CHAPTER 9

Aquatic Resources

Chapter 9 evaluates potential impacts of LBAM Program implementation on aquatic resources. Results of the evaluation are provided at the programmatic level. Section 9.1, Environmental Setting, presents an overview of the aquatic resources in the Program Area and provides an overview of federal, state, and local ordinances and regulations pertinent to these resources that are applicable to the Program. Section 9.2, Environmental Impacts and Mitigation Measures, presents the following:

- Environmental concerns and evaluation criteria to determine whether the Program alternatives would cause significant impacts to aquatic resources
- Evaluation methods and assumptions
- Discussion of the impacts from the No Program and Program alternatives, and recommendations for mitigation, if required, for those impacts
- Cumulative impacts
- A summary of environmental impacts
- Monitoring of recommended mitigation measures

9.1 ENVIRONMENTAL SETTING

9.1.1 Aquatic Resources within the Program Area

The LBAM Program will be implemented over a large portion of the state, encompassing a wide range of aquatic habitats and a diverse array of fish and other aquatic species. The hydrologic provinces and species assemblages presented in Moyle (2002) have been used to describe the areas where the treatment would be implemented and are shown in Figure 9-1. The hydrologic provinces (as described in Moyle 2002) potentially affected by LBAM eradication efforts are described below. Native fish species found in aquatic habitat within these provinces are listed in Table 9-1, along with their legal status and life styles. Brief life-history descriptions for listed species are presented in Appendix E, Lists of Species, Attachment E-1.

9.1.1.1 Sacramento-San Joaquin Province

Central Valley Subprovince

The Central Valley Subprovince is drained by the Sacramento and San Joaquin rivers. Species native to this region are distinct with respect to morphology, physiology, and life-history patterns, reflecting an evolutionary history of adaptation to a unique climate characterized by extended droughts as well as massive floods (Moyle 2002). The hot Mediterranean climate of the Central Valley is characterized by hot, dry summers and cool, damp winters. The rainy season occurs from mid-Autumn through spring, with the northern half of the Central Valley receiving greater precipitation than the semidesert southern half. The four main fish assemblages that occur in the Central Valley Subprovince are (1) the rainbow trout assemblage, (2) the California roach assemblage, (3) the pikeminnow-hardhead-sucker assemblage, and (4) the deep-bodied assemblage. See Table 9-1 for a comprehensive list of the individual species found in this region.

SAN FRANCISCO ESTUARY

The Sacramento-San Joaquin River Delta lies near the confluence of the Sacramento and San Joaquin rivers between the towns of Hood, Vernalis, and Martinez. The Delta is the transition zone between freshwater river habitats of the Central Valley rivers and the successively more saline habitats of Suisun, San Pablo, and San Francisco bays. These habitats are affected by the tides, which cause diurnal changes in flow patterns and water quality, as well as river outflow, which cause more seasonal changes in habitat. The Delta has been substantially modified from its historic condition by levees, agriculture, toxic contaminants from municipal, industrial, and agricultural sources, and water diversions. The estuary is home to a diverse array of native and introduced species, some of which reside in the estuary throughout the year, and others that use the estuary seasonally. These species include winter-run and spring-run Chinook salmon, Central Valley steelhead, green sturgeon, delta smelt, and longfin smelt, all of which are listed by either the federal or California Endangered Species Acts.

The fish fauna that currently characterizes this system (including native and nonnative species) can be most easily described with respect to feeding guilds: planktivores, small benthic predators, bottom-feeding omnivores, and piscivores. The main planktivores in the estuary include delta and longfin smelt, threadfin shad, juvenile striped bass, American shad, and hitch and inland silversides. Small benthic predators include native prickly sculpin, tule perch, starry flounder, juvenile white sturgeon, juvenile splittail, and staghorn sculpin, as well as introduced yellowfin goby, shimofuri goby, bigscale logperch, and juvenile catfishes. Bottom-feeding omnivores include common carps, adult splittal, and Sacramento sucker. The most abundant piscivores in the system are striped bass, white catfish, channel catfish, and largemouth bass, which often prey on smaller migratory fishes such as juvenile salmon and steelhead (Moyle 2002).

CENTRAL VALLEY FLOOR

The Central Valley floor is composed of warm waterways including sluggish river channels, swamps, sloughs, and long stretches of open water. The Central Valley floor fish fauna is composed primarily of species from the deep-bodied fish assemblage. Native deep-bodied fishes, such as Sacramento perch and tule perch, and juvenile fishes occupy the stagnant backwaters, while specialized adult cyprinids (hitch, blackfish, and splittail) inhabit the long stretches of open water. Large pikeminnows and suckers are also abundant, migrating upstream to spawn in tributaries. Anadromous salmon, steelhead, and sturgeon pass through this zone on their way upstream to spawn (Moyle 2002). This domain is now dominated by introduced species including largemouth bass and white and black crappie, bluegill, inland silverside, white catfish and brown and black bullhead, and common carp.

CENTRAL VALLEY FOOTHILLS

Central Valley foothill streams and rivers ascend from the valley floor to the Sierra and Coast Range mountains. These streams and rivers are home to three fish assemblages as defined by Moyle (2002). From lowest to highest elevation, they are the pikeminnow-hardhead-sucker assemblage, the California roach assemblage, and the rainbow trout assemblage. The pikeminnow-hardhead-sucker assemblage occurs just above the valley floor at elevations of 80 to 1,500 feet. This assemblage typically inhabits streams with average summer flows of >300 liters/second, with deep, rocky pools and wide shallow riffles. Water quality and habitat complexity is usually high, although some streams may become intermittent during summer, and summer water temperatures may exceed 25°C. Sacramento pikeminnow and Sacramento sucker are generally the most abundant fishes of this assemblage, while hardhead are confined to cooler waters in reaches with deep, rock-bottomed pools.

