.00	77.21	0.00
NOV 16-30	1	3.85	0.00	70.25	0.00
DEC 1-15	2	3.32	1.06	71.75	1.12
DEC 16-31	0				

APPENDIX 7. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	59.80	12.02	111.31	7.72
JAN 16-31	3	50.56	32.79	102.21	4.55
FEB 1-15	4	55.20	30.53	103.75	5.35
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	25.00	25.30	106.00	0.00
APR 1-15	0				
APR 16-30	0				
MAY 1-15*	1	33.33	0.00	162.00	0.00
MAY 16-31*	1	100.00	0.00	81.00	0.00
JUN 1-15	3	71.12	17.13	35.71	1.36
JUN 16-30*	2	18.06	20.80	45.88	3.93
JUL 1-15	4	76.11	21.79	58.18	12.61
JUL 16-31*	2	66.07	9.03	64.46	4.26
AUG 1-15	7	55.47	33.93	63.49	13.45
AUG 16-31	6	82.33	19.39	74.20	5.17
SEP 1-15	9	77.44	29.73	82.13	6.11
SEP 16-30	11	74.84	21.76	90.82	3.99
OCT 1-15	7	83.54	8.41	98.66	5.36
OCT 16-31	7	88.20	5.89	106.24	2.83
NOV 1-15	2	81.10	10.23	104.25	0.39
NOV 16-30	2	71.00	7.61	96.07	1.36
DEC 1-15	6	74.30	8.16	101.00	6.12
DEC 16-31	4	69.46	16.65	102.75	6.61

* = TOTAL SAMPLE SIZE < 15

APPENDIX 7. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	0.68	1.18	106.00	0.00
JAN 16-31	3	5.56	9.74	101.50	0.00
FEB 1-15	4	5.00	10.10	102.00	0.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	0.00	0.00		
APR 1-15	0				
APR 16-30	0				
MAY 1-15*	1	0.00	0.00		
MAY 16-31*	1	0.00	0.00		
JUN 1-15	3	2.08	2.98	41.00	0.00
JUN 16-30*	2	43.06	44.68	41.09	2.13
JUL 1-15	4	2.27	3.98	22.00	0.00
JUL 16-31*	2	0.00	0.00		
AUG 1-15	7	3.88	6.17	23.37	1.56
AUG 16-31	6	0.19	0.42	84.00	0.00
SEP 1-15	9	1.98	3.78	72.50	34.26
SEP 16-30	11	1.30	4.16	87.00	0.00
OCT 1-15	7	1.10	2.72	105.00	0.00
OCT 16-31	7	0.76	1.22	101.25	4.48
NOV 1-15	2	0.54	0.54	155.00	0.00
NOV 16-30	2	1.60	0.14	97.60	1.69
DEC 1-15	6	0.43	0.66	97.50	1.54
DEC 16-31	4	0.69	1.22	102.00	0.00

APPENDIX 7. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	39.53	10.84	112.78	14.18
JAN 16-31	3	18.89	12.16	111.44	8.79
FEB 1-15	4	39.80	31.33	99.33	6.53
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	1	75.00	25.30	208.75	92.47
APR 1-15	0				
APR 16-30	0				
MAY 1-15*	1	66.67	0.00	144.00	0.00
MAY 16-31*	1	0.00	0.00		
JUN 1-15	3	26.80	19.96	41.85	1.54
JUN 16-30*	2	38.89	40.73	39.89	9.91
JUL 1-15	4	21.62	18.67	44.03	8.61
JUL 16-31*	2	33.93	9.03	46.00	8.11
AUG 1-15	7	40.65	32.14	48.45	22.83
AUG 16-31	6	17.48	19.51	73.16	7.29
SEP 1-15	9	20.58	29.55	75.50	17.60
SEP 16-30	11	23.86	19.17	89.14	15.29
OCT 1-15	7	15.36	7.95	95.78	12.28
OCT 16-31	7	11.04	6.11	103.23	9.46
NOV 1-15	2	18.36	9.69	111.37	6.10
NOV 16-30	2	27.39	7.48	103.78	3.99
DEC 1-15	6	25.27	8.48	95.94	4.17
DEC 16-31	4	29.85	16.03	87.85	10.87

