Response to Comments on Studies of Cooling Water Intake System Entrainment Effects

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Entrainment Study Designs

- Design used for AES and other plants in LA region all based on design for DCPP
- Workshop at National Marine Fisheries Tiburon Lab in October 1996 to design DCPP study

Entrainment Study Designs
Tiburon Workshop

- Attendees
  - U.S. EPA
  - Central Coast RWQCB
  - National Marine Fisheries Service
  - California Department of Fish and Game
  - independent scientists from several universities (UC Davis, UC Santa Cruz, Moss Landing Marine Labs, UC Santa Barbara, UC San Diego - Scripps and University of Washington) and CalCOFI
  - Representative for League for Coastal Protection
  - Tenera Environmental
  - PG&E

Entrainment Study Designs
Tiburon Workshop

- Objective of Workshop

"To determine a method to accurately assess the potential impact of the Diablo Canyon cooling water intake system on the natural resources of the source water body, particularly the eggs and larvae of fisheries resources and/or protected species. This biological resource element of the 316(b) demonstration is to provide an assessment of whether the power plant's cooling water system is employing the best technology available (BTA) for cooling water intake design and location."

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Entrainment Study Designs
Tiburon Workshop

- Second meeting in October 1998 after initial analysis was completed
- Objective - refine analytical approaches and determine how the results could be used to detect any impacts to the populations affected by the plant's cooling water system

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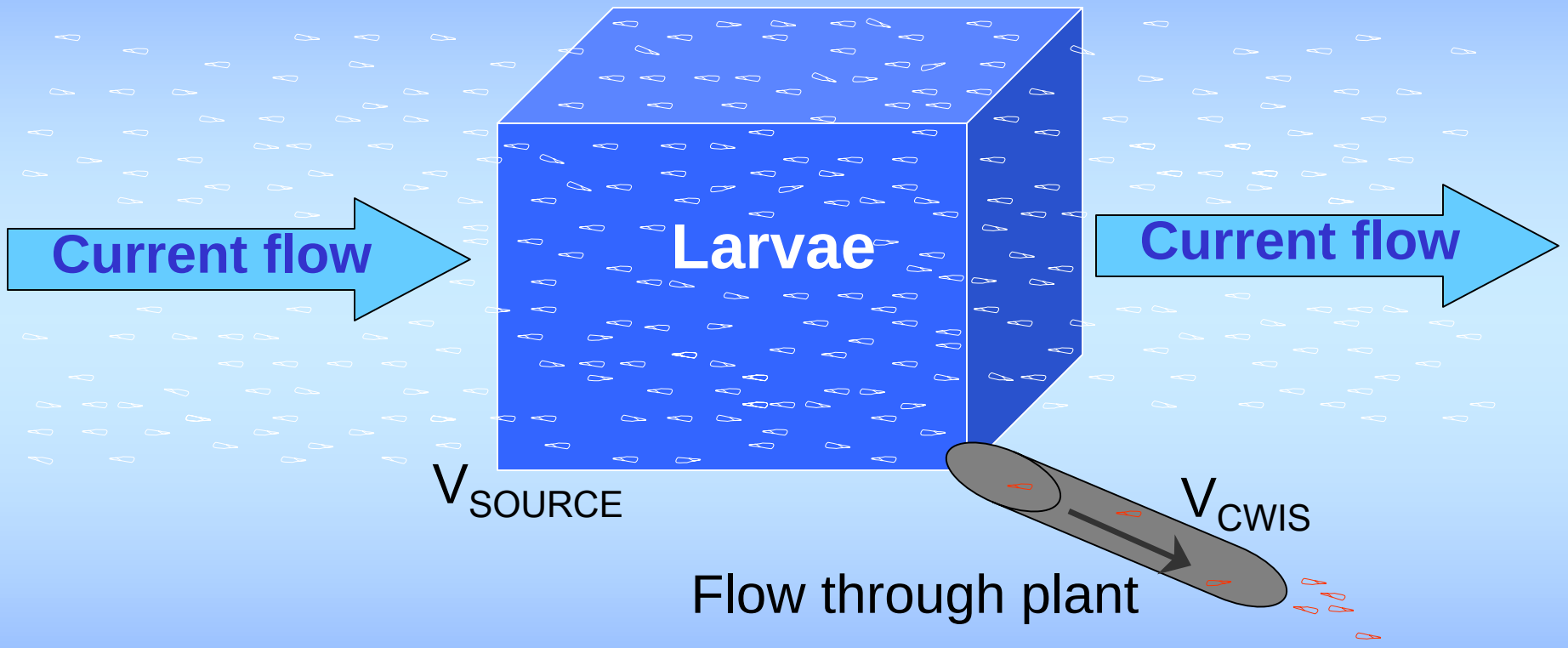
Entrainment Study Designs
Tiburon Workshop Findings

- Conditional mortality using ETM model best approach for assessing effects of entrainment
- Source water sampling used to estimate populations potentially affected by entrainment and estimate conditional mortality
- Hydrodynamics of source water – currents, winds, waves, tides, etc. all affect the size of the source water potentially affected by entrainment. This complexity requires empirical data on currents to estimate source population potentially affected during each sampling event

