Wastewater Treatment Plant Perspectives:

Preliminary Data Suggesting Endocrine Disruptor Effects of Wastewater Discharge into the Pacific Ocean

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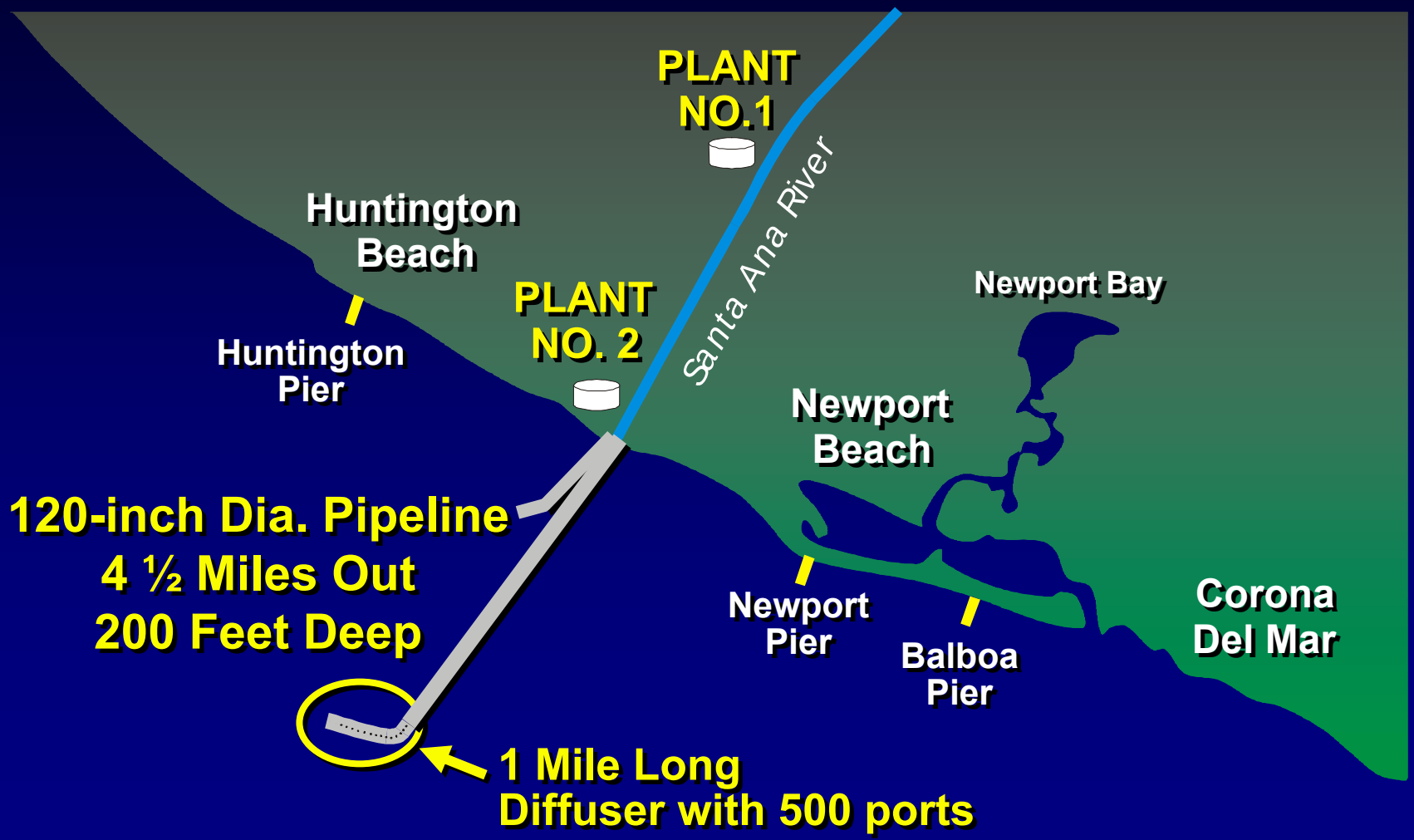
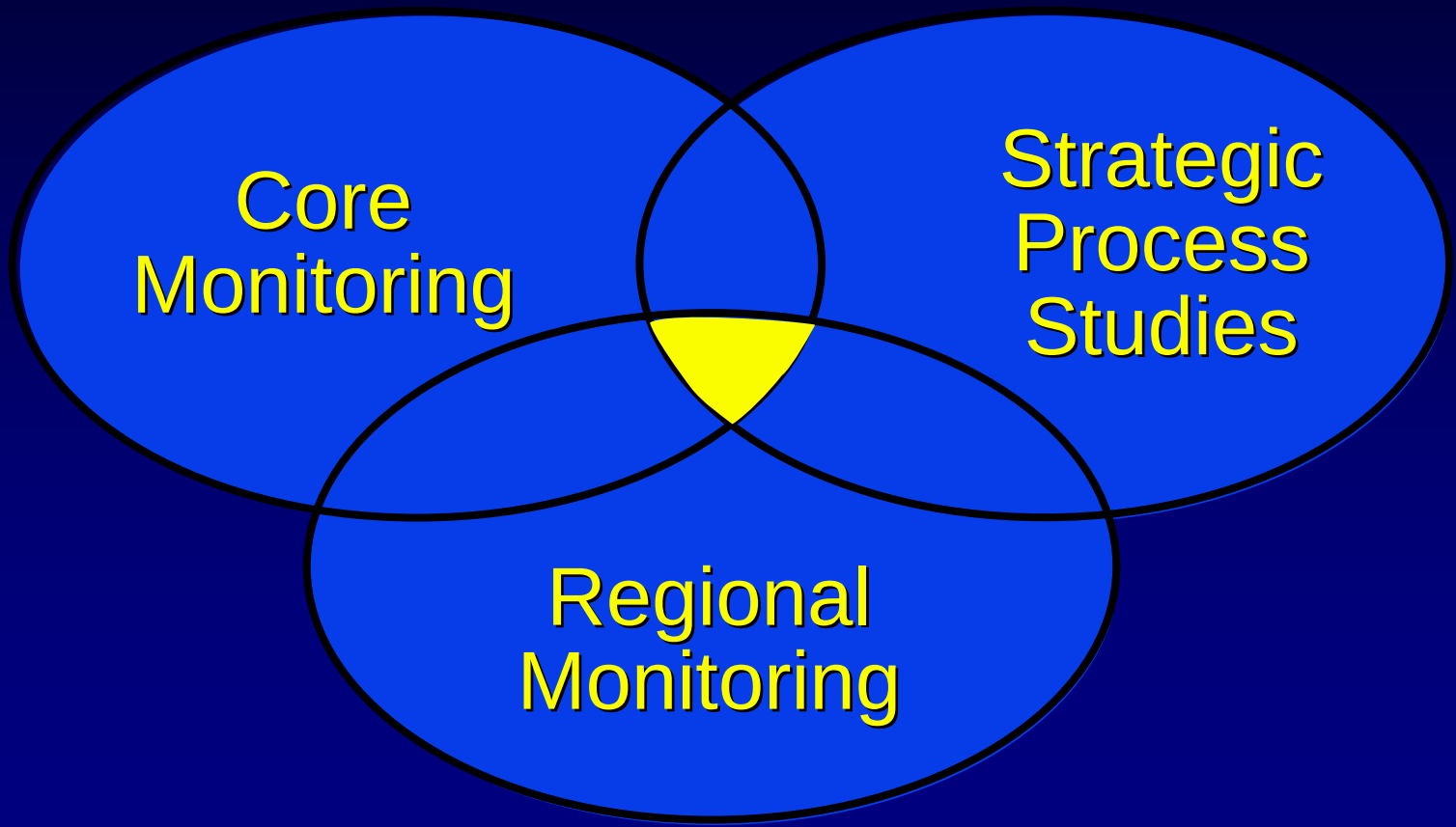
Who is the OCSD?