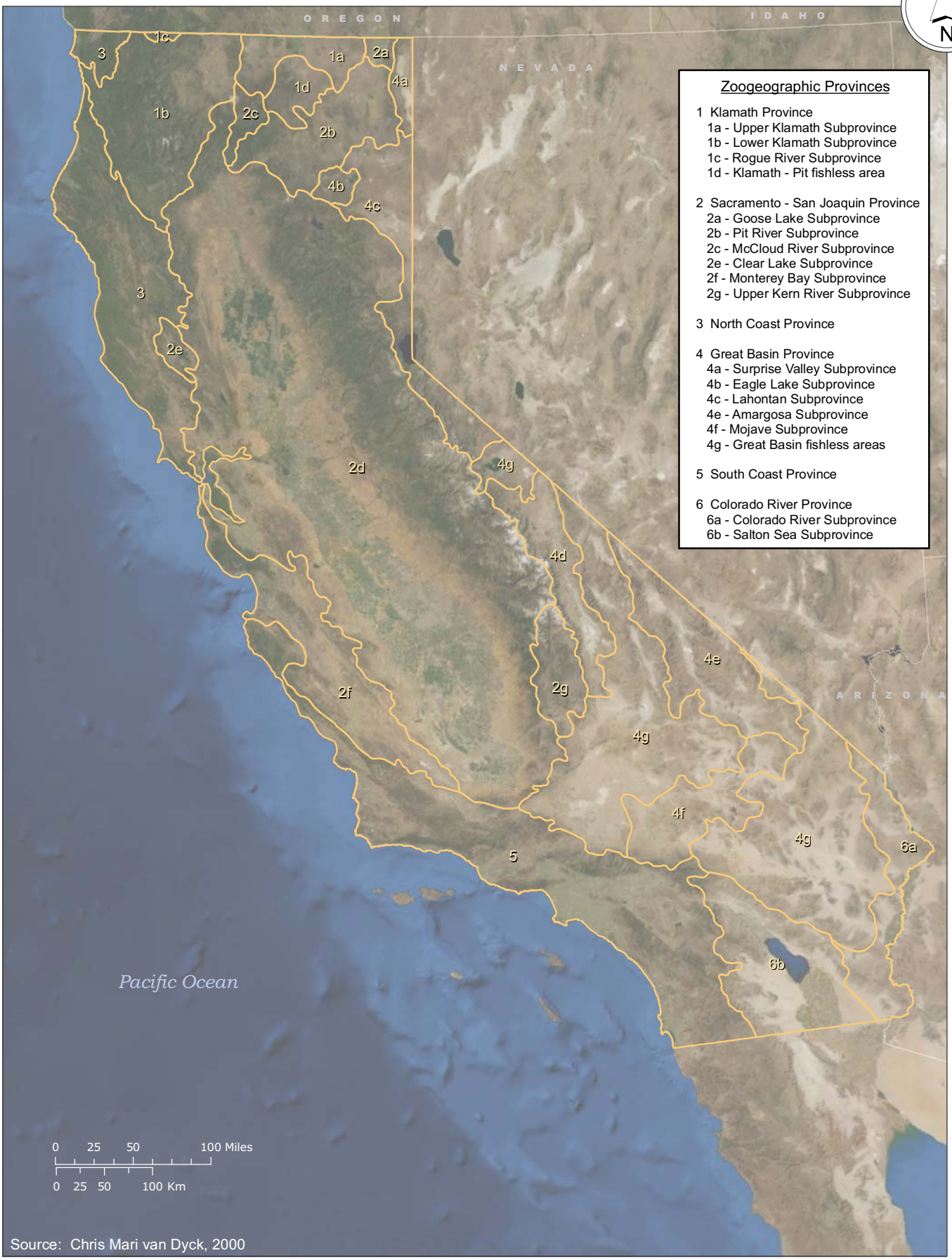

Figure 9-1: Aquatic Zoogeographic Provinces (Moyle 2002)

Table 9-1 Native Species in the Inland Waters of California

Species	Population Status[1]	Listing Status	Life Style[3]	Sacramento San Joaquin	North Coast	South Coast	Klamath
Pacific lamprey *Lampetra tridentata*	B,C		AN,F	+	+	+	+
Pit-Klamath brook lamprey *Lampetra lethophaga*	D		F	+			+
River lamprey *Lampetra ayresi*	D		AN	+	+		+
Kern brook lamprey *Lampetra hubbsi*	C		F	+			
Western brook lamprey *Lampetra richardsoni*	D		F	+	+	+	+
Klamath River lamprey *Lampetra similis*	D		F				+
White sturgeon *Acipenser transmontanus*	E		AN	+	+		+
Green sturgeon *Acipenser medirostris*	B	FT[A]	AN	+	+		+
Tui chub *Siphateles bicolor*	B-E	SE[B], FE[B]	F	+			+
Blue chub *Gila coerulea*	C		F				+
Arroyo chub, *Gila orcutti*	C		F			+	
Lahontan redside *Richardsonius egregius*	E		F	+*			
Hitch *Lavinia exilicauda*	C-D		F	+		+*	
California roach *Lavinia symmetricus*	B-E		F	+	+	+*	
Sacramento blackfish *Orthodon microlepidotus*	E		F	+		+*	
Sacramento splittail *Pogonichthys macrolepidotus*	C		E,F	+			
Hardhead *Mylopharodon conocephalus*	D		F	+			
Sacramento pikeminnow *Ptychocheilus grandis*	E		F	+	+*	+*	
Speckled dace *Rhinichthys osculus*	B-E		F	+	+	+	+
Mountain sucker *Catostomus platyrhynchus*	D		F	+*			
Santa Anna sucker *Catostomus santaanae*	B	FT	F			+	
Sacramento sucker *Catostomus occidentalis*	E		F	+	+	+*	
Modoc sucker *Catostomus microps*	B	SE, FE	F	+			
Owens sucker *Catostomus fumeiventris*	D		F			+*	
Klamath largescale sucker *Catostomus snyderi*	C		F				+

Table 9-1 Native Species in the Inland Waters of California

Species	Population Status[1]	Listing Status	Life Style[3]	Sacramento San Joaquin	North Coast	South Coast	Klamath
Klamath smallscale sucker *Catostomus rimiculus*	E		F				+
Lost River sucker *Catostomus luxatus*	B	SE, FE	F				+
Shortnose sucker Chasmistes brevirostris	B	SE, FE	F				+
Delta smelt Hypomesus transpacificus	B	SE, FT	E	+			
Longfin smelt Spirinchus thaleichthys	B	ST	E	+	+		
Eulachon Thaleichthys pacificus	C		AN		+		+
Coho salmon Oncorhynchus kisutch	B	ST[C]-SE[D], FT[C]-FE[D]	AN		+		+
Chinook salmon Oncorhynchus tshawytscha	B-D	ST[E]-SE[F], FT[G]-FE[H]	AN	+	+		+
Chum salmon Oncorhynchus keta	B		AN	+	+		+
Rainbow trout/Steelhead *Oncorhynchus mykiss*	B-E	FT[I]-FE[J]	AN,F	+	+	+	+
Coastal Cutthroat trout Oncorhynchus clarki	B-C		AN,F		+		+
Striped mullet *Mugil cephalus*	E		E			+	
Topsmelt Atherinops affinis	E		E	+	+	+	
California killfish *Fundulus parvipinnis*	E		E			+	
Threespine stickleback *Gasterosteus aculeatus*	B-E	SE[K], FE[K]	AN,E,F	+	+	+	+
Prickly sculpin *Cottus asper*	E		AM,E,F	+	+	+	+
Coastrange sculpin *Cottus aleuticus*	E		AM		+	+	+
Riffle sculpin *Cottus gulosus*	E		F	+	+		
Pit sculpin Cottus pitensis	E		F	+			
Reticulate sculpin *Cottus perplexus*	C		F				+
Marbled sculpin Cottus klamathensis	D-E		F	+			+
Rough sculpin Cottus asperrimus	C	ST	F	+			
Sacramento perch Archoplites interruptus	C		F	+			+*
Tule perch Hysterocarpus traski	C-E		E,F	+	+		
Shiner perch Cymatogaster aggregata	E		E	+	+	+	

Table 9-1 Native Species in the Inland Waters of California

Species	Population Status[1]	Listing Status	Life Style[3]	Sacramento San Joaquin	North Coast	South Coast	Klamath
Tidewater goby Eucyclogobius newberryi	C	FE[L]	E	+	+	+	
Longjaw mudsucker Gillichthys mirabilis	E		E	+		+	
Starry flounder Platichthys stellatus	E		E	+	+	+	

[1] Population status abbreviations: B, Threatened or endangered; C, Special concern; D, Watch list; E, Stable or increasing.

