# Mitigation for Desalination Plant Intake Impacts: A Fee-Based Approach

**SWRCB Expert Review Panel**

Michael Foster, MLML
Gregor Cailliet, MLML
John Callaway, USF
John Steinbeck, Tenera Environmental
Peter Raimondi, UCSC

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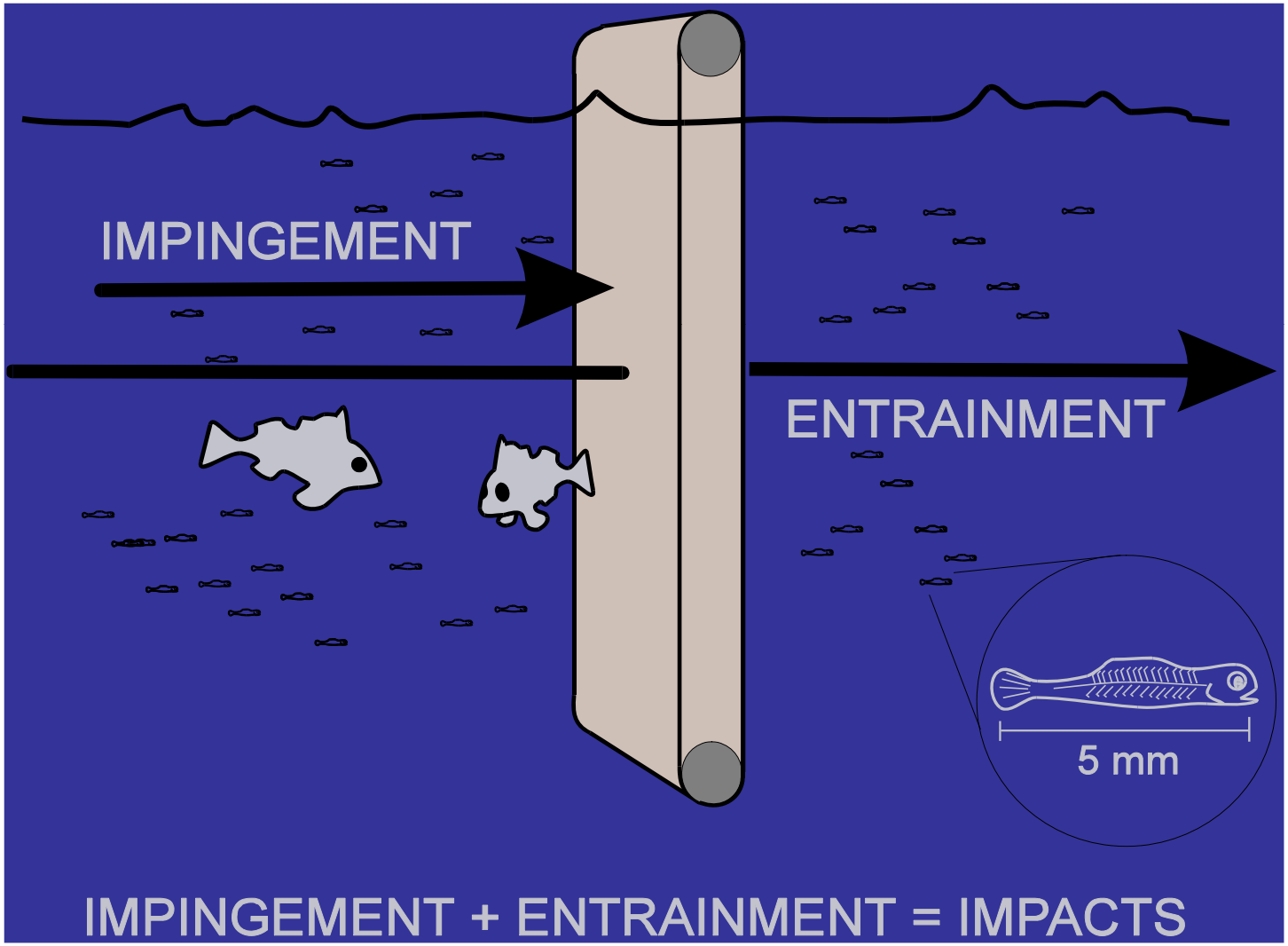
**PRELIMINATY RESULTS**
FOR DISCUSSION AND COMMENT.
**PLEASE DO NOT CITE**.
FINAL REPORT TO SWRCB IN FEBRUARY, 2012

**To Recommend Answers to the Questions**:

- Are there desalination intake technologies and designs that can reduce impingement and entrainment?

- If there is remaining impingement and entrainment after the best site, design and technology are determined for a new desalination plant, how should this remainder best be mitigated?