- Third largest POTW west of the Mississippi River
- 470 sq. mi. service area
- Serves 2.5 million people
- Treats 243 MGD

Ocean Discharge of Effluent



Ocean Monitoring Program



Strategy is to Collaborate with University and Other POTWs on EDC Research Projects

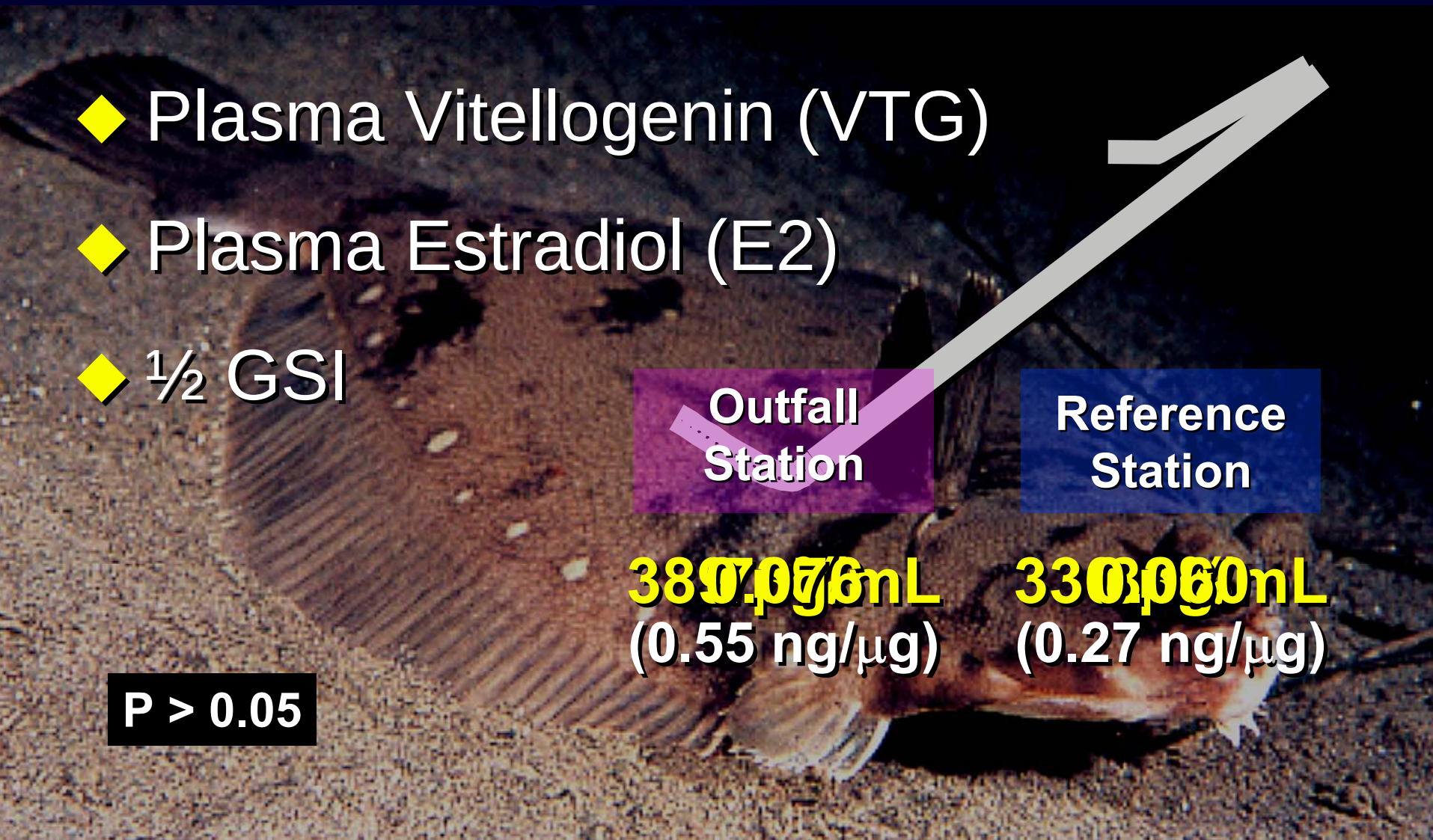
- OCSD staff lacks expertise
- OCSD provides:
  - Ecological expertise
  - In-kind services (vessel, crew and supplies for field collection)
  - Page costs for publications
  - Funding of graduate students

Endpoints of EDC Studies

- Estrogenicity
- Sperm DNA Damage
- Growth
- Stress Response

Estrogenicity

Male Hornyhead Turbot (Pleuronichthys verticalis)



- Plasma Vitellogenin (VTG)
- Plasma Estradiol (E2)
- ½ GSI

Outfall Station	Reference Station
380 ng/mL (0.55 ng/μg)	330 ng/mL (0.27 ng/μg)

P > 0.05

Estrogenicity Regression Analysis

Male Hornyhead Turbot (Pleuronichthys verticalis)

