

ISSUES AND ENVIRONMENTAL IMPACTS ASSOCIATED WITH ONCE-THROUGH COOLING AT CALIFORNIA'S COASTAL POWER PLANTS



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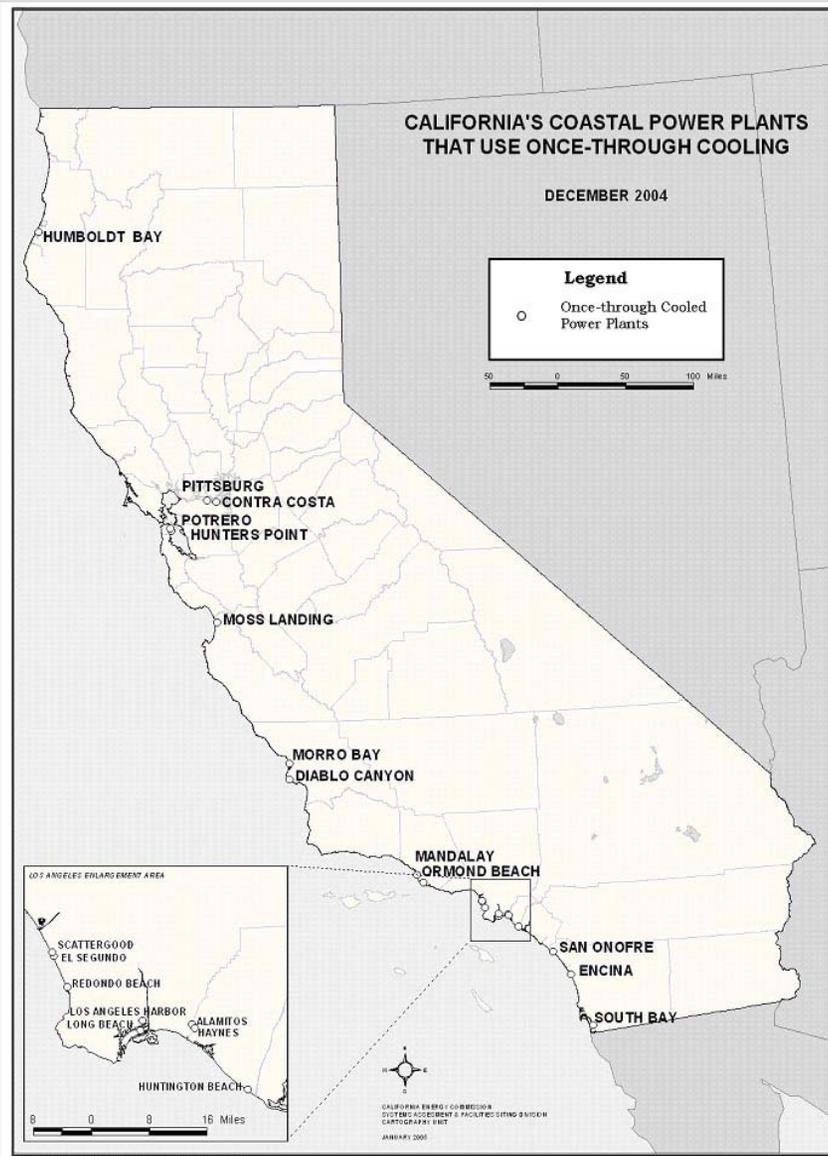
Moss Landing Marine Laboratories

review supported by the

California Energy Commission

MAJOR MARINE IMPACTS

- pollution (nutrients, toxins, sediment)
- over fishing & by catch
- habitat destruction
- invasive species
- ocean warming & sea level rise
- once-through cooling?**



