Mesoamerican Reef threats and health assessment

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Healthy Reefs for Healthy People Initiative

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1. Inappropriate coastal / island development

Direct Impacts of Tourism on Reefs

2. Inappropriate inland land use & development: agriculture

Inappropriate Aquaculture

3. Overfishing

$ $ $

4. Inappropriate port management & shipping

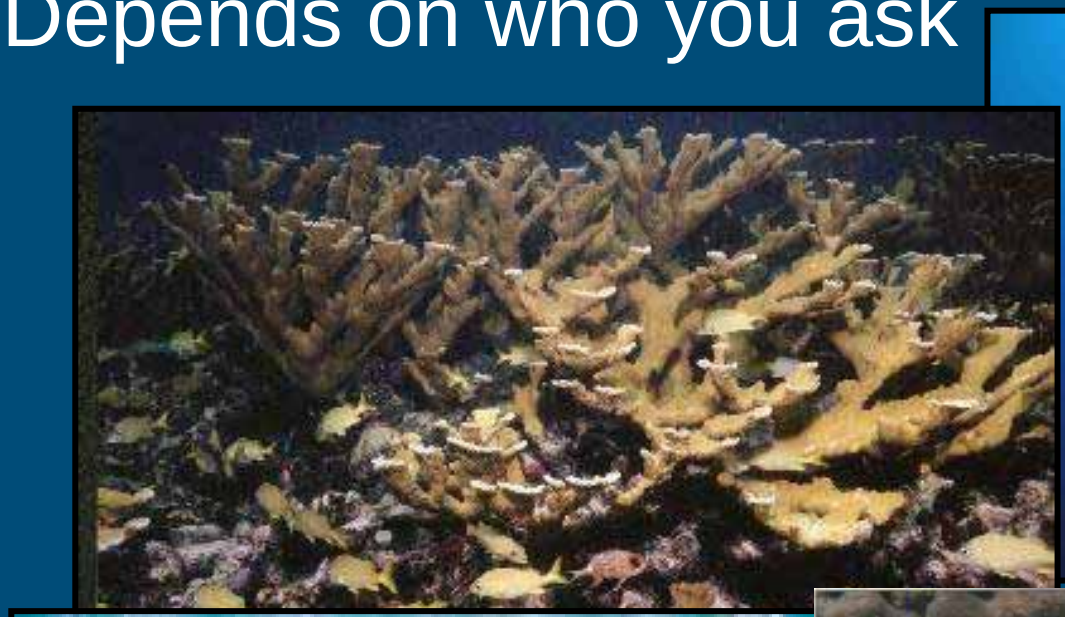
Ship groundings

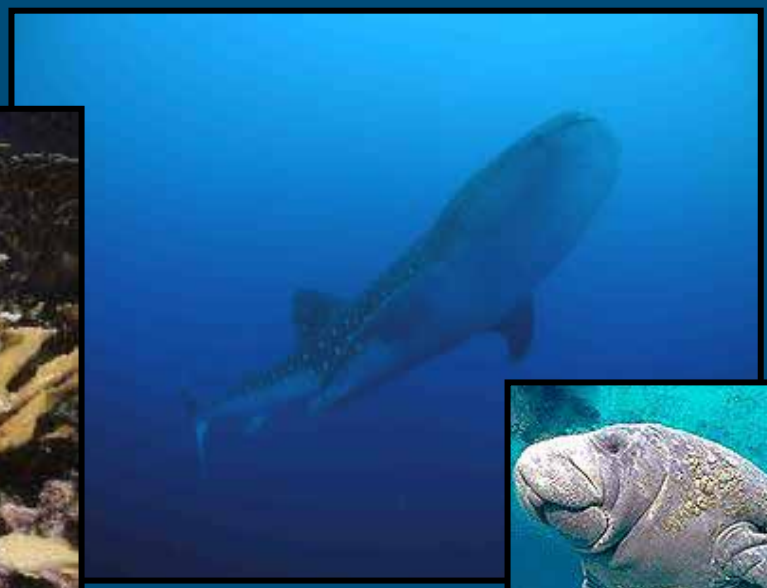
Marine-based pollution


a
July 1998
c
Oct. 1, 1998
5.Climate Change: bleaching, hurricanes, pH, sea level
b
Sept. 1, 1998
d
Nov . 3, 1998

Healthy Mesoamerican Reef ?