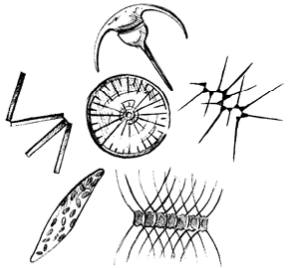
# Intake Impacts



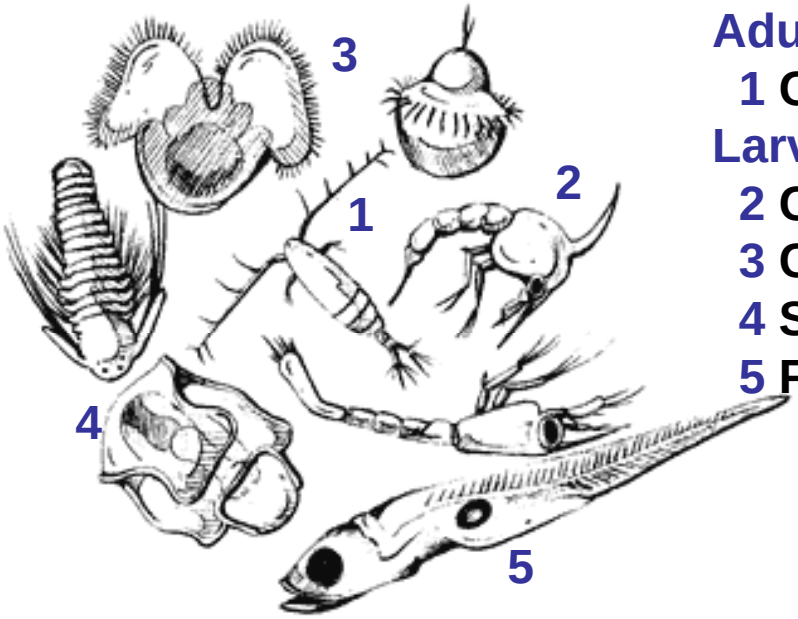

**(from Steinbeck)**

# PLANKTON DIVERSITY (SPP= # species) & ABUNDANCE (# = # /$10^3$ $m^3$) IN CALIFORNIA COASTAL WATERS (= # / .25 x $10^6$ gal)

**Phytoplankton** $10^2$ SPP $10^9$ #



**Zooplankton**




| | SPP | # |
|---|---|---|
| **Adults** | | |
| 1 Copepods and related animals | ~$10^2$ | $10^6$ |
| **Larvae** | | |
| 2 Crabs | 8 | 3x$10^3$ |
| 3 Clams & mussels | > 5 | 1.8x$10^6$ |
| 4 Sea urchins | 2 | 6x$10^2$ |
| 5 Fish | 44-200 | 400 – 600 |

**OTHER LARVAE???**

Data from: phyto, Petipa et al 1970; 1. Hopcroft et al 2002; all other, recent CA entrainment studies.

## Question 1: Technology and Designs to Reduce Intake Impacts

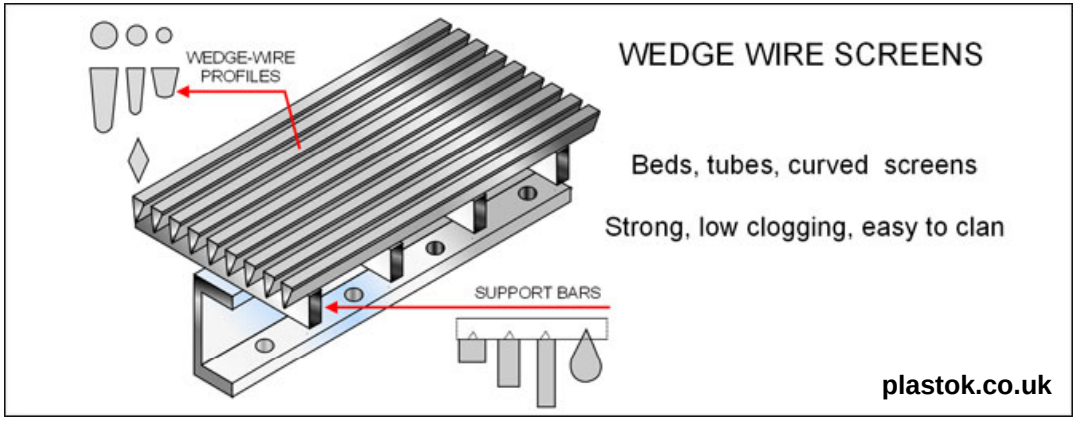
*Subsurface Intakes*: Impacts likely very low or zero.
*Surface Intakes:*

Impingement

- ►likely low if low volume and velocity. Need assessments.
- ►wedge wire screens or similar technology would eliminate impingement of juvenile and adult fishes.

Entrainment

- ►a wedge wire screen type filter (1 - 2 mm mesh) may reduce, but by how much? Modeling 1 mm mesh suggests may be ~ 50% reduction in adult equivalent fish losses. Likely no reduction in other plankton. Need assessments.