[2] Listing status abbreviations: ST = State-listed as Threatened, SE = State-listed as Endangered, FT = Federally listed as Threatened, FE = Federally listed as Endangered

[A] Southern DPS; [B] Mohave and Owens tui chub; [C] So. Oregon/No. CA ESU; [D] Central CA Coast ESU; [E] Sacramento River Spring-run; [F] Winter-run; [G] California Coastal ESU, Central Valley spring-run; [H] Sacramento River winter-run; [I] Northern CA ESU, Central CA Coast ESU, South-Central CA Coast ESU, Central Valley ESU; [J] Southern CA ESU; [K] Unarmored threespine stickleback; [L] Populations in Orange Co. and south. Populations north of Orange Co. delisted

[3] Life-style abbreviations: AM, amphidromous; AN, anadromous; E, estuarine resident; F, freshwater resident.

* Indicates that the species is introduced to the area.

The California roach assemblage overlaps substantially in elevation with the pikeminnow-hardhead-sucker assemblage, although it does not extend to the lowest elevations. This assemblage is found in small, warm tributaries to larger streams that flow through open foothill woodlands of oak and foothill pine. These streams are typically intermittent during summer, resulting in the formation of stagnant pools that can exceed 30°C during the day. In the winter and spring these streams are swift and vulnerable to flooding. These streams provide habitat for the California roach, which is capable of withstanding high temperature and low oxygen levels due to its small size.

The rainbow trout assemblage overlaps with the upper elevations of the pikeminnow-hardhead-sucker and California roach assemblage and extends to the highest elevations. These streams are characterized by swift, permanent flows, steep gradients, and cool temperatures. The water is well oxygenated and cover is abundant. Sculpin, Sacramento sucker, and speckled dace are often part of this assemblage. Introduced brook and brown trout are often found in this assemblage as well, although they generally do not occur at the lower elevations.

CENTRAL VALLEY RESERVOIRS

Dams constructed to store water in the Central Valley of California now provide habitat for a mix of exotic and native species. The nature of the fish fauna in a given reservoir is determined by its elevation, size, location, and water quality. California reservoirs range from clear, oligotrophic, cold-water impoundments at high elevations to turbid, eutrophic, warm-water impoundments at low elevations, but most are found at middle elevations in the foothills. These reservoirs usually provide habitat for warm-water fishes in surface and edge waters and salmonids in deeper, cooler water.

Clear Lake Subprovince

The Clear Lake Subprovince includes Clear Lake, located in a small drainage basin in the Coast Range at an approximately 1,319-foot elevation, and the surrounding watershed. Clear Lake is currently the largest natural freshwater lake located completely within the borders of California. The lake is highly productive due to its warm temperatures (summer temperatures of 20-25°C) and shallow waters, which are well mixed by summer winds. The native fish fauna primarily consists of species found in quiet waters of the Central Valley floor (Moyle 2002). The lake historically supported populations of many native species from the deep-bodied fish assemblage of the Central Valley. These fish were variants adapted to lake environments. Today only four natives, hitch, blackfish, tule perch, and prickly sculpin, have large populations, and many introduced species have come to dominate the lake's fauna. These introduced species include inland silverside, threadfin shad, bluegill, and at least 13 other species. The streams in this subprovince provide a home for Sacramento pikeminnow, Sacramento sucker, California roach, and rainbow trout.

Monterey Bay Subprovince

The Monterey Bay Subprovince is composed of three major streams that flow into Monterey Bay, the San Lorenzo, Pajaro, and Salinas rivers, as well as the small coastal drainages from Santa Cruz to San Francisco (Moyle 2002). This subprovince had nearly the full complement of species from the Central Valley floor, excluding hardhead and splittail), as well as saltwater dispersant fishes including the Pacific lamprey, threespine stickleback, prickly sculpin, steelhead, and coho salmon (Moyle 2002, Table 9-1).

9.1.1.2 North Coast Province

The North Coast Province consists of coastal drainages from the Golden Gate in San Francisco Bay to the Smith River on the Oregon border, excluding the mouth of the lower Klamath River (Moyle 2002). North Coast streams are highly variable, ranging from warm, intermittent streams to permanent, cold-flowing streams. Because these streams drain low mountain ranges and do not develop snowpacks, their flow patterns largely reflect rainfall. As a consequence, they may be raging torrents in winter and spring, and small trickling streams in summer. Coastal streams and rivers within this province have largely independent zoogeographic histories, but are very similar with respect to their faunal assemblages. The Russian River is unique in this region in that it provides a home to much of the Sacramento-San Joaquin freshwater dispersant fauna. In general, however, anadromous and other saltwater dispersant fishes dominate the fauna in the North Coast Province.

Three intergrading fish assemblages are observed in this area: resident trout, anadromous fishes, and estuarine fishes. Most of the fish in this subprovince are anadromous or saltwater dispersant species, but a few freshwater fish from the Central Valley are also observed here. The resident trout assemblage occupies the uppermost reaches of larger watersheds, typically above natural barriers to migration. The water is cold, swift, and well- oxygenated. This area is typically dominated by rainbow trout. The anadromous fish assemblage (steelhead, coho, and lamprey) is distributed as far upstream as fishes can migrate and downstream to reaches influenced by tidal action. Streams in this area are cold and fast moving; however, pools become increasingly large and frequent as streams approach the ocean. Long stretches of shallow riffles over rock, gravel, or sand between pools there are used by anadromous salmon for spawning. Lamprey, three-spine stickleback, prickly and coast-range sculpin, California roach and Sacramento sucker are also present. The estuarine fish assemblage occupies areas of streams affected by daily tides. Consequently, these fish experience reversing currents, temperature fluctuation, and salinity gradients daily. Species found in the estuarine areas include threespine stickleback, prickly sculpin, coastrange sculpin, staghorn sculpin, topsmelt, starry flounder, and tidewater goby (Moyle 2002; see Table 9-1).

9.1.1.3 Klamath River Province

The Klamath River Province occupies the northern portion of California and portions of southern Oregon. It is divided into upper and lower subprovinces. The two of greatest importance for the LBAM Program are the Upper Klamath River Basin above Klamath Falls, but extending downstream to Iron Gate Dam, and the Lower Klamath River Basin below Iron Gate Dam. These two regions have distinctly different habitat characteristics, with the upper Klamath being dominated by large shallow lakes and sluggish rivers and the lower Klamath having large, swift rivers. The province historically supported 30 native fish species, 10 of them endemic. The upper basin supports 9 endemic species, including 3 suckers, 3 cyprinids, and 3 sculpins. The lower basin is occupied mainly by saltwater dispersant fish including several species and races of anadromous salmonids and sturgeon. Six species are listed as threatened or endangered under federal or California Endangered Species Act laws.

9.1.1.4 South Coast Province

The South Coast Province includes 10 large watersheds and many smaller coastal drainages from Baja California north to Monterey Bay. This province has somewhat limited fish fauna with a relatively long, complex history due to the arid conditions and active geological history that characterize these regions (Moyle 2002). Streams within the Los Angeles Basin have an endemic group of freshwater dispersant species (arroyo chub, Santa Ana sucker, and speckled dace). Most of this watershed, however, has been dominated by salt water dispersants including anadromous rainbow trout and Pacific lamprey. Multiple euryhaline marine species are found in lagoons and lower reaches of streams within the South Coast Province, but the tidewater goby and California killifish are two species that are found only in these habitats (Moyle 2002, Table 9-1).