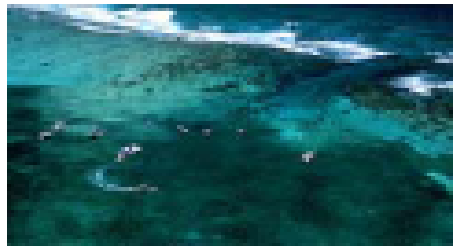
Depends on who you ask





And when you ask

Opinion Survey on the Health of the Mesoamerican Reef Ecosystem

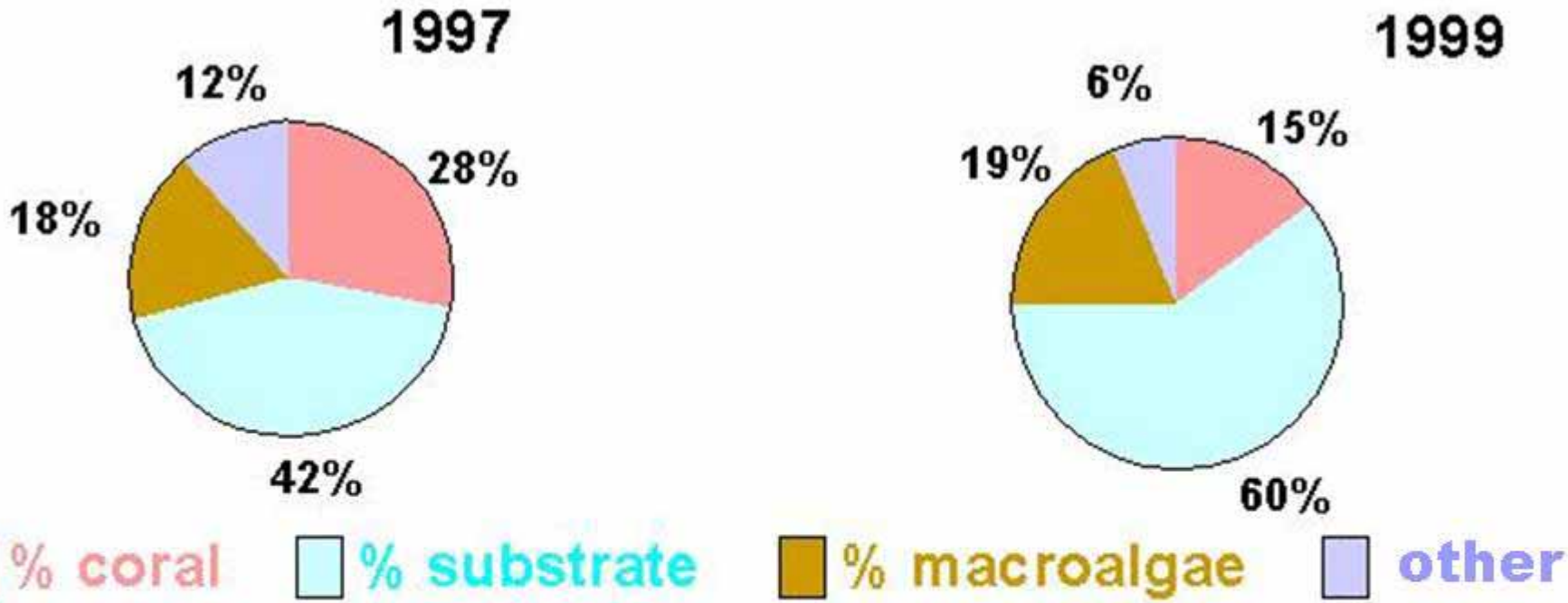


	Status	Trend
Coral reef ecosystem	Declining — Improving	↓
Fisheries	Declining — Improving	↓
Water quality	Declining — Improving	↓
Social well-being	Declining — Improving	↔
Governance / stewardship	Declining — Improving	↔

A small group (n=102) of people (managers, conservationists, scientists, fishermen, agroindustry and tourism stakeholders) participated in the Healthy Reefs Opinion Survey. The purpose of the opinion survey was to capture perceptions on the prevailing conditions of the Mesoamerican Reef Ecosystem. The above table shows the collective responses to the following questions:

Questions 11-18. How would you grade the status over the last 10 years of the Coral reef ecosystems, Fisheries, Water quality, Social well-being, and Governance/stewardship in the Mesoamerican Reef

Belize Reef Community Composition



What is a Healthy Reef ?

A reef is healthy if it <u>maintains</u> its structure and function, is <u>resilient</u> to stress, and allows for the fulfillment of <u>reasonable</u> human needs

Adapted from N.O. Nielsen, Professor Emeritus, UG

How do we actually measure this?
When is our baseline?

How Healthy (or unhealthy) is the MAR ?