21 Power Plants

Permitted To Use ~ 17 Billion Gallons Per Day

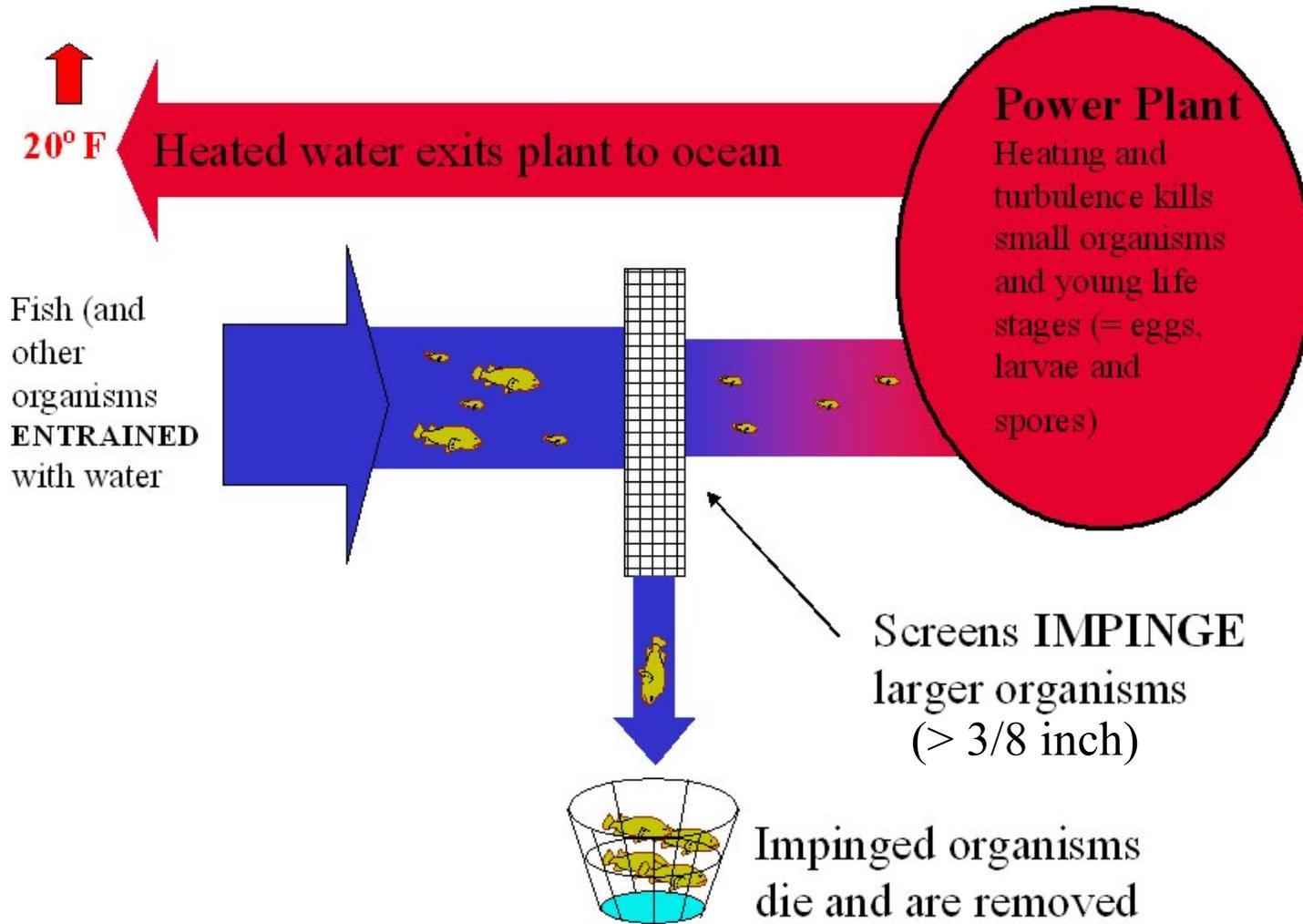
Coast Sand/Rock (2)	5.12 BGD
Coast Sand/Harbor (6)	3.43 BGD
Bay/Estuary (13)	8.39 BGD



DISCHARGE →
- Thermal

INTAKE ↗
- Impingement
- Entrainment

Thermal Effects, Impingement and Entrainment



(modified from Raimondi)



500 m

Lion Rock

Diablo Rock

Field's Cove

Temperatures °C
above Ambient
Intake
Temperatures



Diablo Canyon
Power Plant

Intake Cove

South Control

Test TV-9

Date: June 12, 1986

Time: 08:24 (daylight savings)

Unit	Discharge Temp °C	Cooling Water Flow (cfs)	Reactor Power (%)
1	22.3	2000	100
2	20.1	2000	71

Intake Temp °C: 11.3

Tide: (-.42)-.73 ft (MLLW)

Wind: 7.5 mph from 205° (true)

Offshore Currents: 47.9 ft/min, 118° true

Waves: (H13) .74 cm 9 sec from 274° true

Air Temperature: 13.0 °C

Thermal Impacts – *very site specific but can be large*
- rock bottoms and enclosed waters

Before Discharge



After Discharge



Impingement – *very site specific but can be large*
= 8-30% of Sport Fishing Catch in Southern California
(> 90% of this impingement by San Onofre)