9.1.2 Special-Status Species

The Program Area includes much of California and, thus, has the potential to affect numerous species listed as threatened or endangered under the federal or California Endangered Species Acts. These species are included in Table 9-1. Brief summaries of the legal status of these species and their life histories are provided in Appendix E, Lists of Species, Attachment E-1, for invertebrates and fish.

9.1.3 Regulatory Setting

9.1.3.1 Federal

Endangered Species Act of 1973 (16 USC Section 1531 et seq.; 50 CFR Parts 17 and 222)

This law includes provisions for protection and management of species that are federally listed as threatened or endangered and designated critical habitat for these species. This law prohibits "take" of federally listed species, except as authorized under an incidental take permit or incidental take statement. The USFWS is the administering agency for this authority for freshwater species. The National Marine Fisheries Service (NMFS) is the administering agency for anadromous species.

Magnusson-Stevenson Fishery Conservation and Management Act 1996 (Public Law 94-265)

This law provides for the conservation and management of all fish resources within the exclusive economic zone of the U.S. and supports and encourages the implementation and enforcement of international fisheries agreements for conservation and management of highly migratory species. It called for the establishment of Regional Fisheries Management Councils to develop, implement, monitor, and revise fish management plans to promote domestic commercial and recreational fishing. Specifically to this Program, it calls for the protection of essential fish habitat in review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. The NMFS is responsible for the administration of this act.

9.1.3.2 State

California Fish and Game Code Section 1600 et seq.

This law provides for protection and conservation of fish and wildlife resources with respect to any project that may substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of any river, stream, or lake. The administering agency is the CDFG.

California Endangered Species Act of 1984 (California Fish and Game Code Sections 2050-2098)

This law provides for the protection and management of species and subspecies listed by the State of California as endangered or threatened, or designated as candidates for such listing. They are listed at 14 CCR Section 670.5. This law prohibits "take" of state-listed or candidate species, except as otherwise authorized by the Fish and Game Code. (The term "take" is defined by Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." This definition is different in some respects from the definition of "take" under the Federal Endangered Species Act.) The administering agency is the CDFG.

California Fish and Game Code Section 5650

This law protects water quality from substances or materials deleterious to fish, plant life, or bird life. It prohibits such substances or materials from being placed in waters or places where they can pass into waters of the state, except as authorized pursuant to, and in compliance with, the terms and conditions of permits or authorizations of the State Water Resources Control Board or a Regional Water Quality Control Board such as a waste discharge requirement issued pursuant to California Water Code Section 13263, a waiver issued pursuant to Water Code Section 13269(a), or permit pursuant to Water Code Section 13160. The administering agency for Fish and Game Code Section 5650 is the CDFG.

9.1.3.3 Local

California state law (California Food and Agricultural Code Section 11501.1) preempts local regulation and restriction of pesticide use. Local governing bodies may pass ordinances that regulate or restrict pesticide use in their own operations. For example, a city council may pass an ordinance that restricts pesticide use in municipal buildings and in public parks, and a school district board can decree that certain pesticides cannot be used in schools (DPR 2001). However, these restrictions do not apply to state operations and would not be applicable to treatments proposed under the Program alternatives.

9.2 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

9.2.1 Evaluation Concerns and Criteria

This section presents the significance criteria used to evaluate the likely impacts of the various Program alternatives under CEQA and identifies the environmental issues. The significance criteria establish thresholds for determining whether an impact rises to a level that is biologically significant. The environmental issues describe the mechanisms by which such impacts might occur.

9.2.1.1 Significance Criteria

Significance criteria were developed based on applicable regulations and management policies, a review of the available information, and the professional judgment of the authors.

The mandatory findings of significance as explained in CEQA, Public Resources Code Section 21083; Guidelines Section 15065, indicate that a project will have a significant effect on biological resources if it will:

- Substantially degrade environmental quality,
- Substantially reduce fish or wildlife habitat,

- Cause a fish or wildlife habitat to drop below self-sustaining levels,
- Threaten to eliminate a plant or animal community, or
- Reduce the numbers or range of a rare, threatened, or endangered species.

Additional thresholds of significance for biological resources under CEQA have been used in the following evaluation. Impacts were considered significant if they would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFG, USFWS, or USFS.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

9.2.1.2 Environmental Concerns

Several aquatic resource concerns exist regarding the Program. These aquatic resource concerns include the potential adverse consequences of:

- Increased pesticide use to control LBAM under the No Program Alternative. Related impacts include the toxicity of the chemicals to aquatic resources and the indirect impacts of increased pesticide use on nontarget insects, which are an important component of the food supply for fish.
- Pheromone and associated components entering the aquatic environment.
- Release of sterile insects and parasitic wasps into the environment, which may affect food supply for fish.

9.2.2 Evaluation Methods and Assumptions

Impacts are evaluated with regard to desired fish species (e.g., native and listed species), macroinvertebrate communities, and effects on food supply for fish, using the criteria described above. Potential impacts were assessed using available information on the toxicity of the various chemicals used, the treatment descriptions, and the physical and biological connections between upland and aquatic ecosystems. This information was evaluated in the context of the treatment alternatives and the existing environment in the Program Area as described in Section 9.1.1, Aquatic Resources within the Program Area.

9.2.2.1 Methodology

The potential impacts of the alternatives were evaluated based on the magnitude and duration of the treatments and the toxicity information presented in Ecological Risk Assessment, Appendix F for the various treatment strategies. The evaluation considered the life histories of the different listed fish species and ecological interactions including impacts to the aquatic food chain.

9.2.2.2 Assumptions

This evaluation does not incorporate any assumptions about which alternative treatment strategy or strategies would be applied in any given area. Therefore, each treatment alternative is considered as a stand-alone option, although the Program may include multiple alternative treatments within a given area (i.e., male moth attractant followed by sterile moth release).

9.2.3 No Program Alternative

The No Program Alternative would continue and expand quarantine and detection and inspection activities but without the application of the pheromone or any other insecticides on an areawide basis by the USDA or CDFA.

The No Program Alternative would use hydraulic spraying, defined as a medium to coarse spray continuously applied by either truck-based equipment or backpack-based equipment, of the No Program insecticides by farm and nursery operators (and their registered pesticide applicators). The target vegetation would be trees, shrubs, or crops on private land. These chemicals may be used more widely than they are currently, because of the economic risk of an LBAM infestation to an area.

9.2.3.1 Effects on Aquatic Resources

These chemicals could be applied to substantial areas. The No Program Alternative chemicals would be applied on days when winds are light to minimize drift, and would not be applied within buffer areas surrounding water bodies. However, the risk of drift or runoff from these chemicals into aquatic environments remains. While these chemicals tend to bind readily to sediment, pyrethroid pesticides have been implicated as potential contributors to the decline of pelagic fish populations in the Delta, even though these chemicals are not applied directly to aquatic environments (DWR and CDFG 2007). Each of the insecticides that would be used under the No Program Alternative (lambda-cyhalothrin, permethrin, and chlorpyrifos,) is characterized as being highly toxic to aquatic organisms (Appendix F) and have HQs that exceed 1.0 for aquatic invertebrates, fish, or both (see Table 12-9). Additionally, these chemicals are also not specific to LBAM and would not likely be applied in a manner that just targets LBAM, and so may have a substantial effect on nontarget insects that contribute to the aquatic food chain. The No Program Alternative would have **potentially significant toxic effects on aquatic resources and would have potentially significant indirect effects on aquatic resources through its impacts on the aquatic food chain**.

