SUMMARY OF CALFED BAY-DELTA PROGRAM ANALYSIS STRATEGY FOR STRIPED BASS ASSESSMENT VARIABLES

Five assessment variables have been identified for analysis of striped bass benefits and impacts from CALFED Bay-Delta Program (CALFED) action components and programmatic alternatives: spawning and egg deposition conditions, early development habitat, downstream transport, young rearing habitat, and yearling and adult habitat. CALFED alternative components will directly affect a number of control variables (e.g., habitat, riverflow, exports from the south Delta, Delta outflow) that will lead to changes in the assessment variables (e.g., young rearing habitat) through chains of relationships between supporting variables and assessment variables.

The CALFED alternatives may include many habitat, operational, and structural actions that cause direct or indirect beneficial or detrimental effects on striped bass. Effects may be observable at various stages of the striped bass life cycle and may not be simulatable in the adult population or escapement estimates; therefore, assessment variables include indices of effects on specific stages of the life cycle of the striped bass (i.e., yearling and adult habitat).

Support variables are those directly affected by CALFED actions. Habitat, operational, and structural actions proposed by CALFED may lead to direct or indirect effects on the various runs of striped bass. The striped bass population will be responsive to many of the proposed action components and structural and operations changes in the water management system that differ among alternatives. The ultimate tool in measuring the effects of the common and alternative specific changes would be a population relationship that simulates responses in terms of changes in population abundance. However, such a tool is not available for reliable estimates of population changes. Intermediate variables that are directly affected by flow and habitat conditions may be more useful as assessment variables as indicators of potential population changes.

Seven basic categories of actions may affect striped bass:

1. **Habitat Restoration.** Spawning, rearing, and migrating habitat would be increased directly or indirectly by a number of actions in the Bay-Delta and in the rivers and tributaries upstream of the Delta.

2. **Water Transport.** Constructing new water conveyance facilities in the Central Valley could reduce the number of striped bass lost at existing diversion/export facilities. Such conveyance facilities may also affect basic productivity of the Bay-Delta rearing areas of the striped bass that would affect the foodweb supporting the striped bass.

3. **Water Storage.** Constructing new water storage facilities upstream of the Delta, within the Delta, or south of the Delta may indirectly reduce striped bass losses and improve striped bass survival by shifting the timing of diversions.

4. **Fish Protection and Transport.** Eliminating, reducing, or screening diversions may improve survival of juvenile striped bass in the Bay and Delta. Improving fish facilities at Central Valley Project/State Water Project (CVP/SWP) pumping plants may reduce losses of striped bass.

5. **Water Diversion Management.** Shifts in the timing of flows and exports could reduce losses and improve survival of striped bass. Real-time monitoring may reduce losses of striped bass related to project operations.

6. **Fisheries Management.** Reestablishing hatchery programs and controlling fishery harvest may improve population levels of striped bass.

7. **Water Quality Management and Protection.** Improvements in water quality could improve striped bass survival, especially in the adult stages.

Assessing the effects of these actions on the striped bass population of the Bay-Delta is the goal of the analytical strategy for the environmental impact statement/environmental impact report (EIS/EIR). Examples of relationships that could be used to assess the effects of these action components on striped bass are discussed in the following section by life-history stage. Several of these relationships are shown in attachments.

- **Spawner-Recruitment Relationship.** A simple spawner-recruitment relationship can be used to assess effects of some of the actions. Such a relationship has been developed by Botsford and Brittnacher (1994). With such a spawner-recruitment relationship, future changes in population abundance relative to targets (e.g., doubling goals) could be predicted from arrays of actions if it is known how the actions can be translated into population losses or survival. Enhancements to the basic relationship may include adding independent factors, such as flow, harvest, and habitat conditions, that may affect recruitment independent of stock size. Available stock-recruitment relationships between life stages (e.g., 8 mm to 38 mm) help to build subelements of the overall relationship.
- **Transport.** Survival of eggs to juveniles as measured by the juvenile abundance index is related to a downstream transport function based on flow.
- **Juvenile survival in Bay-Delta.** Abundance of juvenile striped bass, the area of optimum habitat for striped bass, and the early survival of striped bass are related to the position of X2.
- **Salvage of juvenile striped bass at export facilities.** Over the past 25 years there has been an increase in the loss of striped bass at Byron and Tracy fish facilities of the SWP and CVP export facilities. Changes in losses at these facilities could be simulated from salvage/loss relationships developed from the salvage data. The losses could be built into the spawner-recruitment or other population relationships to show the potential benefits of reducing losses at the export facilities.

Assessment Variable		Supporting Variable		CALFED Action Component*
II. Biological Environment				
J. Fish Populations				
10. Striped bass abundance	Early freshwater and estuary survival	Habitat quality	River and Delta flows	
		Transport	Riparian habitat	Riparian habitat restoration
			Foodweb production	Water quality enhancement
			Water quality-toxins	
			Water temperature	
			Wetland habitat	Protect, enhance, restore wetland habitat
		Diversion loss	Diversion rate	
			Screening Delta Cross Channel PG&E	Screening, relocating diversions, flow management
		Predation		
		Competition		
	Adult survival	Habitat conditions	Flows	Flow management
		Recreational harvest	Foodweb production	Water quality enhancement
			Water quality-toxins	
	Spawning success	Habitat quality	River and Delta flows	Flow management
		Adult abundance	Water quality-toxins	Source controls
		Adult health	Water temperature	Flow management

* FIXED = relationship is assumed to not change.
INPUT = monthly hydrologic or meteorologic conditions.
FEEDBACK = relationship is addressed elsewhere in table.
FLOWS = water management control.
IFIM = Instream Flow Incremental Methodology
BMP = Best Management Practices

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