- Estradiol vs. Vitellogenin
- Estradiol vs. Sperm DNA Damage

Outfall Station

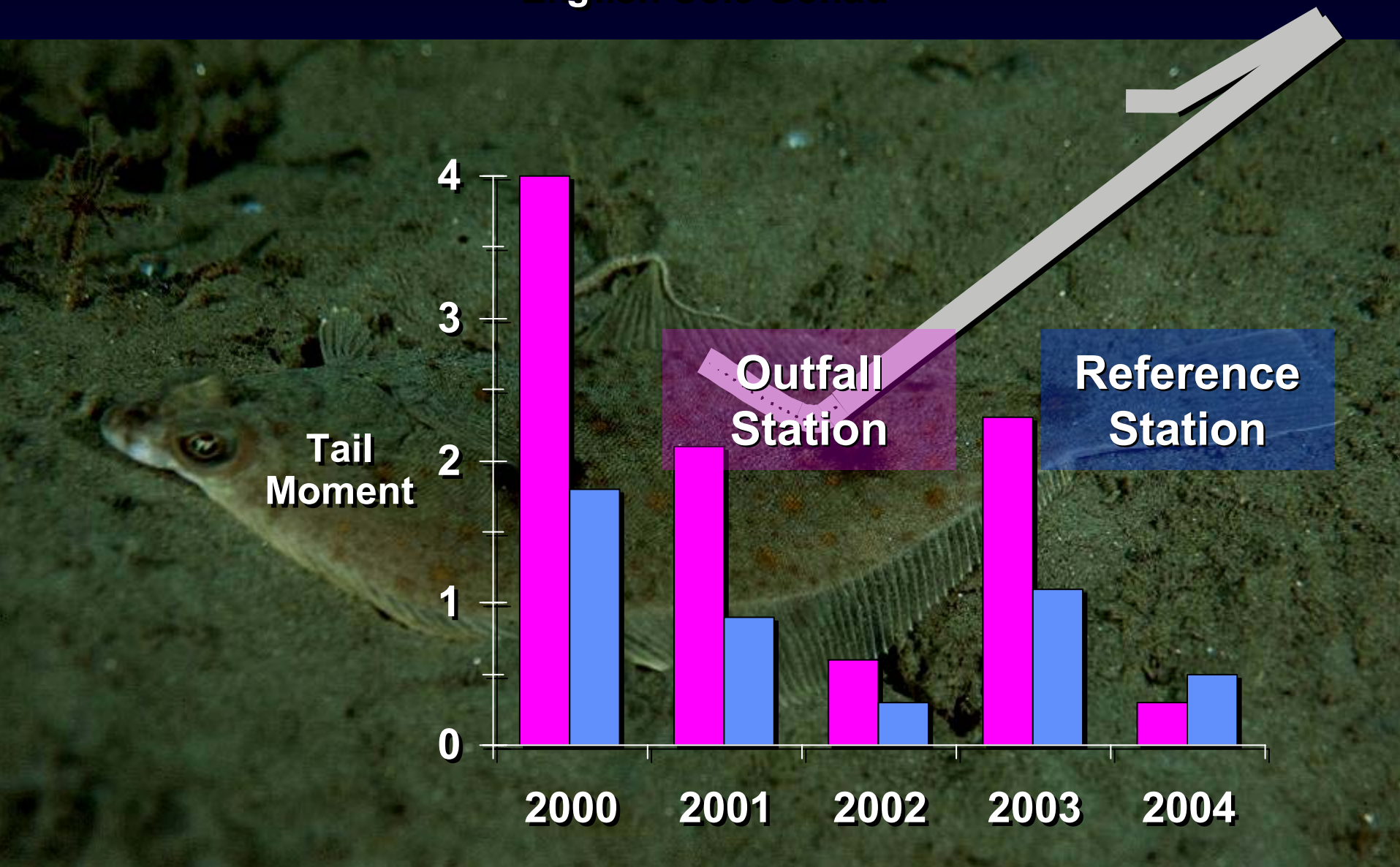
$R^2 = 0.71, P < 0.05, 7 df$

Sperm DNA Damage

- Studies conducted 2000–2004
- Comet Assay
- DNA damage consistently greater at Outfall Station over Reference Station

Sperm DNA Damage

English Sole Gonad



Stress Response (Cortisol)

- Produced via the HPI Axis
- Cortisol production is inhibited by chronic stress
- Inhibition may be caused by PPCP/EDCs?

Stress!!

handling

crowding / captivity

pollutants

Stress!!