9.2.3.2 Impacts to Listed Species

Similarly to the effects on aquatic resources in general, these chemicals are highly toxic to listed aquatic species (see Table 12-9). Additionally, these chemicals are also not specific to LBAM and would not likely be applied in a manner that just targets LBAM, and so may have a substantial effect on nontarget insects that contribute to the aquatic food chain for listed species. The No Program Alternative would have **potentially significant toxic effects on listed aquatic species and would have potentially significant indirect effects on listed aquatic species through its impacts on the aquatic food chain**.

9.2.4 Mating Disruption (Alternative MD)

The LBAM pheromone would be used to disrupt the moth's mating activities. The three mating disruption methodologies under consideration include twist ties, ground application of pheromones, and aerial application of pheromones. Alternative MD does not include the use of pesticides.

9.2.4.1 Twist Ties (Alternative MD-1)

Plastic ties infused with LBAM pheromone are to be used in small isolated infestations (at least 5 miles from a regulated area or separated from a regulated area by a physical barrier, such as a largely uninhabited area or mountain range).Twist ties would be used as a stand-alone treatment or in conjunction with larval treatments of Btk or spinosad. No mechanical equipment is required for this application method.

Effects on Aquatic Resources

This application results in precise placement of the plastic twist ties at specific locations, usually in trees, which allows for the avoidance of areas with any sensitivity for aquatic resources. The use of twist ties would result in minimal (if any) runoff of the pheromone into the surrounding environment. The pheromone used is practically nontoxic to all forms of aquatic life (Appendix F, Section 12.3).

Impact AR-1: This application method has little potential to introduce the pheromone into aquatic environments and the pheromone is practically nontoxic to aquatic resources. No impact would occur from Alternative MD-1 on aquatic resources. Therefore, no mitigation is required.

Impacts to Listed Species

As described above, this treatment would not result in any runoff of the pheromone into the aquatic environment, and the pheromone is practically nontoxic to aquatic resources. The greatest potential impact from this treatment would be any disturbance involved in placing the twist ties adjacent to aquatic habitats.

Impact AR-2: Twist-tie placement near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require mitigation. This impact would be potentially significant if it disrupted spawning behavior for anadromous salmonids. Mitigation is required.

Mitigation Measure AR-2: Restrict access for twist-tie placement adjacent to the same stretch of streams or rivers where anadromous salmonids are known to spawn to fewer than one visit per month during the spawning season. Spawning areas are to be identified with NOAA Fisheries' and CDFG's assistance.

Significance after Mitigation: Less than significant

9.2.4.2 Ground Application (Alternative MD-2)

Several different methods exist for applying treatment compounds using ground-based equipment. The methods identified by the CDFA include:

- **Caulk Gun.** The pheromone would be mixed with an inert ingredients matrix to form the treatment compound, which would have a toothpaste-like consistency). A dollop of the treatment compound is squeezed onto the target using a applicator similar to a caulk gun. The target would either be trees and shrubs or telephone poles on private or public land. No drift is associated with this method.
- **Measured Dose Spray.** Depending on the treatment compound, a different delivery method may be used. For all methods, a pre-determined amount of treatment compound is applied per "shot" using a pod gun, backpack dose spray gun, or truck dose spray gun.

Effects on Aquatic Resources

This application results in precise placement of the pheromone and its inert ingredients matrix. The pheromone and its two matrices (Hercon, SPLAT) are weather resistant, so runoff of the material into the surrounding environment would be minor. The pheromone and matrix is practically nontoxic to aquatic life.

Impact AR-3: This application method has little potential to introduce the pheromone into aquatic environments and the pheromone is practically nontoxic to aquatic resources. No impact would occur from Alternative MD-2 on aquatic resources. Therefore, no mitigation is required.

Impacts to Listed Species

As described above, this treatment would result in minimal if any runoff of the pheromone into the aquatic environment and the pheromone is practically nontoxic to aquatic resources. The greatest potential impact from this treatment would be any disturbance by people and their equipment involved in treating areas adjacent to aquatic habitats.

Impact AR-4 Treatment near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require mitigation. This impact would be potentially significant if it disrupted spawning behavior for anadromous salmonids. Mitigation is required.

Mitigation Measure AR-4: Restrict access for treatment adjacent to the same stretch of stream or river where anadromous salmonids are known to spawn to fewer than one visit per month during the spawning season. Spawning areas are to be identified with NOAA Fisheries' and CDFG's assistance.

Significance after Mitigation: Less than significant

9.2.4.3 Aerial Application (Alternative MD-3)

Aerial applications of pheromone for mating disruption would be used to treat denser LBAM populations. The area for aerial applications is a 1.5-mile radius around each location where LBAM is detected in an undeveloped area. The volume of treatment is expected to be about 137 to 227 grams per acre for Hercon Bio-Flake and 150 to 300 grams per acre for SPLAT-LBAM. This method could result in the direct introduction of the pheromone and its carrier (Hercon flake or SPLAT-LBAM) into aquatic environments as well as runoff of the treatment materials from the watershed into aquatic environments. The Hercon flake may be attractive to fish as a potential food source.

Effects on Aquatic Resources

This treatment method would result in greater amounts of the treatment materials entering aquatic environments than the twist tie or ground application methods. The pheromone, Hercon Bio-Flake, and SPLAT are practically nontoxic to aquatic life (Appendix F, Chapter 12). The Hercon Bio-Flake may be used as a food source by fish. Given the limited frequency (every 1 to 2 months) and volume (137 to 227 grams per acre); however, it would be unlikely for it to occur in such concentrations and for a sufficient period of time in the environment as to replace natural food items.

Impact AR-5: The treatment materials are practically nontoxic to aquatic resources. Therefore, no impacts would occur to aquatic resources from Alternative MD-3, and no mitigation is required.

Impact AR-6: Hercon Bio-Flake may be used as a food resource by fish. This effect is expected to occur infrequently and in small quantities, and so would not result in displacement of natural food resources in the diet. This impact under Alternative MD-3 would be less than significant, and no mitigation is required.

Impacts to Listed Species

The effects of this treatment on listed species are the same as described for general aquatic resources above. Unlike Alternatives MD-1 and MD-2, this treatment would not result in disturbance of fish during the application process.

Impact AR-7: Impacts to listed aquatic species under Alternative MD-3 would be less than significant, and no mitigation is required.

9.2.5 Male Moth Attractant (Alternative MMA)

Alternative MMA involves ground treatment with the LBAM-specific pheromone plus permethrin to kill male moths. Alternative MMA is conducted in advance of the aerial mating disruption (if needed) to enhance the efficacy of the aerial mating disruption pheromone applications. The treatment area consists of a 1.5-mile radius around any detection site. Treatments may occur on street trees and utility poles, 8 feet aboveground. Male attractant treatment sites would be out of reach of the general public. The method of application would be the same as that discussed for the ground application of SPLAT in Section 9.2.4.2, Ground Application (Alternative MD-2), including backpack and truck-mounted spraying. The application is considered rainfast after it dries (about 4 hours after application).