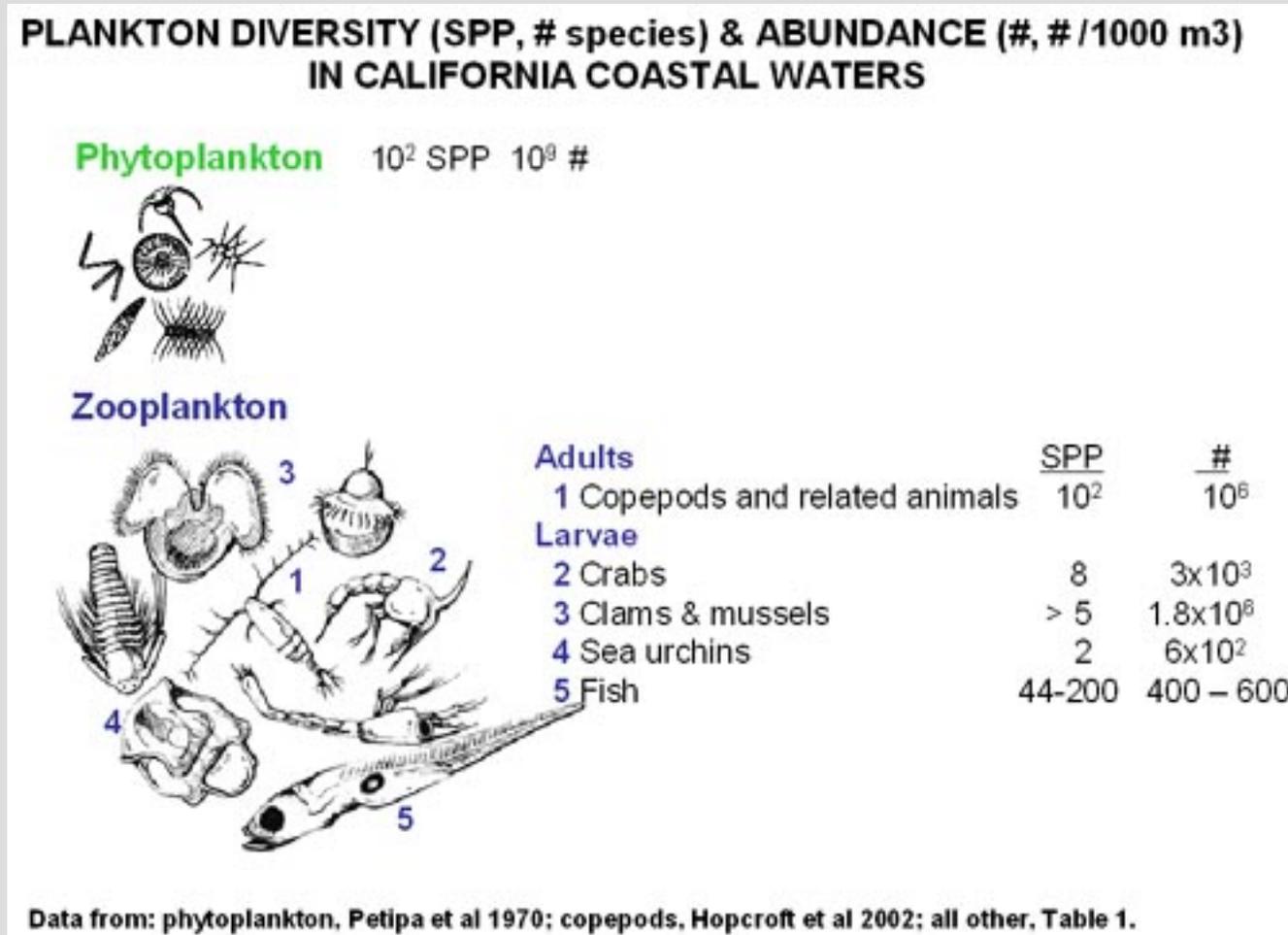


ENTRAINMENT - THE OCEAN IS NOT LIMITLESS

**COASTAL AND ESTUARINE WATERS ARE DISTINCT HABITATS
AND COMMUNITIES WITH LIMITED EXTENT**



SEAWATER IS A COMMUNITY, NOT JUST SALTY WATER



~ 50 Million Marine & Estuarine Fish Entrained Per Day in CA

1000 m³ x 100,000 ≈ 17 Billion Gallons

ENTRAINMENT IMPACT ASSESSMENT

*Traditional:
Sample at Intake*



*Modern:
Also Sample Source Water*



AEL & FH

Use # of Larvae
Entrained to Estimate
of Adult
Equivalents Killed &
compare to fishery catch.