APPENDIX 8. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	57.80	5.35	111.41	5.52
JAN 16-31*	1	64.29	0.00	103.33	0.00
FEB 1-15	2	43.87	10.91	109.47	6.82
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	1	0.00	0.00		
APR 1-15	0				
APR 16-30*	1	100.00	0.00	110.00	0.00
MAY 1-15	0				
MAY 16-31*	2	100.00	0.00	139.67	10.03
JUN 1-15	1	0.00	0.00		
JUN 16-30	1	0.00	0.00		
JUL 1-15	1	0.00	0.00		
JUL 16-31	0				
AUG 1-15	1	6.87	0.00	53.59	0.00
AUG 16-31	2	56.70	35.20	74.00	0.92
SEP 1-15*	1	4.55	4.70	94.00	0.00
SEP 16-30	5	61.36	29.15	91.54	3.47
OCT 1-15	3	74.66	9.62	100.33	7.23
OCT 16-31	2	65.94	4.18	108.36	4.67
NOV 1-15	1	55.33	0.00	102.25	0.00
NOV 16-30	1	73.53	0.00	100.83	0.00
DEC 1-15	2	40.29	8.58	102.82	1.41
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 8. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	2.63	2.72	102.00	0.00
JAN 16-31*	1	0.00	0.00		
FEB 1-15	2	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	1	0.00	0.00		
APR 1-15	0				
APR 16-30*	1	0.00	0.00		
MAY 1-15	0				
MAY 16-31*	2	0.00	0.00		
JUN 1-15	1	0.00	0.00		
JUN 16-30	1	75.00	25.72	46.50	20.50
JUL 1-15	1	100.00	0.00	26.00	0.00
JUL 16-31	0				
AUG 1-15	1	0.00	0.00		
AUG 16-31	2	0.00	0.00		
SEP 1-15*	1	4.55	4.70	78.33	0.00
SEP 16-30	5	3.33	6.86	62.00	0.00
OCT 1-15	3	0.00	0.00		
OCT 16-31	2	1.08	1.11	103.67	0.00
NOV 1-15	1	0.00	0.00		
NOV 16-30	1	2.94	0.00	90.25	0.00
DEC 1-15	2	0.56	0.58	98.00	0.00
DEC 16-31	0				

APPENDIX 8. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR AMERICAN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	2	39.57	2.62	103.30	1.76
JAN 16-31*	1	35.71	0.00	95.20	0.00
FEB 1-15	2	56.13	10.91	102.85	2.44
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	1	100.00	0.00	119.67	2.42
APR 1-15	0				
APR 16-30*	1	0.00	0.00		
MAY 1-15	0				
MAY 16-31*	2	0.00	0.00		
JUN 1-15	1	100.00	0.00	44.00	0.00
JUN 16-30	1	25.00	25.72	50.83	0.00
JUL 1-15	1	0.00	0.00		
JUL 16-31	0				
AUG 1-15	1	93.13	0.00	27.97	0.00
AUG 16-31	2	43.30	35.20	70.33	7.39
SEP 1-15*	1	90.91	9.41	86.35	2.13
SEP 16-30	5	35.31	24.12	85.44	5.66
OCT 1-15	3	25.34	9.62	93.42	15.82
OCT 16-31	2	32.99	3.07	107.73	1.06
NOV 1-15	1	44.67	0.00	99.58	0.00
NOV 16-30	1	23.53	0.00	102.78	0.00
DEC 1-15	2	59.14	9.17	97.45	1.27
DEC 16-31	0				

APPENDIX 9. BIMONTHLY MEAN FORK LENGTH (mm) AND MORTALITY RATES (%) FOR STEELHEAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

HANDLING TEST

DATES	NUMBER OF TEST	GRAND MEAN FORK LENGTHS (MM)	STD of the MEAN FORK LENGTHS (MM)	GRAND MEAN MORTALITIES (%)	STD of the MEAN MORTALITIES (%)
MAR 16-31*	1	249.00	0.00	0.00	0.00
APR 1-15*	1	428.00	0.00	0.00	0.00
APR 16-30*	2	260.25	91.3	0.00	0.00
MAY 1-15*	2	273.00	2.83	0.00	0.00