Effects on Aquatic Resources

The pheromone and the inert ingredients in a thick matrix (i.e., SPLAT) are practically nontoxic to fish and would not be applied directly to aquatic environments, as described under Alternative MD-2. As described in the No Program Alternative and in Chapter 12, Ecological Health Concerns and Appendix F, Ecological Risk Assessment, permethrin is a pyrethroid pesticide, that is highly toxic to fish and other aquatic resources, including frogs. It can be toxic at very low levels in the environment (µg/L) for short durations. It has a half life of less than 5 days in water, but binds readily to sediment. It has a low to moderate tendency to bioconcentrate. It is recognized as having little tendency to bioaccumulate. The mechanism of application for Alternative MMA indicates that little or no drift would occur and that little or no permethrin would be expected to run off into the aquatic environment. Furthermore, a 25-foot buffer from water bodies is required for application of permethrin under its label directions. The hazard quotient for aquatic resources from Alternative MMA is less than 1 for both acute and chronic exposure, based on the method of application, as described in Chapter 12. Potential also exists for the permethrin to affect nontarget insects, which could affect the amount of food available to aquatic resources. However, the specific nature of the pheromone attractant and highly localized nature of the application method minimize this potential effect.

Impact AR-8: Alternative MMA would place permethrin into the environment. It would not result in the direct introduction into the aquatic environment. The application technique is highly localized and rainfast once the matrix dries, which would minimize the amount of runoff. Alternative MMA would have a less-than-significant impact to aquatic resources, and no mitigation is required.

Impact AR-9: Alternative MMA could affect nontarget insects due to the permethrin component, which could affect food-chain dynamics for aquatic resources. However, the application technique is highly localized and the pheromone treatment is species specific to LBAM, so any contact with nontarget insects would be incidental and at a very small scale. Alternative MMA would have a less-than-significant impact to aquatic resources, and no mitigation is required.

Impacts to Listed Species

The toxicity impacts to listed fish species would be the same as described for general aquatic resources above. The application may result in disturbance of fish as described for Alternative MD-2.

Impact AR-10: Treatment near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require

mitigation. This impact would be potentially significant if it disrupted spawning behavior for anadromous salmonids.

Mitigation Measure AR-10: Same as Mitigation Measure AR-4.

Significance after Mitigation: Less than significant

9.2.6 Organically Approved Insecticides (Alternatives Btk and S)

Application methods for these alternatives would include hydraulic spraying, where a medium to coarse spray is continuously applied by either truck-based equipment or backpack-based equipment. The target vegetation would be trees or shrubs on private or public land.

9.2.6.1 Alternative Btk

Alternative Btk would apply an organically approved pesticide, *Bacillus thuringiensis kurstaki*, in targeted areas. This treatment would be applied by hydraulic spraying using either truck-based or backpack-based equipment. This treatment would be applied every 14 days at a volume of 490 grams per acre. Btk is relatively immobile in soils (Appendix F, Section F3.4.1.2) and may rapidly settle out when applied to aquatic environments. However, it can persist for more than 2 months in the freshwater environment and for more than 1 month in saltwater environments. The CDFA has determined that they will not use Btk within 25 feet of water bodies.

Effects on Aquatic Resources

Alternative Btk may affect aquatic resources through toxicity or impacts to nontarget invertebrates. Btk has low toxicity to fish, frogs, and aquatic invertebrates, as described in Appendix F and Chapter 12. It is not expected to substantially affect nontarget insects, such as beetles and flies (Coleoptera and Diptera), that have aquatic larval forms that may be important components of fish diets. This alternative would be precisely applied over relatively small areas, and, therefore, would be expected to have a limited impact on nontarget organisms.

Impact AR-11: The toxicological effects of Btk application would be less than significant on aquatic resources and would not require mitigation.

Mitigation Measure AR-11: Although not required, the CDFA will implement a 25-foot buffer zone around aquatic environments to prevent drift of Btk into these environments. The CDFA will ask the CDFG to identify aquatic environments to be protected within planned treatment areas and confirm the width of the planned buffer zone sufficient to afford protection.

Impacts to Listed Species

The impacts to listed species would be similar to those described for general aquatic resources above. In addition, these species may be subject to the disturbance impacts during application near aquatic environments as described for Alternative MD-2.

Impact AR-12: Same as Impact AR-4.

Mitigation Measure AR-12: Same as Mitigation Measure AR-4.

Significance after Mitigation: Less than significant

9.2.6.2 Spinosad (Alternative S)

Alternative S would apply an organically approved pesticide, spinosad, in targeted areas. These areas are expected to be relatively small, encompassing one or two properties and the immediate area around these properties. This treatment would be applied by hydraulic spraying using either truck-based or backpack-based equipment. This treatment would be applied every 14 days at a volume of 19 grams per acre. Spinosad is relatively immobile in soils (Appendix F). It degrades rapidly within the environment, generally within a few days.

Effects on Aquatic Resources

Like Btk, spinosad may affect aquatic resources through toxicity or impacts to nontarget insects resulting in food-chain effects. Toxicity studies indicate that it may be nontoxic to moderately toxic to fish, and direct application to surface water or intertidal areas has been shown to be detrimental to aquatic life. However, the USEPA did not find acute or chronic levels of concern for aquatic species (Appendix F). The ecotoxicology model indicates that spinosad has a hazard quotient generally 2 orders of magnitude less than 1.0, the level considered potentially significant. The CDFA has determined that they will not use spinosad within 25 feet of water bodies.

Impact AR-13: Spinosad application could have toxicological effects on aquatic resources. This impact would be less than significant on aquatic resources and would not require mitigation.

Impact AR-14: Spinosad application may affect nontarget insects and, thus, may affect the food supply for fish. However, the area affected would be small and, therefore, this impact is less than significant, and no mitigation is required.

Impacts to Listed Species

The impacts to listed species would be similar to those described for general aquatic resources above. In addition, these species may be subject to the disturbance impacts during application near aquatic environments as described for Alternative MD-2.

Impact AR-15: Same as Impact AR-4.

Mitigation Measure AR-15: Same as Mitigation Measure AR-4.

Significance after Mitigation: Less than significant

9.2.7 Inundative Parasite Wasp Releases (Alternative Bio-P)

Inundative *Trichogramma* species (stingless parasite wasp) releases may be made in areas with more than 50 LBAM detections. This form of biological control would use native, commercially available parasitic wasps.

The estimated number of the native wasps (*Trichogramma platerni* and *T. pretiosum*) to be released is 1,000,000 per square mile (based on release rates used in commercial agriculture for the same insects). Wasp eggs are attached to index cards with Elmer's® glue and then attached to foliage where LBAM has been detected.

Effects on Aquatic Resources

Alternative Bio-P may temporarily increase food availability to fish populations through drop of both wasps and affected prey items into aquatic environments. This effect is expected to be small given the treatment density of 1,000,000 wasps per square mile and would not be expected to affect fish population levels or fish growth. As the parasitic wasps use insects other than LBAM as hosts, this application may also affect nontarget insect populations, which may affect food availability to aquatic resources. Given the limited treatment, these effects are expected to be minimal.

Impact AR-16: Release of parasitic wasps would result in a temporary, localized increase in prey for predators of *Trichogramma* wasps, followed by a return to normal prey levels. Based on low treatment densities, however, Alternative Bio-P would have no impact on aquatic resources, and no mitigation is required.

Impact AR-17: Alternative Bio-P could affect nontarget insects and, thus, affect food availability for aquatic resources. This impact would be less than significant given the targeted nature of placement of the parasitic wasps. Therefore, mitigation is not required.