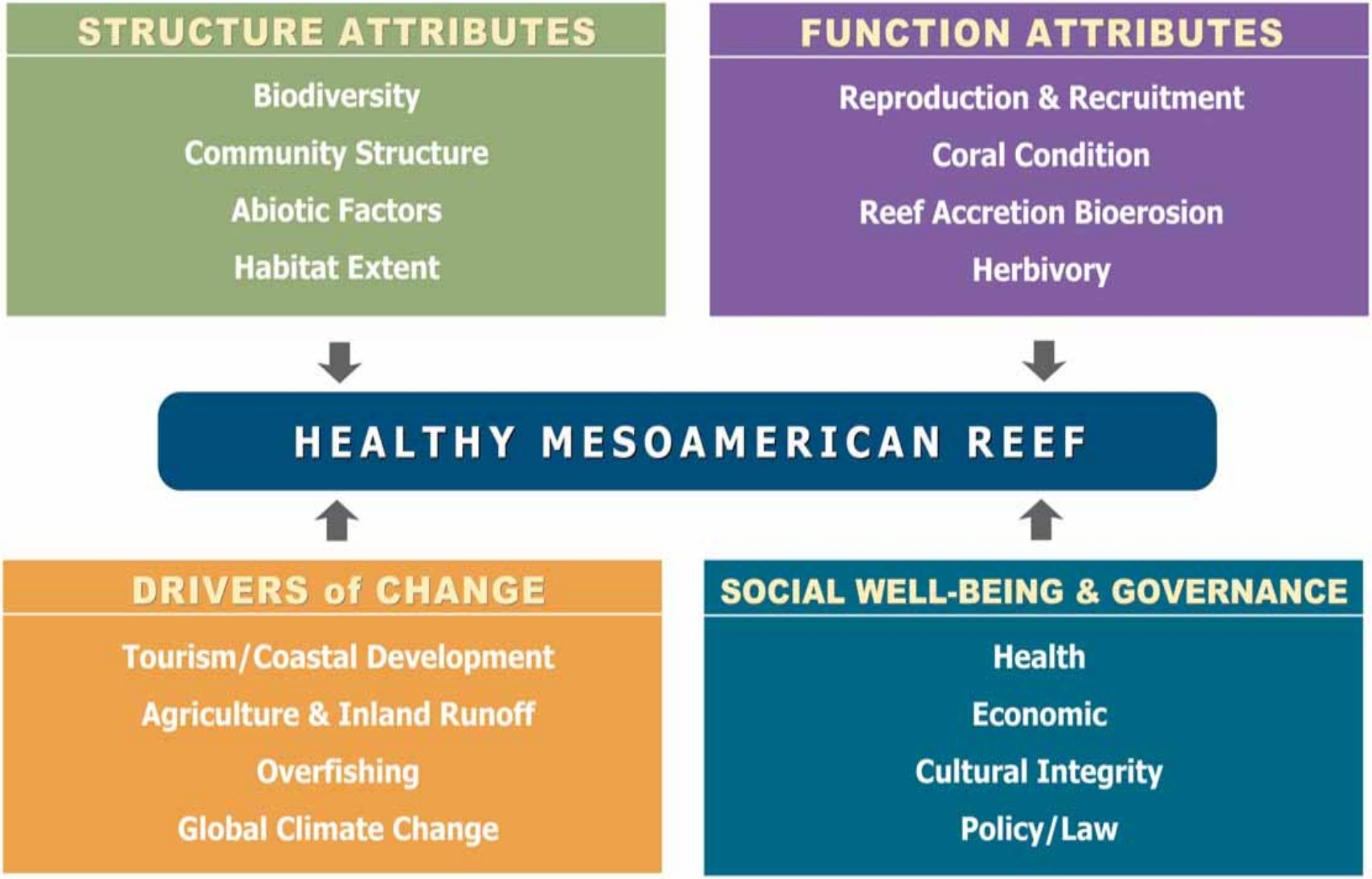
Many More Questions

- What are the best indicators to measure & track reef health?
- How do we establish red flag and target values?
- How do we monitor the success of our conservation efforts?

Healthy Reefs

For Healthy People

Conceptual Framework



STRUCTURE ATTRIBUTES

Biodiversity

Community Structure

Abiotic Factors

Habitat Extent

Focal Species Abundance
Coral Cover
Coral:Macroalgae Ratio
Water Transparency
Extent of Mangroves