TRUCKING TEST

DATES	NUMBER OF TEST	GRAND MEAN FORK LENGTHS (MM)	STD of the MEAN FORK LENGTHS (MM)	GRAND MEAN MORTALITIES (%)	STD of the MEAN MORTALITIES (%)
MAR 16-31*	1	343.00	0.00	0.00	0.00
APR 1-15*	1	225.00	0.00	0.00	0.00

* = TOTAL SAMPLE SIZE <15

APPENDIX 10. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	68.24	22.71	98.48	2.66
JAN 16-31*	4	13.39	8.97	89.22	6.03
FEB 1-15	6	8.29	7.57	86.90	8.83
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	83.45	5.09	93.33	2.91
APR 1-15	2	90.21	3.57	98.46	0.47
APR 16-30	4	99.82	0.31	93.05	2.26
MAY 1-15	5	98.38	2.38	92.14	1.77
MAY 16-31	5	100.00	0.00	92.13	10.19
JUN 1-15*	3	58.33	42.87	98.33	0.67
JUN 16-30*	3	100.00	0.00	96.17	3.83
JUL 1-15	5	84.44	26.15	81.03	16.73
JUL 16-31*	2	80.00	20.20	51.37	1.99
AUG 1-15	7	88.10	11.45	59.46	7.86
AUG 16-31	6	80.57	17.41	62.92	12.76
SEP 1-15	10	79.77	34.52	70.28	13.23
SEP 16-30	11	96.19	4.77	70.27	9.76
OCT 1-15	7	88.09	20.79	73.03	9.57
OCT 16-31	7	96.04	7.36	86.96	2.08
NOV 1-15	2	100.00	0.00	93.43	4.47
NOV 16-30	2	96.21	0.98	88.89	2.08
DEC 1-15	6	88.19	14.65	90.62	3.30
DEC 16-31	4	87.29	4.44	87.43	1.79

* = TOTAL SAMPLE SIZE < 15

APPENDIX 10. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	13.57	18.15	103.38	3.42
JAN 16-31*	4	44.64	30.76	98.94	4.06
FEB 1-15	6	37.36	18.04	101.66	4.25
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	1.27	0.80	98.89	3.93
APR 1-15	2	3.33	3.36	82.00	0.00
APR 16-30	4	0.00	0.00		
MAY 1-15	5	0.00	0.00		
MAY 16-31	5	0.00	0.00		
JUN 1-15*	3	0.00	0.00		
JUN 16-30*	3	0.00	0.00		
JUL 1-15	5	0.00	0.00		
JUL 16-31*	2	10.00	10.10	52.00	0.00
AUG 1-15	7	4.31	9.72	43.91	22.27
AUG 16-31	6	3.75	7.49	38.40	9.05
SEP 1-15	10	1.28	2.35	51.94	25.48
SEP 16-30	11	0.06	0.18	63.00	0.00
OCT 1-15	7	1.79	4.41	24.00	0.00
OCT 16-31	7	0.56	1.39	104.50	0.00
NOV 1-15	2	0.00	0.00		
NOV 16-30	2	0.00	0.00		
DEC 1-15	6	0.00	0.00		
DEC 16-31	4	1.39	2.43	86.50	0.00

APPENDIX 10. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15	4	18.20	8.04	105.04	4.38
JAN 16-31*	4	41.96	37.16	101.78	5.35
FEB 1-15	6	54.35	14.11	100.21	2.22
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	4	15.28	4.75	93.11	1.95
APR 1-15	2	6.46	0.21	91.50	1.52
APR 16-30	4	0.18	0.31	90.00	0.00
MAY 1-15	5	1.62	2.38	72.75	17.98
MAY 16-31	5	0.00	0.00		
JUN 1-15*	3	41.67	42.87	75.00	43.56
JUN 16-30*	3	0.00	0.00		
JUL 1-15	5	15.56	26.15	74.50	29.89
JUL 16-31*	2	10.00	10.10	120.00	0.00
AUG 1-15	7	7.59	8.18	46.59	18.93
AUG 16-31	6	15.68	12.17	50.91	18.03
SEP 1-15	10	14.45	29.70	58.09	30.97
SEP 16-30	11	3.75	4.78	57.29	19.48
OCT 1-15	7	10.12	20.65	56.08	29.79
OCT 16-31	7	3.40	5.99	81.50	18.61
NOV 1-15	2	0.00	0.00		
NOV 16-30	2	3.79	0.98	77.50	0.51
DEC 1-15	6	11.81	14.65	81.78	11.05
DEC 16-31	4	11.32	2.56	92.99	8.95