BUT how about impacts
to other species?

1. Use Empirical Transport Model (ETM) to determine Proportional Mortality (PM) = proportion of larvae killed from entrainment that could be entrained (larvae in source population)
2. Determine area of source population
3. Determine average of 1. & 2. for species assessed ("target species")
4. Average PM x Average Area = area equivalent to 100% loss =
HABITAT PRODUCTION FOREGONE (HPF)
Representative of all species lost to entrainment

More direct determination of community impacts?

large areas + many species + natural variation
+ multiple impacts = **presently impossible**

Habitat Production Foregone

Hypothetical Example of a Power Plant in an Estuary

Assume Entrainment Study Found:

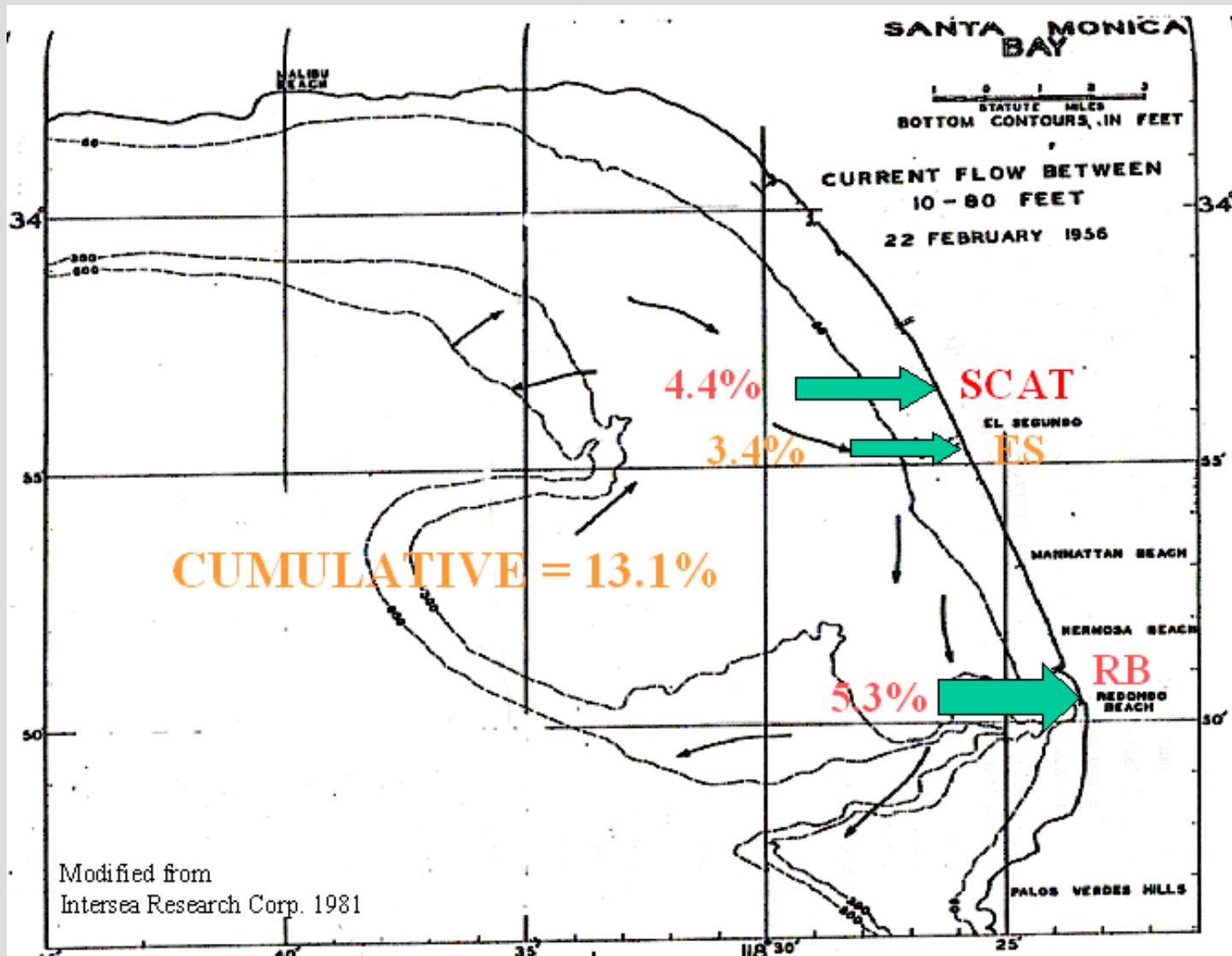
1. Average Proportional Mortality of Estuarine Species = 17%
2. Area of Estuary = 2000 Acres (= source water; same for all species)