FUNCTION ATTRIBUTES

Reproduction & Recruitment

Coral Condition

Reef Accretion Bioerosion

Herbivory

Coral Recruitment
Coral Disease
Coral Bleaching
Urchin Density
Herbivorous Fish

DRIVERS of CHANGE

Tourism/Coastal Development

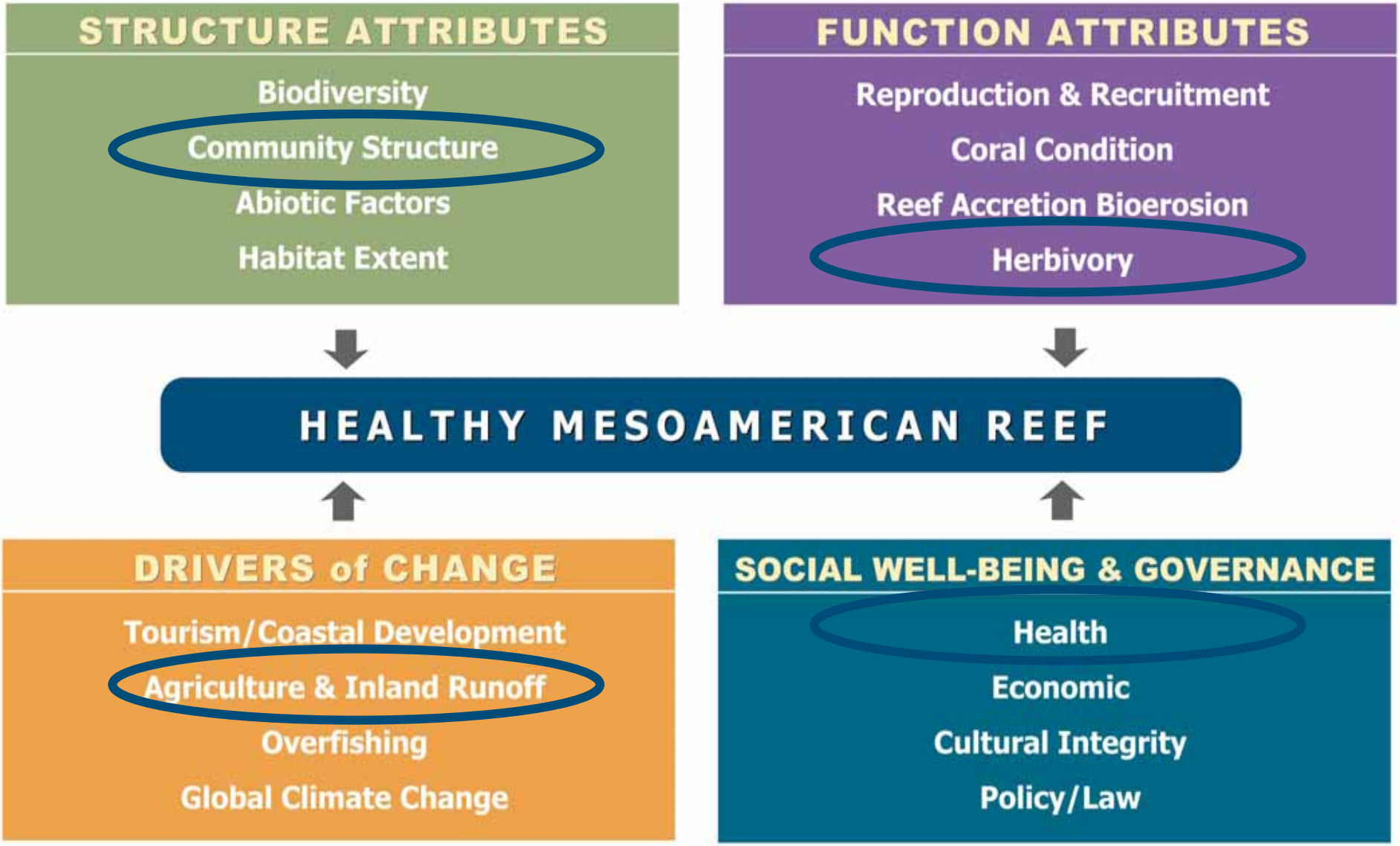
Agriculture & Inland Runoff

Overfishing

Global Climate Change

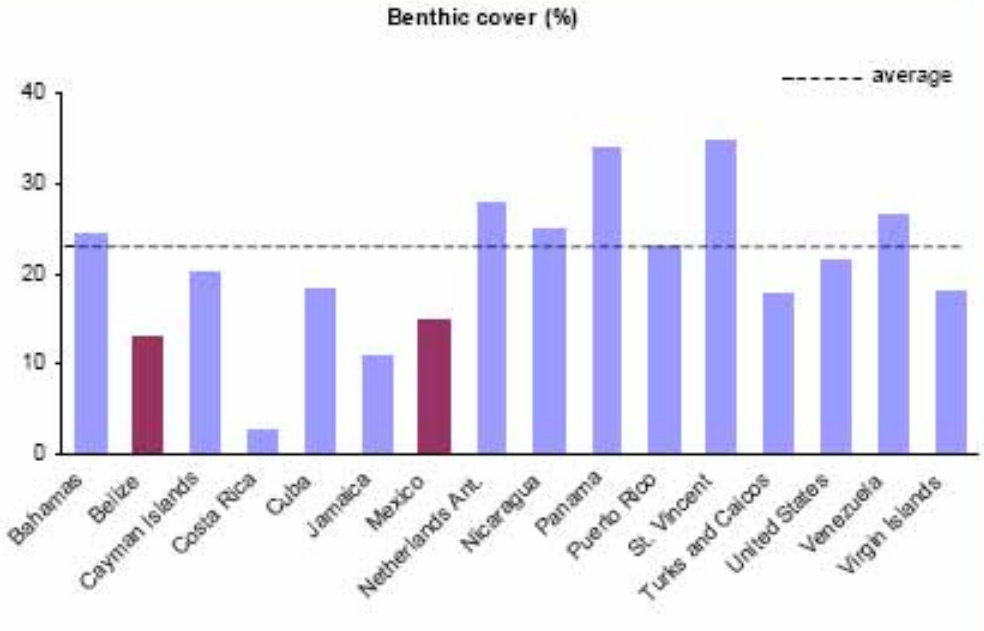
Coastal Development Index
Sewage Biomarkers
Contaminants in Biota & Sediments
Conch Abundance
Coral Bleaching Index