Stimulate the HPI Axis

elevated CORTISOL levels

(+)

Catabolic Pathways

- ↑ Glucose, other fuels
- ↑ Hepatic glucose production
- ↑ AA release from muscle
- ↑ Lipid breakdown

increased fuel mobilization

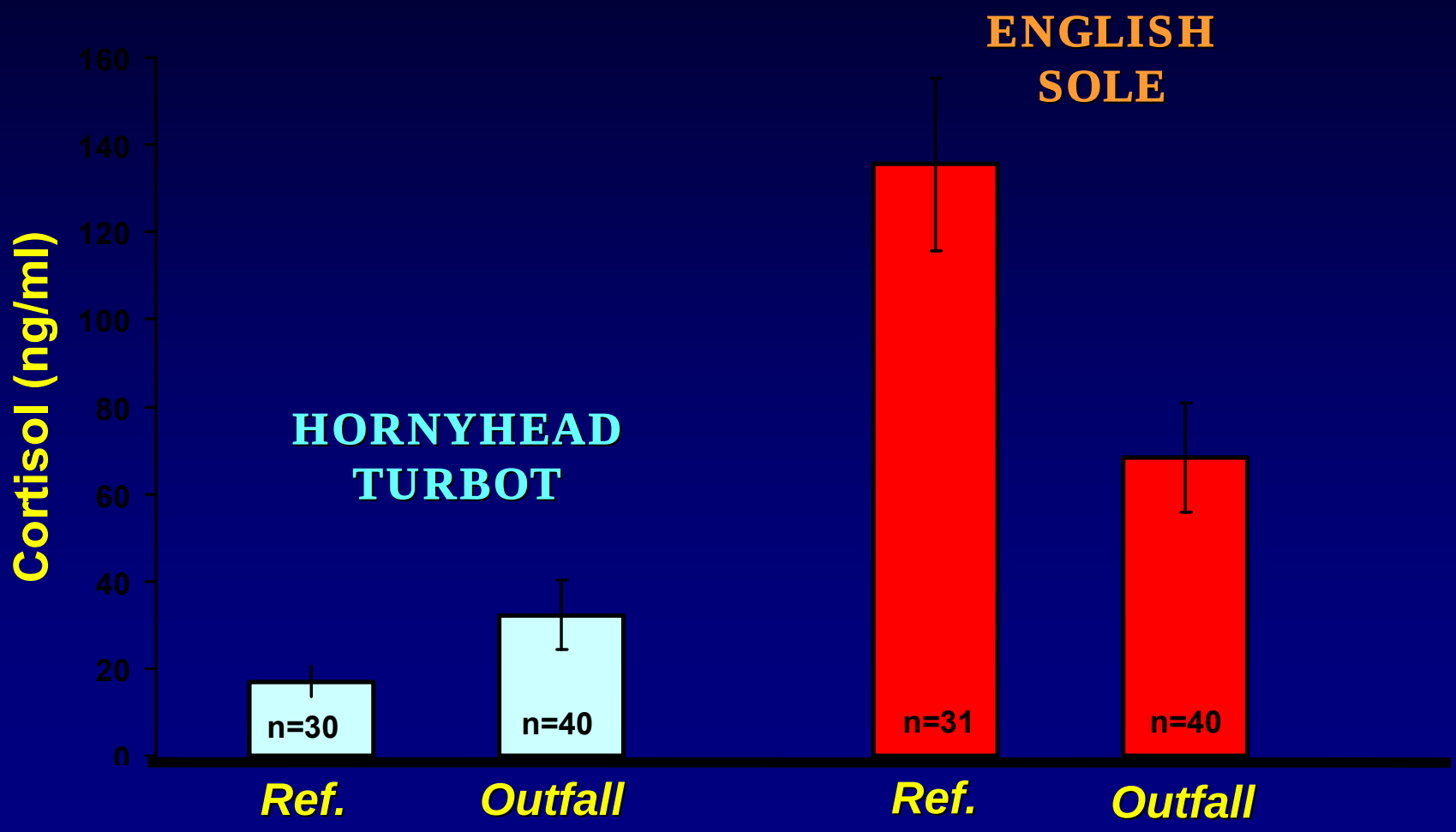
(-)