APPENDIX 11. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	49.40	6.75	102.85	2.46
JAN 16-31	1	0.00	0.00		
FEB 1-15	2	1.22	1.26	72.00	0.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	2	67.06	7.43	96.79	2.62
APR 1-15	2	90.77	5.22	97.03	1.50
APR 16-30	2	98.08	1.96	94.99	3.64
MAY 1-15	2	100.00	0.00	93.08	0.78
MAY 16-31*	1	100.00	0.00	90.70	0.00
JUN 1-15	0				
JUN 16-30*	2	87.30	1.62	94.58	4.16
JUL 1-15	2	100.00	0.00	70.25	14.23
JUL 16-31	0				
AUG 1-15	1	32.63	0.00	42.03	0.00
AUG 16-31	2	56.21	29.40	64.47	4.81
SEP 1-15	2	29.55	30.45	81.23	0.00
SEP 16-30	3	97.08	2.61	74.96	4.09
OCT 1-15	1	100.00	0.00	78.59	0.00
OCT 16-31	1	98.51	0.00	85.64	0.00
NOV 1-15*	1	50.00	0.00	92.00	0.00
NOV 16-30	1	97.37	0.00	84.58	0.00
DEC 1-15	1	81.75	4.09	92.25	1.59
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 11. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	10.71	3.68	87.83	4.37
JAN 16-31	1	57.14	0.00	106.25	0.00
FEB 1-15	2	60.11	1.62	101.99	1.80
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	2	0.00	0.00		
APR 1-15	2	4.09	3.14	93.00	4.20
APR 16-30	2	0.00	0.00		
MAY 1-15	2	0.00	0.00		
MAY 16-31*	1	0.00	0.00		
JUN 1-15	0				
JUN 16-30*	2	0.00	0.00		
JUL 1-15	2	0.00	0.00		
JUL 16-31	0				
AUG 1-15	1	15.92	0.00	28.67	0.00
AUG 16-31	2	30.14	27.78	31.53	8.63
SEP 1-15	2	4.55	4.69	43.50	0.00
SEP 16-30	3	0.56	0.81	96.00	0.00
OCT 1-15	1	0.00	0.00		
OCT 16-31	1	0.00	0.00		
NOV 1-15*	1	50.00	0.00	47.00	0.00
NOV 16-30	1	2.63	0.00	101.00	0.00
DEC 1-15	1	2.28	0.51	83.50	0.52
DEC 16-31	0				

APPENDIX 11. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR THREADFIN SHAD DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	39.88	3.07	94.36	1.19
JAN 16-31	1	42.86	0.00	86.00	0.00
FEB 1-15	2	38.67	0.36	97.24	4.09
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31	2	32.94	7.43	92.61	0.92
APR 1-15	2	5.13	2.07	86.33	0.70
APR 16-30	2	1.92	1.96	101.50	0.00
MAY 1-15	2	0.00	0.00		
MAY 16-31*	1	0.00	0.00		
JUN 1-15	0				
JUN 16-30*	2	12.70	1.62	98.50	3.61
JUL 1-15	2	0.00	0.00		
JUL 16-31	0				
AUG 1-15	1	51.45	0.00	30.08	0.00
AUG 16-31	2	13.37	1.34	42.33	17.58
SEP 1-15	2	65.91	35.14	87.93	28.39
SEP 16-30	3	2.36	2.82	69.75	28.66
OCT 1-15	1	0.00	0.00		
OCT 16-31	1	1.49	0.00	87.00	0.00
NOV 1-15*	1	0.00	0.00		
NOV 16-30	1	0.00	0.00		
DEC 1-15	1	15.97	3.58	80.79	3.22
DEC 16-31	0				