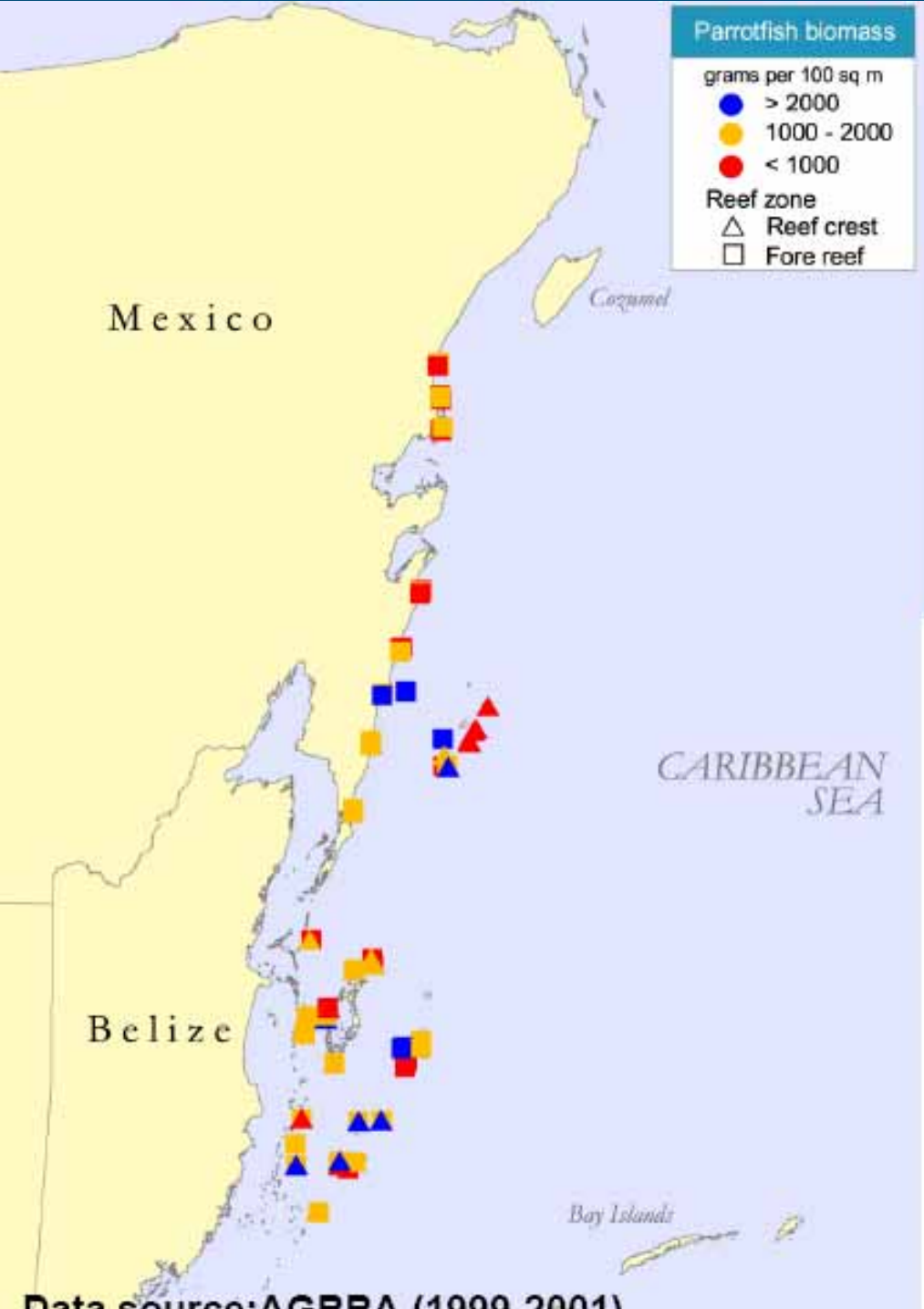
Conceptual Framework



Live coral cover

- Cover varies spatially in region
- Higher on fore reefs 15% than crests
- Most reefs have < 15% cover
- Lower than Caribbean average (20%)
- Macroalgae>coral cover (2:1 ratio)

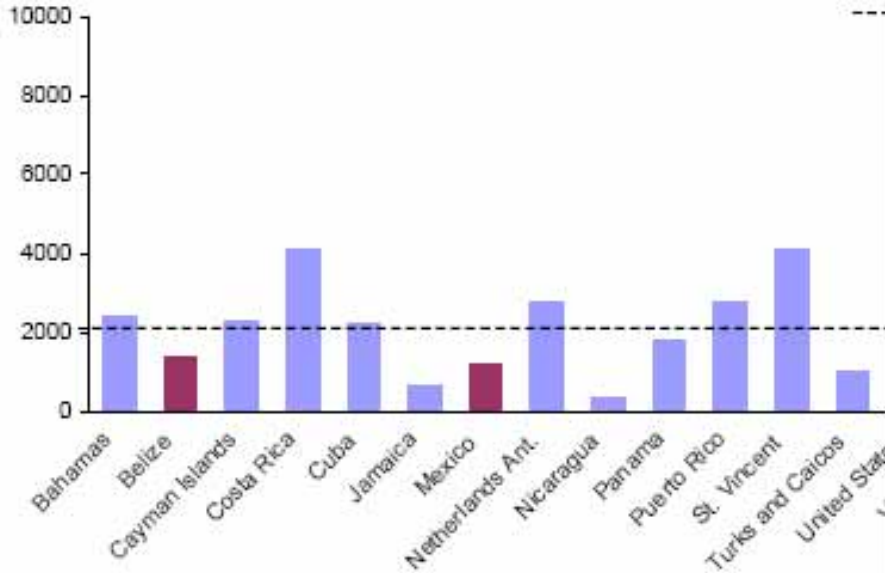




Parrotfish & Macroalgae

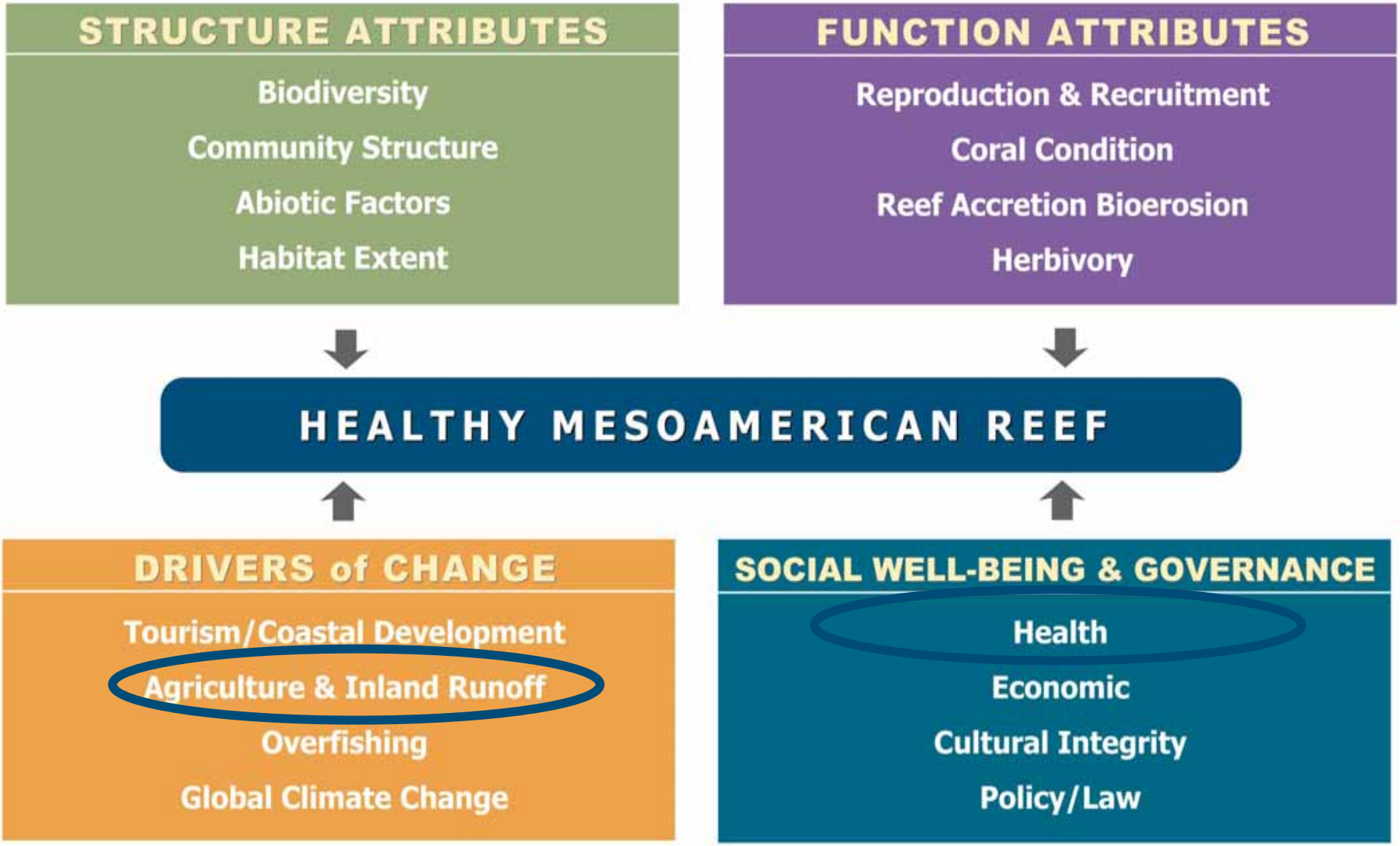
- Higher on reef crests than fore reefs (1390 vs g/100m2).
- Fleshy macroalgae abundant (esp. fore reefs)
- Correlation with presence of large-sized herbivores.
- MAR avg 1302 g/100m2