## Question 2: Mitigation For Remaining Intake Impacts - Entrainment

***Sample At Intake***

***ALSO Sample Source Water***

**Adult Equivalent Losses (AEL)**
-Compare to price of fish. – BUT no mitigation for impacts to organisms other than fish.

1. Using Empirical Transport Model (ETM), determine Proportional Mortality (**PM**)
   = proportion of larvae lost from entrainment that could be entrained (larvae in source population)
2. Determine the area of the source population
3. Determine the average of 1. and 2. for species assessed ("target species").
4. Average PM X average area = area equivalent to 100% loss =

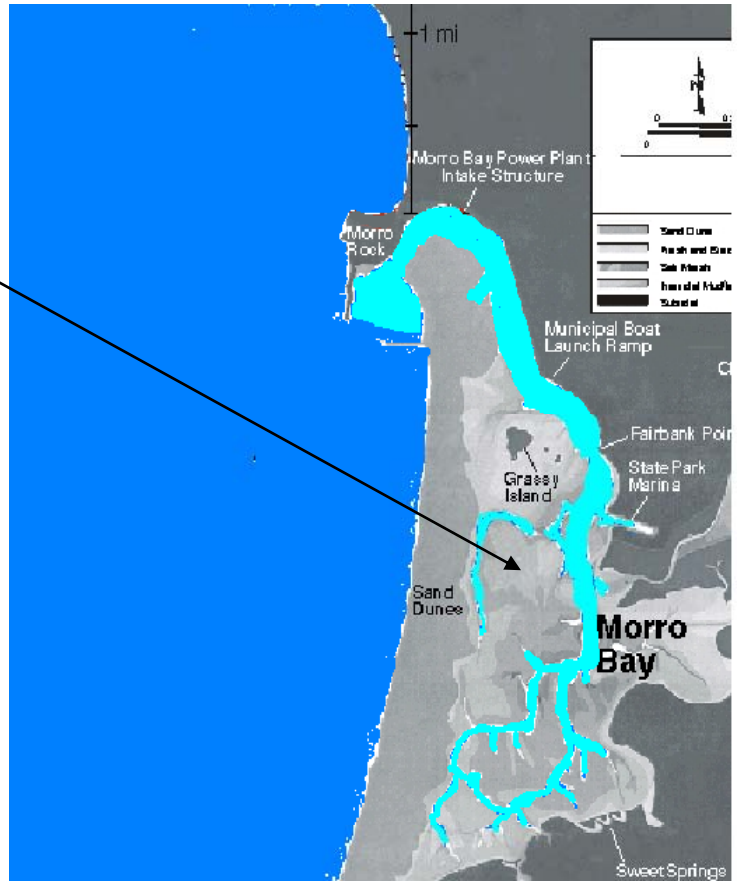
**Area of Production Foregone (APF**) or
**Habitat Production Foregone (HPF),**
Representative of all species lost to entrainment.

**Mitigation cost** = $ required to create or restore this amount of habitat.

# Morro Bay Power Plant Example Average Proportional Mortality of Bay Species = 38%

Calculate area of Bay (**B**)
= 2000 acres
Then the habitat required to compensate for larval losses
**= B x 0.38**

**Then (2000 x 0.38) 760 acres of new bay habitat needed to produce larvae equivalent to entrainment losses. Cost of new habitat = ~$14,000,000**




(modified from Raimondi )

**FEE DETERMINATION FOR DESAL PLANT OPERATING < 50 YEARS**

*Approach*:

►used prior APF determinations and mitigation cost for five intakes (4 power, 1 desal) and divided this by intake vol. in million gallons/year (MG) to determine a mitigation fee as $/MG.

► increased for inflation and assumed mitigation half-life of 50 years.

$$\text{Mitigation fee} = \frac{(\text{total cost of mitigation})(\text{inflation escalator})}{(\text{intake vol. in MG/yr})(50)} = \$/\text{MG}$$

*Result*:

►Fee ranged from $1.66 – $3.28/MG with average = $2.45/MG. Does not include mitigation for impingement or for monitoring success of mitigation. If add these costs = ~ $3.00/MG?

►For comparison, the fee using AEL based on price/pound of fish and associated economic losses to mitigate for the Huntington Beach Power Plant would be about $0.77/MG. This mitigation fee, however, only compensates for impacts to fish. Approach could be used to determine cost to mitigate impingement.

►Flow used to determine fee would be reduced from baseline depending on efficacy of technology or designs that show, with suitable studies, that impacts have been reduced and by how much.

►Use same fee for all intakes.

## Use of Mitigation Fees:

- ►pay into a fund administered by ?
- ►aggregate fees to enable projects with maximum environmental benefit
- ► minimize administrative costs and maximize environmental benefits
- ► strive for projects that compensate in-kind and at site or in region of impacts.