APPENDIX 12. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	50.00	50.52	170.00	0.00
JAN 16-31	0				
FEB 1-15*	2	100.00	0.00	197.00	58.80
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	4	51.96	30.70	163.33	33.52
APR 1-15*	2	25.76	7.65	150.25	51.96
APR 16-30*	3	41.67	11.94	137.33	30.09
MAY 1-15*	5	62.00	37.48	78.19	18.86
MAY 16-31	5	72.62	16.36	124.63	40.29
JUN 1-15*	3	26.72	11.19	141.33	44.90
JUN 16-30*	4	5.28	3.54	86.94	25.49
JUL 1-15	6	21.60	21.90	60.38	34.58
JUL 16-31*	2	12.88	3.84	29.25	0.25
AUG 1-15	8	46.33	27.06	68.70	36.16
AUG 16-31	6	39.30	27.65	102.39	36.72
SEP 1-15	10	22.33	28.75	97.04	68.30
SEP 16-30	11	46.12	24.18	136.55	30.09
OCT 1-15	8	38.54	39.70	176.14	30.99
OCT 16-31*	4	91.67	14.62	167.25	84.32
NOV 1-15*	1	0.00	0.00		
NOV 16-30	0				
DEC 1-15*	2	100.00	0.00	189.00	53.73
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 12. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	0.00	0.00		
JAN 16-31	0				
FEB 1-15*	2	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	4	15.44	20.79	134.08	33.26
APR 1-15*	2	34.85	1.53	133.63	21.53
APR 16-30*	3	50.00	0.00	129.33	69.96
MAY 1-15*	5	26.50	37.93	138.33	33.84
MAY 16-31	5	9.52	13.30	70.50	1.54
JUN 1-15*	3	20.37	18.52	108.88	17.20
JUN 16-30*	4	41.33	16.29	112.15	10.19
JUL 1-15	6	33.86	34.13	103.84	64.30
JUL 16-31*	2	18.18	18.42	116.00	0.00
AUG 1-15	8	14.93	18.16	137.85	70.60
AUG 16-31	6	2.22	5.03	45.50	0.00
SEP 1-15	10	7.76	16.49	135.30	52.06
SEP 16-30	11	11.20	13.86	149.14	46.20
OCT 1-15	8	30.63	41.11	183.70	71.16
OCT 16-31*	4	0.00	0.00		
NOV 1-15*	1	100.00	0.00	172.00	0.00
NOV 16-30	0				
DEC 1-15*	2	0.00	0.00		
DEC 16-31	0				

APPENDIX 12. BIMONTHLY HANDLING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	2	50.00	50.52	157.00	0.00
JAN 16-31	0				
FEB 1-15*	2	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	4	32.60	20.10	145.40	19.66
APR 1-15*	2	39.39	6.12	141.50	2.54
APR 16-30*	3	8.33	11.94	143.00	0.00
MAY 1-15*	5	11.50	15.29	140.50	4.57
MAY 16-31	5	17.86	18.87	148.00	102.21
JUN 1-15*	3	52.91	8.44	116.52	8.45
JUN 16-30*	4	53.39	17.23	128.78	13.63
JUL 1-15	6	44.54	29.08	101.46	42.49
JUL 16-31*	2	68.94	14.58	137.78	11.07
AUG 1-15	8	26.24	24.67	181.27	17.09
AUG 16-31	6	58.48	29.22	157.37	28.94
SEP 1-15	10	69.91	30.87	152.60	34.86
SEP 16-30	11	42.68	23.03	174.83	43.26
OCT 1-15	8	30.83	33.23	166.62	13.16
OCT 16-31*	4	8.33	14.62	222.00	0.00
NOV 1-15*	1	0.00	0.00		
NOV 16-30	0				
DEC 1-15*	2	0.00	0.00		
DEC 16-31	0				

APPENDIX 13. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA.