Lower than Caribbean average (2074 g/m



Data source:AGRRA (1999-2001)

Conceptual Framework



Threats: Agricultural & runoff pollution

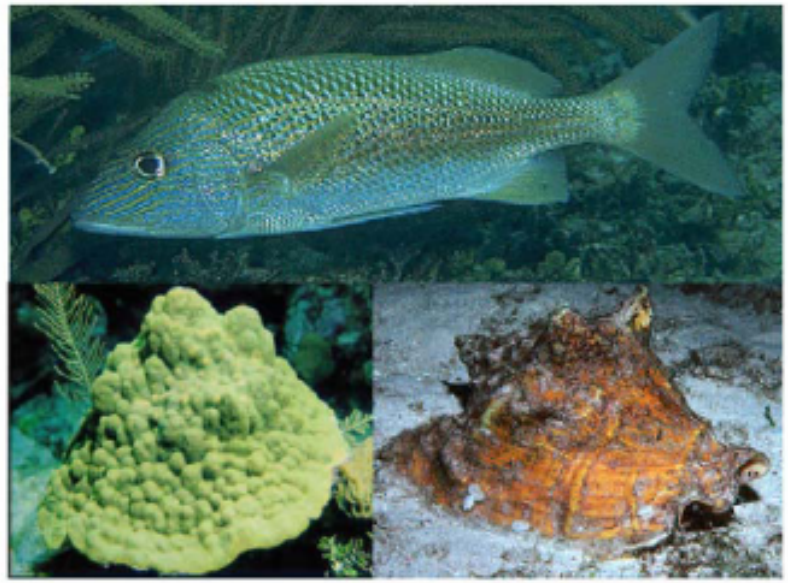
Indicator: Contaminants in reef biota

Goals:

- Engage Agro-Industry partners
- Develop joint monitoring protocol – instill standardization/confidence
- Monitor links between reef contamination & agrochemicals used
- Develop better management practices to reduce contamination

Sampling, Biomarker, and Contaminant Chemical Target Analyte Protocols

Assessing the Effectiveness of Agricultural Better Management Practices in the Mesoamerican Reef