Impacts to Listed Species

The impacts to listed species would be similar to those described for general aquatic resources above. In addition, these species may be subject to the disturbance impacts during application near aquatic environments as described for Alternative MD-2.

Impact AR-18: Same as Impact AR-4.

Mitigation Measure AR-18: Same as Mitigation Measure AR-4.

Significance after Mitigation: Less than significant

9.2.8 Sterile Insect Technique (Alternative SIT)

SIT would be the primary tool for LBAM eradication in California when it becomes fully operational. The Program would release sterile moths into the environment to disrupt LBAM mating and eradicate the population. The USDA has already accelerated the process of developing large-scale mass-rearing capabilities in support of LBAM eradication. The goal is to produce and release a minimum of 20 million sterile male moths per day at full capacity. These moths would be applied over a large treatment area (tens to hundreds of square miles) and, thus, localized densities would be low relative to overall insect numbers.

Effects on Aquatic Resources

The effects of Alternative SIT would be similar to those described for Alternative Bio-P. Food supplies may be increased temporarily following treatment. This treatment would likely result in a greater contribution to aquatic food supplies, as moths would be released from planes and, thus, potentially more likely to land in the water than the parasitic wasps distributed on cards. Releases would occur every 7 to 14 days for 2 lifecycles of LBAM. Because of low treatment densities relative to total insect populations, this treatment is not anticipated to result in a substantial increase in food supply for fish and, thus, would not affect growth rates or population levels.

Impact AR-19: Release of sterile moths would result in a minor, temporary, localized increase in prey for aquatic moth predators, followed by a return to normal prey levels. Based on low treatment densities, however, Alternative SIT would have no impact on aquatic resources, and no mitigation is required.

Impacts to Listed Species

The impacts to listed species would be similar to those described for general aquatic resources above, and no mitigation is required.

Impact AR-20: Release of sterile moths would have no impact on listed species. No mitigation is required.

9.2.9 Cumulative Impacts

The less-than-significant impacts to food supply for fish under some Program alternatives would not contribute incrementally to any decline in fisheries throughout the Program Area. The most significant cumulative impacts to fishery resources in the state from various activities statewide are those associated with Pelagic Organism Decline (POD) and the recent collapse of Central Valley salmonid populations.

The LBAM Program would not contribute substantially to these fisheries issues. The only alternative expected to have any potential for cumulative effects would be Alternative MMA. Under this alternative, the pesticide permethrin would be used, in conjunction with pheromones, to attract and then kill male LBAMs. Permethrin is highly toxic to aquatic organisms. However, this treatment would be applied in very localized areas, using a technique that would minimize drift, is rainfast, and would eliminate contaminated runoff associated with the treatment from the application areas. Thus, Alternative MMA would not contribute in any substantial way to the cumulative impacts from other factors or other project activities affecting fishery resources. Additional information is provided below.

9.2.9.1 Pelagic Organism Decline

POD refers to the recent (2002–present) steep decline of pelagic fishes (i.e., fish that occupy open-water habitats) within the Bay-Delta estuary (Armor et al. 2005; DWR and CDFG 2007; Sommer 2007). This environmental issue has emerged as one of overwhelming concern in the Delta.

The issues surrounding POD were announced in early 2005 as a possible change in the estuary's ability to support pelagic species and appeared to be a “step-change” from the preceding long-term decline. Four fish species are of primary concern: delta smelt, longfin smelt, young-of-year striped bass, and threadfin shad. From 2002 to 2007, despite moderate hydrologic conditions in the estuary, which would have been expected to result in moderate increases in population sizes, the populations of these species experienced sharp declines. Populations of each of the four species have been at or near all-time record lows since 2002. This change has persisted for a sufficiently long period to conclude that it is the result of something other than the pattern of widely variable population levels observed historically or as part of the long-term decline previously observed.

The POD Management Team has hypothesized that the three factors most likely to be responsible for the decline are the effects of exotic species, toxins (including pesticides, ammonia, and other chemicals), and water operations (DWR and CDFG 2007). The individual importance of these three potential factors is still an unresolved question.

Many of the Interagency Ecological Program studies to evaluate POD’s causes have focused on these factors. To date, research has failed to identify a single factor responsible for the decline of all species or even that of a single species (DWR and CDFG 2007; Sommer 2007). POD researchers currently believe that important factors responsible for the decline may be different for each species and that even for a single species these factors may differ between seasons and by hydrologic condition (Wet and Dry years). These factors may operate cumulatively to cause the observed population declines.

9.2.9.2 Salmonid Population Trends

The four runs of Chinook salmon: fall, late-fall, winter, and spring, as well as Central Valley steelhead, have all experienced long-term declines over the past several decades. Within the past decade some stocks have declined while others have stabilized or even improved, creating a complex current situation in regards to Central Valley salmonids. The heavy influence of hatchery stocks among all of these runs further complicates the overall assessment of current species status. Fall-run returns have improved over the past decade but the population has become heavily dependant on hatchery production, leaving managers uncertain of the overall sustainability of wild populations (Williams 2006). The late-fall run is included in the Central Valley fall-run Evolutionarily Significant Unit and has received very little attention in terms of research and monitoring. As a result, the population trajectory of this run, and the factors governing it, remains unclear (Williams 2006). The winter-run remains a small population with limited habitat downstream of Keswick Dam. The population has grown in recent years but remains far from recovery (Williams 2006). Spring-run populations in Sacramento River tributary streams such as Butte Creek have grown in recent years while stocks in the mainstem Sacramento River have declined (NMFS 2005; Williams 2006). Overall, the spring-run has shown broad fluctuations in abundance (NMFS 2005). Wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries with other much smaller populations in the lower Sacramento and San Joaquin basins. Data on Central Valley steelhead are limited but the Distinct Population Segment is thought to be highly fragmented and suffering a continued decline corresponding with declining habitat conditions throughout the Central Valley (NMFS 2005).

While the long-term trend has been increasing, the 2007 Central Valley fall-run totaled only 90,400 fish, the lowest count since 1973 and below the Pacific Fishery Management Council's minimum conservation target of 122,000 fish (Lindley et al. 2009). In 2008, an estimated 66,000 adults returned, and in 2009 the estimated returns for the Central Valley fall-run Chinook is projected to just meet the conservation target of 122,000 without any fishing. As a result of these poor returns, commercial fishing was closed and recreational fishing was substantially curtailed in 2008 and 2009. The cause of these low numbers has been attributed to poor ocean conditions in 2004 and 2005, on top of steady, long-term degradation of freshwater and estuarine habitats (Lindley et al. 2009).

Treatment for LBAM near aquatic environments could disturb aquatic species, which would be a less-than-significant impact unless the disturbance was to spawning behavior for anadromous salmonids, which is a potentially significant impact. This impact can be avoided with proper mitigation to avoid stream disturbance. Because the decline in salmonid populations is from many sources and multiple causes and is a significant cumulative impact from multiple watersheds, and the Program's incremental contribution is less than significant with mitigation, the Program's incremental impact is not cumulatively considerable.

9.2.10 Environmental Impacts Summary

Table 9-2 provides a summary of the impacts of the alternatives on aquatic resources. Symbols for the CEQA determinations of impact are listed at the end.