		LIVE FISH			
DATES	NUMBER OF TEST	GRAND MEAN SURVIVAL (%)	STD OF THE MEAN SURVIVAL (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	100.00	0.00	155.33	0.00
JAN 16-31	0				
FEB 1-15	1	100.00	0.00	161.53	0.00
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	2	47.01	8.81	136.30	23.08
APR 1-15	2	22.60	15.36	145.33	4.83
APR 16-30*	2	100.00	0.00	147.00	76.60
MAY 1-15*	2	70.83	4.29	72.58	12.51
MAY 16-31*	2	75.00	25.77	76.94	12.36
JUN 1-15*	1	55.56	0.00	81.60	0.00
JUN 16-30	2	5.00	5.15	259.00	0.00
JUL 1-15	3	41.67	24.55	99.40	92.22
JUL 16-31	0				
AUG 1-15*	1	20.00	0.00	113.00	0.00
AUG 16-31*	2	42.31	35.68	132.20	59.83
SEP 1-15	2	18.18	18.74	132.88	0.00
SEP 16-30	5	27.35	25.29	182.70	101.79
OCT 1-15*	3	38.33	31.58	173.83	31.23
OCT 16-31*	1	100.00	0.00	139.50	0.00
NOV 1-15	0				
NOV 16-30	0				
DEC 1-15*	1	100.00	0.00	74.00	0.00
DEC 16-31	0				

* = TOTAL SAMPLE SIZE < 15

APPENDIX 13. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		IMMEDIATE MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN IMMEDIATE MORTALITY (%)	STD OF THE MEAN IMMEDIATE MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	0.00	0.00		
JAN 16-31	0				
FEB 1-15	1	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	2	0.00	0.00		
APR 1-15	2	32.69	17.84	133.63	7.62
APR 16-30*	2	0.00	0.00		
MAY 1-15*	2	29.17	4.29	80.50	13.36
MAY 16-31*	2	0.00	0.00		
JUN 1-15*	1	22.22	0.00	130.00	0.00
JUN 16-30	2	20.41	5.57	95.67	18.72
JUL 1-15	3	5.56	8.10	33.50	0.00
JUL 16-31	0				
AUG 1-15*	1	0.00	0.00		
AUG 16-31*	2	0.00	0.00		
SEP 1-15	2	0.00	0.00		
SEP 16-30	5	30.72	30.85	115.65	17.26
OCT 1-15*	3	15.00	11.13	112.00	43.83
OCT 16-31*	1	0.00	0.00		
NOV 1-15	0				
NOV 16-30	0				
DEC 1-15*	1	0.00	0.00		
DEC 16-31	0				

APPENDIX 13. BIMONTHLY TRUCKING GRAND MEAN SURVIVAL AND MORTALITY RATES (%) AND FORK LENGTHS (mm) FOR WHITE CATFISH DURING THE 1984 AND 1985 HANDLING AND TRUCKING EVALUATIONS AT THE JOHN E. SKINNER DELTA FISH PROTECTIVE FACILITY, BYRON, CALIFORNIA. (continued)

		24 HOUR MORTALITY			
DATES	NUMBER OF TEST	GRAND MEAN 24 HOUR MORTALITY (%)	STD OF THE MEAN 24 HOUR MORTALITY (%)	GRAND MEAN FORK LENGTHS (mm)	STD OF THE MEAN FORK LENGTHS (mm)
JAN 1-15*	1	0.00	0.00		
JAN 16-31	0				
FEB 1-15	1	0.00	0.00		
FEB 16-28	0				
MAR 1-15	0				
MAR 16-31*	2	52.99	8.81	102.00	
APR 1-15	2	44.71	33.20	139.35	4.59
APR 16-30*	2	0.00	0.00		
MAY 1-15*	2	0.00	0.00		
MAY 16-31*	2	25.00	25.77	70.00	
JUN 1-15*	1	22.22	0.00	127.00	0.00
JUN 16-30	2	74.60	0.42	101.69	
JUL 1-15	3	19.44	17.65	109.91	31.93
JUL 16-31	0				
AUG 1-15*	1	80.00	0.00	178.75	0.00
AUG 16-31*	2	57.69	35.68	164.29	
SEP 1-15	2	81.82	18.74	160.91	1.30
SEP 16-30	5	41.93	26.97	224.54	
OCT 1-15*	3	46.67	42.36	139.25	23.45
OCT 16-31*	1	0.00	0.00		
NOV 1-15	0				
NOV 16-30	0				
DEC 1-15*	1	0.00	0.00		
DEC 16-31	0				