Anabolic Pathways

- ↓Growth & Repair
- ↓Reproduction
- ↓Immune function

reduced energy-expensive processes

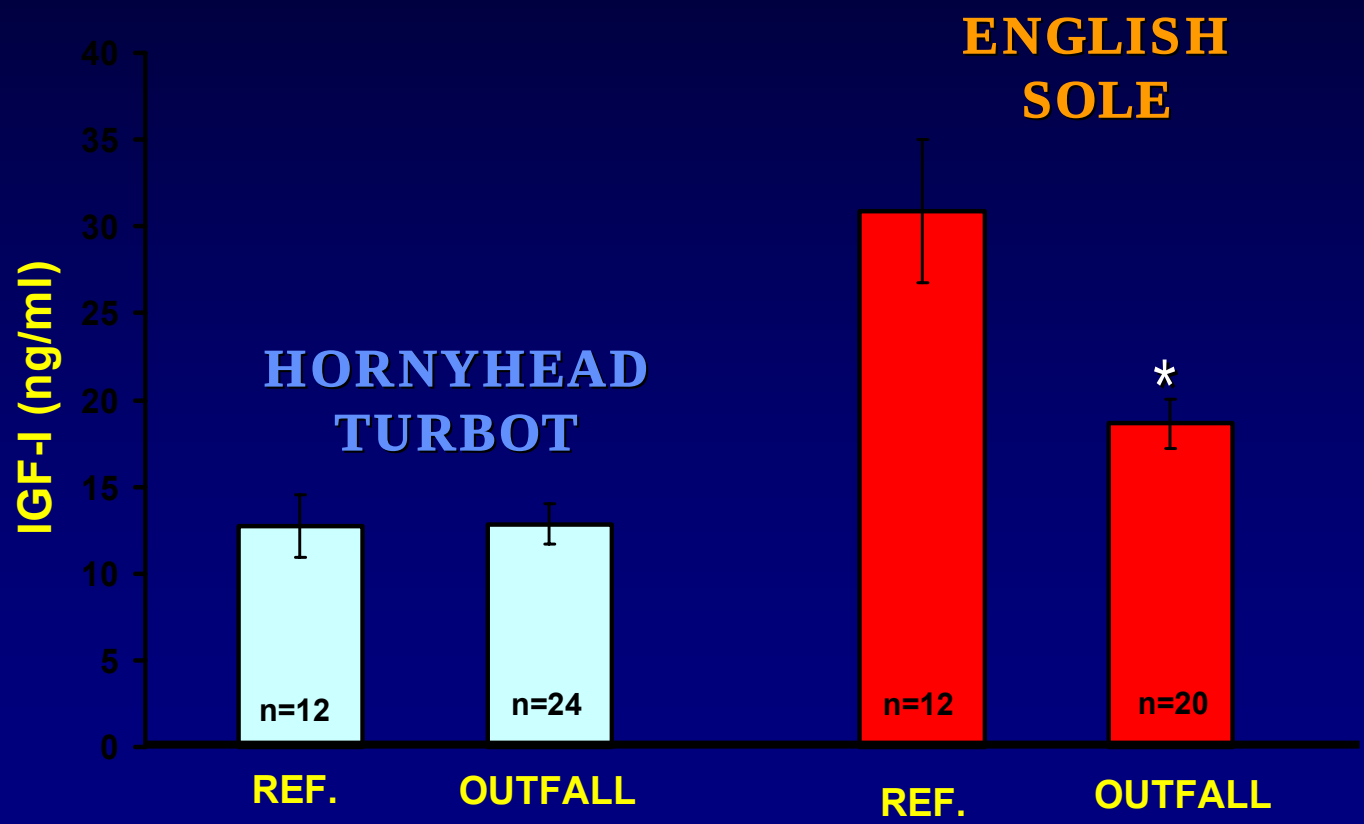
Peak Cortisol Concentrations in Post-trawl Flatfish



Insulin-like Growth Factor 1 (IGF-1)

- Mediates the effects of growth hormone
- Depressed in stressed fish
  - Elevated cortisol levels inhibits the production of IGF-1

Plasma IGF-I Concentrations in Flatfish



Studies in Progress

- Estrogenicity Source Identification
  UC Riverside, Doctoral Student Research
- Sperm DNA Damage *(on-going)*
  Computer Sciences Corporation
- Cortisol Inhibition *(on-going)*
  CSU Long Beach
- *Proposed Study:* Correlation of EDCs in Fish Tissues to POTW Effluent, Sediments, and Infauna (Food)
  CSU Long Beach, OCSD, and City of LA

Conclusions

- Evidence of EDC exposure from OCSD wastewater outfall
- No population-level effects evident
- Definitive cause-effect studies needed linking effluent to receiving water impacts

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