Hacrecticus Environmental Laboratory

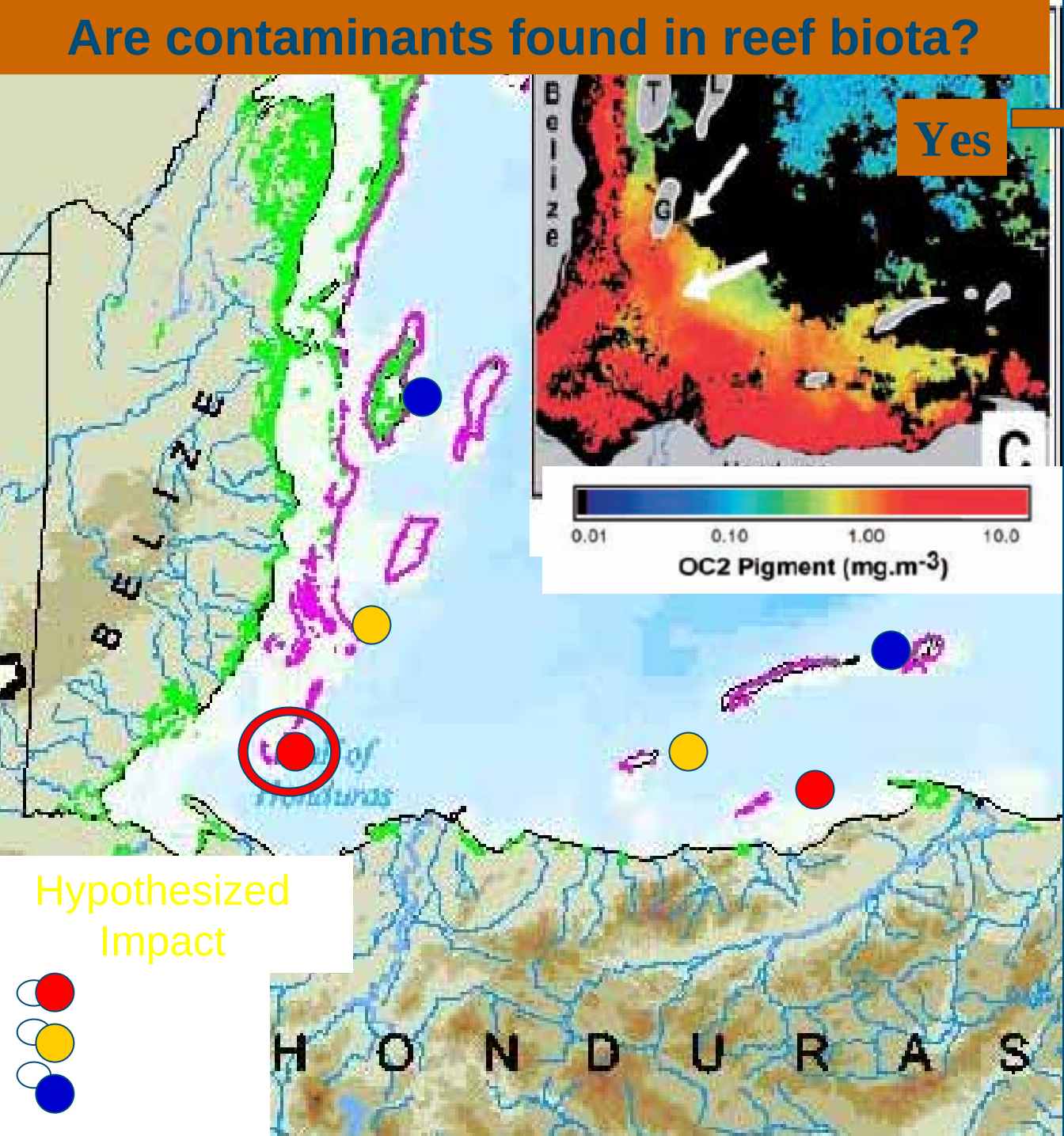
WWF

ICRAN

International Coral Reef Action Network

UNEP

Are contaminants found in reef biota?



Yes

Hypothesized Impact

Ranked Contamination

- dog snapper gonads
- white grunt liver (f)
- white grunt gonads
- school master liver (m
- white grunt liver (m)
- dog snapper liver
- conch A (organs)
- sponge
- palythoa (Cnidaria)
- macroalgae (*dictyota*)
- barracuda liver
- schoolmaster liver (f)
- seagrass (*Thalassia*)
- penshell clam
- conch B (organs)
- mangrove oyster
- schoolmaster gonads
- sea cucumber

2004 results BAHA

Chosen for semi-annual monitoring

Need EcoTox Data for Cnidaria

including different life stages (recruitment impairment)

- ACUTE TOXICITY -	Aldrin	Chlorothalonil	Cyfluthrin	DDT	Deltametr	Fipronil	Imidaclor	Lindane	Malathion	Mancozeb	Propani
Amphibians	MT	HT		ST	VHT			MT	HT	HT	ST
Annelida				MT				MT	ST		
Aquatic Plants											
Cnidaria											
Crustaceans	VHT	VHT		VHT				MT	MT		ST
Echinoderms									ST		
Fish	HT	VHT	MT	HT	HT	HT	NT	HT	MT	MT	MT

?

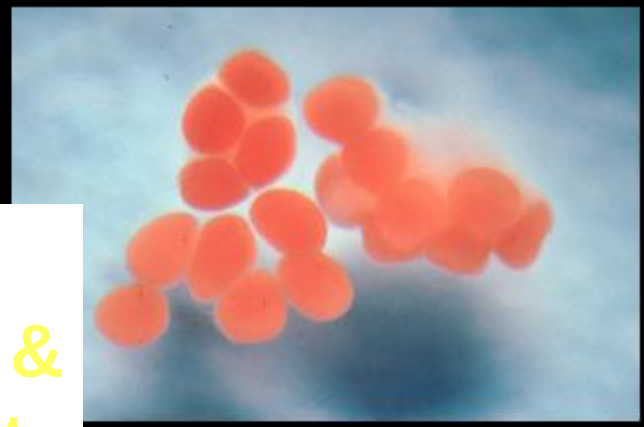
Sample Toxicity Data

Aquatic animals: Chlorothalonil is highly toxic to fish, and highly toxic to aquatic invertebrate animals. It builds up in fish, but clears rapidly when fish are placed in clean water. Acute toxic level:

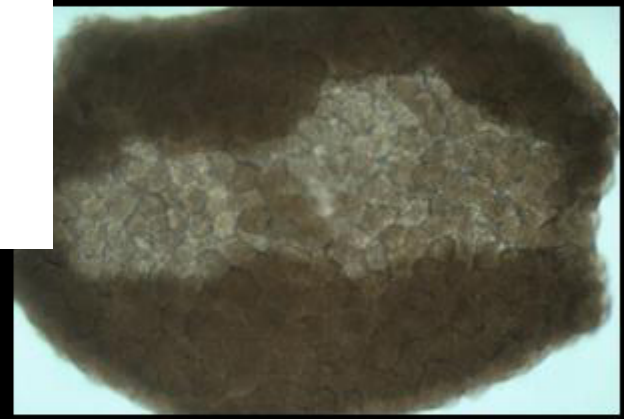
species	LC50	Source Table
trout	49 ppb	(Table II, Aquatic)
bluegill	62 ppb	(Table II, Aquatic)
water flea	70 ppb	(Table II, Aquatic)

Dog snapper gonads had 6000ppb – coral had >100ppb

Some agro-companies have already switched to another fungicide



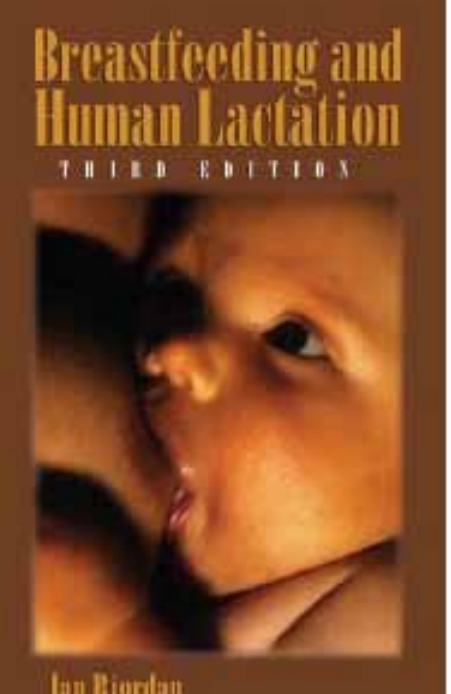
Coral settlement & recruitment highly sensitive phases



Help

Social well-being: Human health indicator

Contamination in human breast milk & fish



Goals:

1. Determine biocide contaminant composition and concentration in breast milk
1. Determine if there are trends based on residence location, occupation and food consumption behavior
1. Conduct an infant health risk assessment based on significant trends of the target analytes and food consumption behavioral patterns.

