



Managing Freshwater Inflows to Estuaries

Global Trends ... and ... Just Why Should We Care?

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### Samana Bay, Dominican Republic

- Estuaries & seafood production?
- Freshwater inflows & productivity?
- Governance options?

![](_page_1_Figure_5.jpeg)

Laguna de Terminos, Mexico

![](_page_2_Picture_0.jpeg)

![](_page_2_Picture_1.jpeg)

![](_page_2_Picture_2.jpeg)

#### MANAGING FRESHWATER INFLOWS TO ESTUARIES: A METHODS GUIDE

![](_page_2_Picture_4.jpeg)

AUTHORS: Stephen B. Olsen, Tiruponithura V. Padma, Brian D. Richter

![](_page_2_Picture_6.jpeg)

![](_page_2_Picture_7.jpeg)

![](_page_2_Picture_8.jpeg)

#### GUÍA PARA EL MANEJO DE LA AFLUENCIA DE AGUA DULCE A LOS ESTUARIOS: UNA GUÍA DE MÉTODOS

![](_page_2_Picture_10.jpeg)

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## Socioeconomic implications ...

- ✓ food security
- ✓ livelihoods
- ✓ social safety net
- ✓ biodiversity
- $\checkmark\,$  economic rent to the developing world
- ✓ transboundary conflict
- ✓ peace and security
- ✓ supply for a growing portion of world seafood demand

![](_page_4_Figure_0.jpeg)

#### **Global Distribution of Cities**

### **River Fragmentation and Flow Regulation**

![](_page_5_Figure_1.jpeg)

Source: Revenga et al., World Resources Institute (WRI), Washington DC, 2000.

## **Global trends in watershed dynamics ...**

### **Demographics**

#### Land Use

- Forests
- Agriculture
- Wetlands
- Urban

### Water Use

- Dams
- Diversions
- Withdrawals
- Pollution

#### **Climate Change**

![](_page_6_Picture_13.jpeg)

### Factors contributing to collapsed stocks ...

- ✓ Growing demand
- Globalized trade
- ✓ Over-fishing
- ✓ Destructive fishing
- ✓ Habitat loss
- ✓ Pollution
- ✓ Climate change
- ✓ Altered freshwater inflows

#### GLOBAL LOSS OF SEAFOOD SPECIES

% of species collapsed

![](_page_7_Figure_11.jpeg)

# **The Physics:**

![](_page_8_Figure_1.jpeg)

Fresh, less dense water flows seaward over the denser landward flowing salty bottom water.

![](_page_9_Figure_0.jpeg)

### Freshwater inflows ...

### maintain salinity gradient

- import essential nutrients
- recharge the system with sediments
- dilute & transport wastes
- moderate bay water temperatures
- > maintain natural circulation pattern

- increased salinity & reduced mixing
- increased predators, parasites, & disease
- diminished nutrients & primary productivity
- *fisheries and biodiversity losses*
- > altered sediment budget & circulation
- benthic sediments become anaerobic
- concentrated pollutants
- > saltwater intrusion

# Complexity and Conflict ...

![](_page_12_Picture_1.jpeg)

![](_page_13_Picture_0.jpeg)