THEN: The Habitat Required
to Compensate for Larval Losses
(= New Estuarine Habitat Needed
to Produce The Number of
Larvae Equivalent to
Entrainment Losses)

$$= (2000 \times 0.17) = \mathbf{340 \text{ Acres}}$$



POTENTIAL CUMULATIVE IMPACTS SANTA MONICA BAY (% / 6 weeks)



ENTRAINMENT IMPACTS FOUND IN RECENT STUDIES

	Original Study (1979-80)	Recent Study – Habitat Loss (1999-2005)
Moss Landing	no adverse	1100 acres - estuary
Morro Bay	no adverse	230-760 acres - estuary
Huntington	no adverse	370-780 acres - sandy coast
Diablo Canyon	not reliable	300-600 acres - rocky reef
South Bay	no adverse	1000 acres - estuary
Potrero	no adverse	370-780 acres - estuary

Projected Total Bay/Estuarine Habitat Production Foregone from Power Plants :

13 power plants, 8.39 BGD - 1.2 acres/MGD - \$114,000/acre

~10,000 ACRES LOST ~ \$1.1 BILLION TO RESTORE

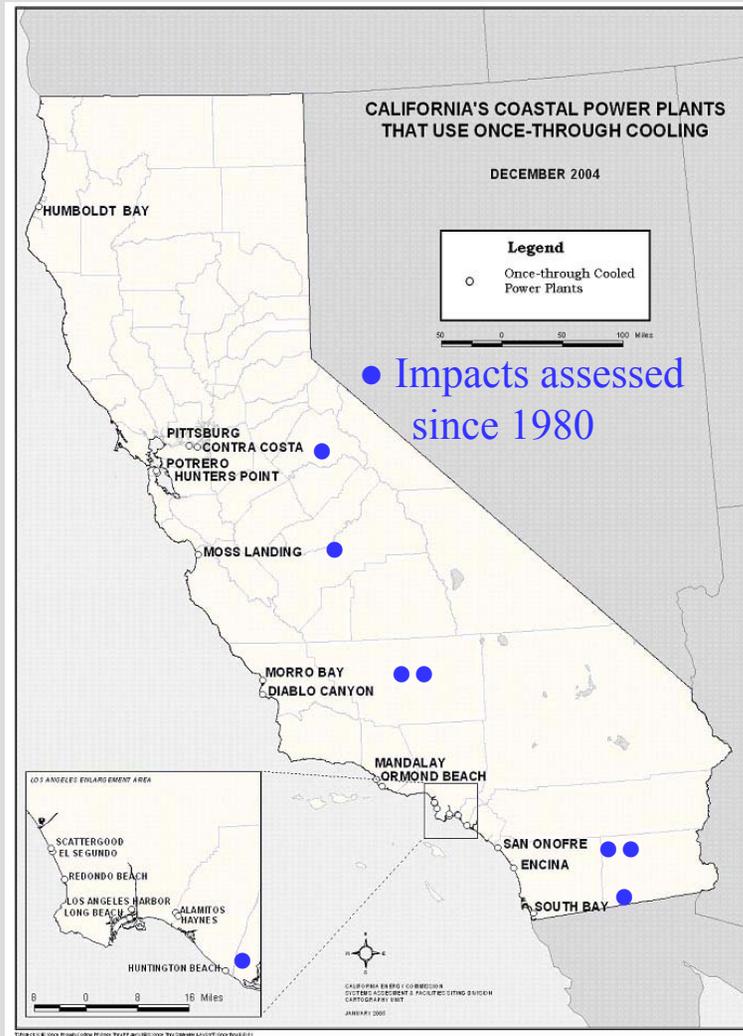
13 Coastal Power Plants Lack Recent Entrainment Impact Assessments

- Accuracy of Original Assessments Unknown
- Only Considered Impact on Fished Species
- No Cumulative Impact Assessments

- 25 Years Old = Out of Date

NEED:

- TO KNOW THESE IMPACTS, INDIVIDUAL & CUMULATIVE
- CONSISTENT APPROACHES & INTERPRETATIONS
- REVIEW BY UNBIASED EXPERTS



ASSESSMENT IS A SCIENCE ISSUE