Conceptualization of *ETM*



Approximation of larval mortality due to entrainment = $\frac{V_{CWIS}}{V_{SOURCE}}$

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Entrainment Study Designs

- Similar approaches used in all subsequent studies done by Tenera in California – MLPP, MBPP, SBPP, HBGS (with MBC), PPP, EPS
- Continued to work with scientists from resource agencies and academia on these studies
- Developed consensus on study design approach – not always interpretation of results

Entrainment Study Designs

- CEC contracted with Tenera to prepare report on entrainment study design and analytical methods
- Principal Author – John Steinbeck, Tenera with
  - Dr. John Hedgepeth, Tenera
  - Dr. Dave Mayer, Tenera
  - Dr. Peter Raimondi, UC Santa Cruz
  - Dr. Greg Cailliet, Moss Landing Marine Laboratories (MLML)
  - Dr. John Skalski, U of Washington School of Fisheries
  - Other collaborators – Drs. Alec MacCall, NMFS; John Largier, UC Davis; and Mike Foster, MLML

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Entrainment Study Designs

LA Basin Studies

- All studies designed using same principals presented in CEC draft report
- Cooperation among AES, NRG, and LADWP have resulted in proposal for a study in Santa Monica Bay that is the most comprehensive cooling water system assessment since DCPP

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Entrainment Study Designs
LA Basin Studies

- Studies include both entrainment and source water sampling. Multiple current meters – data on alongshore and onshore currents
- Design recognizes that potential for entrainment effects extend beyond the hydraulic ROI of the intake

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Entrainment Study Designs Intake ROI

- Intake ROI only affected by tides and plant operation
- Larvae passing through ROI affected by numerous physical and biological factors
  - interaction of nearshore and coastal currents, tides, winds, waves, season, etc.
  - reproductive biology, behavior, etc.

Entrainment Study Designs Intake ROI

- Focus on ROI could lead to biased sampling
  - Habitats outside ROI not sampled although they contribute larvae to entrainment
- Ignores dynamics of source water
- Sampling includes regions within ROI and areas outside ROI affected by larger scale coastal hydrodynamic forces other than the intake
- Assessment (e.g. Empirical Transport Model) fully accounts for ROI as it predicts the likelihood for entrainment mortality for source water populations using any selected source water volume

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Entrainment Study Designs
Target Organisms

- New 316(b) rules require characterization of all life stages of fishes and shellfishes entrained, but

> *"..the Director has significant discretion as to how the performance standards are applied in the permit. For example, the Director may determine that all species must be considered or that only representative species are to be considered."*

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Entrainment Study Designs
Target Organisms

- All previous studies have processed samples for **all** fish larvae and shellfish larvae from species that are locally important in commercial or recreational fisheries
- Have not processed samples for fish eggs

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Entrainment Study Designs
Target Organisms

- Fish eggs not included
  - Entrainment generally dominated by fishes that do not have planktonic eggs that can be entrained
  - Eggs can only be identified for a few species
  - Effects on source populations due to egg entrainment incorporated in assessment models
- Do not provide any additional information that can be used in assessing effects of CWIS entrainment
- Consensus opinion of CEC technical workgroups and other independent scientists

Entrainment Study Designs
Target Organisms

- 'Shellfish' – definition as species locally important in commercial or recreational fisheries consistent with language in NPDES permits for required impingement monitoring
- Focus on life stages of commercial or recreational spp. that might be more susceptible to entrainment beyond early stages that are in high abundances where effects are proportional to CWS volumes
- Many early life stages of invertebrates are difficult to identify to species and require different sampling gear

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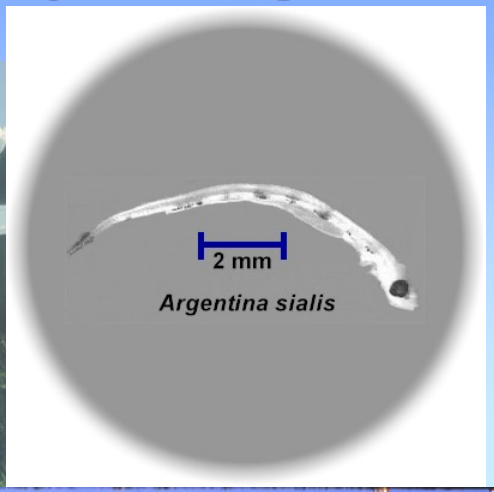
Entrainment Study Designs
Target Organisms

- Focus on larval fishes
  - Taxonomic descriptions available for most spp.
  - Life history usually available for at least a few spp.
  - Assessment models developed for fishes
  - Higher likelihood to deviate from uniform distribution
- Try to analyze a suite of species representative of all source water habitats
- Use ‘average’ entrainment mortality for other species not analyzed. Could also assume uniform distribution where entrainment mortality = volumetric ratio (ETM)

Questions?



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