Table 9-2 Summary Comparison of Impacts of Alternatives

Impact Statement	No Program	MD-1	MD-2	MD-3	MMA	Btk and S	Bio-P	SIT
Effects on Aquatic Resources	PS	N	N	N, LS	LS	LS	N, LS	N
Impact AR-1: This application method has little potential to introduce the pheromone into aquatic environments and the pheromone is practically nontoxic to aquatic resources. No impact would occur from Alternative MD-1 on aquatic resources.	na	N	na	na	na	na	na	na
Impact AR-3: This application method has little potential to introduce the pheromone into aquatic environments and the pheromone is practically nontoxic to aquatic resources.	na	na	N	na	na	na	na	na
Impact AR-5: The treatment materials are practically nontoxic to aquatic resources.	na	na	na	N	na	na	na	na
Impact AR-6: Hercon Bio-Flake may be used as a food resource by fish. This effect is expected to occur infrequently and in small quantities, and so would not result in displacement of natural food resources in the diet.	na	na	na	LS	na	na	na	na
Impact AR-8: Alternative MMA would place permethrin into the environment. It would not result in the direct introduction into the aquatic environment. The application technique is highly localized and rainfast once the matrix dries, which would minimize the amount of runoff.	na	na	na	na	LS	na	na	na
Impact AR-9: Alternative MMA could affect nontarget insects due to the permethrin component, which could affect food-chain dynamics for aquatic resources. However, the application technique is highly localized and the pheromone treatment is species specific to LBAM, so any contact with nontarget insects would be incidental and at a very small scale.	na	na	na	na	LS	na	na	na
Impact AR-11: The toxicological effects of Btk application would be less than significant on aquatic resources and would not require mitigation.	na	na	na	na	na	LS	na	na
Impact AR-13: Spinosad application could have toxicological effects on aquatic resources.	na	na	na	na	na	LS	na	na
Impact AR-14: Spinosad application may affect nontarget insects and, thus, may affect the food supply for fish.	na	na	na	na	na	LS	na	na
Impact AR-16: Release of parasitic wasps would result in a temporary, localized increase in prey for predators of *Trichogramma* wasps, followed by a return to normal prey levels.	na	na	na	na	na	na	N	na
Impact AR-17: Alternative Bio-P could affect nontarget insects and, thus, affect food availability for aquatic resources.	na	na	na	na	na	na	LS	na
Impact AR-19: Release of sterile moths would result in a minor, temporary, localized increase in prey for aquatic moth predators, followed by a return to normal prey levels.	na	na	na	na	na	na	na	N
Impacts to Listed Species	PS	SM	SM	LS	SM, LS	SM	SM	N
Impact AR-2: Twist-tie placement near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require mitigation.	na	SM	na	na	na	na	na	na
Impact AR-4 Treatment near aquatic environments may result in disturbance of aquatic species.	na	na	SM	na	na	na	na	na

Table 9-2 Summary Comparison of Impacts of Alternatives

Impact Statement	No Program	MD-1	MD-2	MD-3	MMA	Btk and S	Bio-P	SIT
Effects on Aquatic Resources	PS	N	N	N, LS	LS	LS	N, LS	N
Impact AR-7: Impacts to listed aquatic species under Alternative MD-3 would be less than significant.	na	na	na	LS	na	na	na	na
Impact AR-10: Treatment near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require mitigation.	na	na	na	na	SM	na	na	na
Impact AR-12: Same as Impact AR-4.	na	na	na	na	na	SM	na	na
Impact AR-15: Same as Impact AR-4.	na	na	na	na	na	SM	na	na
Impact AR-18: Same as Impact AR-4.	na	na	na	na	na	na	SM	na
Impact AR-20: Release of sterile moths would have no impact on listed species.	na	na	na	na	na	na	na	N

Key:
LS = Less-than-significant impact
N = No impact
na = Not applicable
PS = Potentially significant impact (Applies to No Program only. Program alternatives have either feasible mitigations or unavoidable impacts.)
SM = Potentially significant but mitigable impact
SU = Potentially significant and unavoidable impact

9.2.11 Mitigation and Monitoring

Mitigation and monitoring for aquatic resources are presented in this section of the document. The primary mitigation measures are minimizing disturbance near aquatic environments when sensitive life stages of fish are present, and establishing appropriate buffers adjacent to aquatic environments to minimize drift of insecticides into these environments. The specific implementation details (e.g., location of salmon spawning habitat and aquatic environments to be protected by buffers and the width of those buffer zones) must be developed in cooperation with the CDFG and NMFS prior to any treatment applications. Monitoring of the measures effectiveness will be conducted by the CDFA.

Twenty-five-foot buffer zones will be established around aquatic environments to prevent drift of Btk or spinosad into these environments as stated in Section 2.5.4. The CDFA will ask the CDFG to identify aquatic environments to be protected within planned treatment areas and the width of the buffer zone sufficient to afford protection.

Impact AR-2: Twist-tie placement near aquatic environments may result in disturbance of aquatic species. This impact would be potentially significant but mitigable if it disrupted spawning behavior for anadromous salmonids. Mitigation is required.

Mitigation Measure AR-2: Restrict access for twist-tie placement adjacent to the same stretch of stream or river where anadromous salmonids are known to spawn to fewer than one visit per month during the spawning season. Spawning areas are to be identified with NOAA Fisheries' and CDFG's assistance.

Location: All treatment areas with streams or rivers supporting anadromous salmonids
Monitoring/Reporting Action: Concurrence with CDFG and NMFS
Effectiveness Criteria: CDFG and NMFS to establish areas for restricted access and may conduct selected site visits during treatment
Responsible Agency: CDFA
Timing: Prior to treatment

Impact AR-4: Treatment near aquatic environments may result in disturbance of aquatic species. Short-term disturbance is expected to be less than significant and would not require mitigation. This impact would be potentially significant if it disrupted spawning behavior for anadromous salmonids. Mitigation is required.

Mitigation Measure AR-4: Restrict access for treatment adjacent to the same stretch of stream or river where anadromous salmonids are known to spawn to fewer than one visit per month during the spawning season. Spawning areas are to be identified with NOAA Fisheries' and CDFG's assistance.

Location: All treatment areas with streams or rivers supporting anadromous salmonids
Monitoring/Reporting Action: Concurrence with CDFG and NMFS
Effectiveness Criteria: CDFG and NMFS to establish areas for restricted access and may conduct selected site visits during treatment
Responsible Agency: CDFA
Timing: Prior to treatment

Impact AR-10: Same as Impact AR-4.

Mitigation Measure AR-10: Same as Mitigation Measure AR-4.

Impact AR-11: The toxicological effects of Btk application would be less than significant on aquatic resources and would not require mitigation.

Mitigation Measure AR-11: Although not required, the CDFA will implement a 25-foot buffer zone around aquatic environments to prevent drift of Btk into these environments. The CDFA will ask the CDFG to identify aquatic environments to be protected within planned treatment areas and confirm the width of the planned buffer zone sufficient to afford protection.

Location: Identified aquatic environments
Monitoring/Reporting Action: Concurrence with CDFG
Effectiveness Criteria: CDFG to identify areas to be protected
Responsible Agency: CDFA and CDFG
Timing: Prior to treatment

Impact AR-12: Same as Impact AR-4.

Mitigation Measure AR-12: Same as Mitigation Measure AR-4.

Impact AR-15: Same as Impact AR-4.

Mitigation Measure AR-15: Same as Mitigation Measure AR-4.

Impact AR-18: Same as Impact AR-4.

Mitigation Measure AR-18: Same as Mitigation Measure AR-4.