Contaminants in breast milk from individuals consuming reef fish in Belize

Chem	Concent.	ADI
Malaoxon*	49 ppb	49,000 times higher
Endosulfan	2.4 ppb	12 times higher
Mirex	9 ppb	15,000 times higher
DDT	91 ppb	65 times higher
Aldrin	2.2 ppb	8 times higher

*Malaoxon Is a derivative of malathion and is ~10,000 times > toxic

ppb = parts per billion

ADI = Allowable Daily Intake for a 2.8 kg infant

POPs (Stockholm Convention)

Public and Media Interest in Human Health and Contaminants

USGS Reports Most U.S. Rivers and Marine Life Contain Pesticides

Date Published: Saturday, March 4th, 2006 ***By Steven DiJoseph***

Kids Even More Vulnerable to Pesticides Than Previously Believed, Study Shows Health, Environment Groups Warn Government Ignores Scientific Evidence of Higher Risk to Children

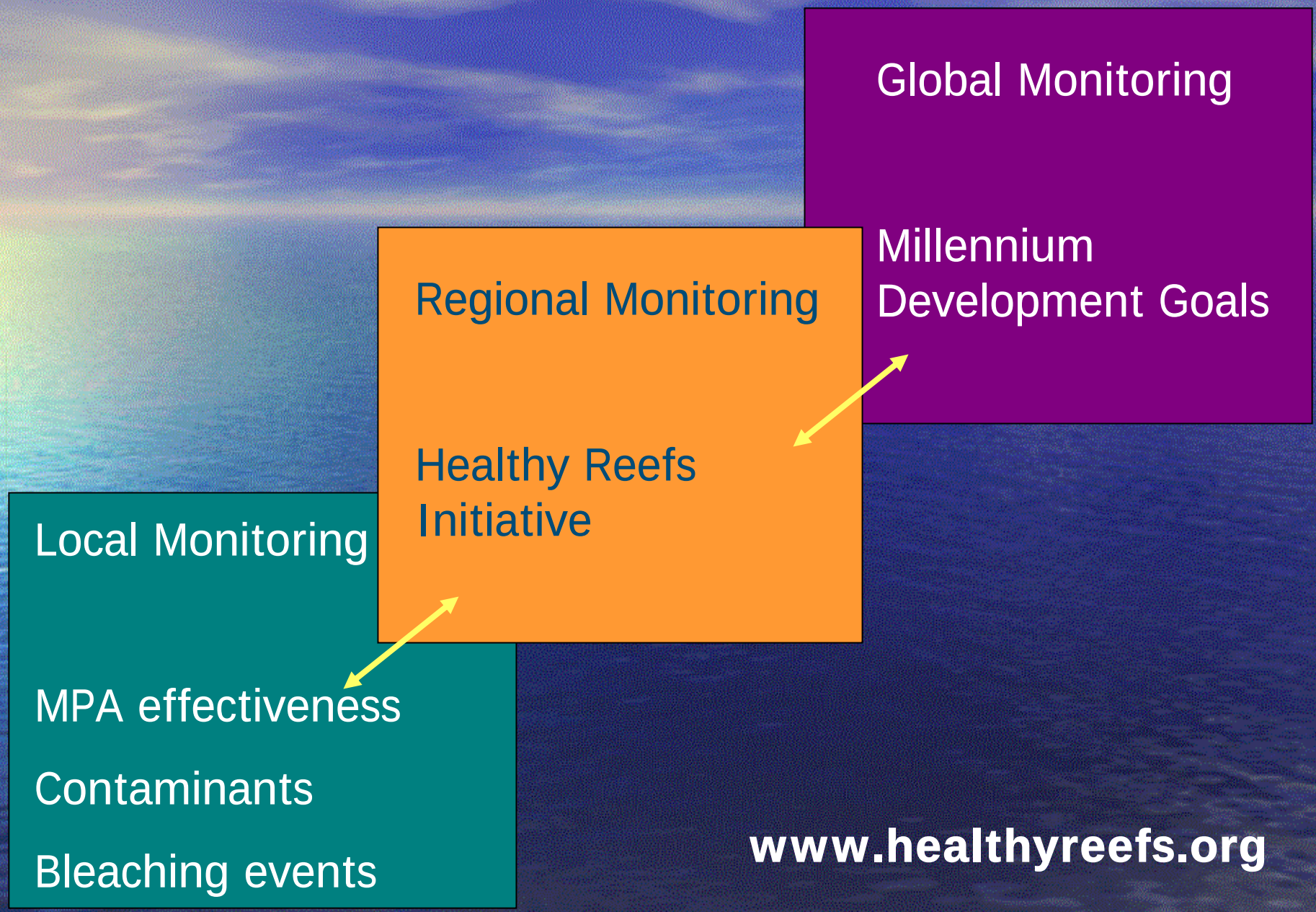
By: NRDC

Published: Mar 4, 2006 at 07:09

Readily understandable link between environmental & human health risks

Healthy People

and healthy reefs


Global Monitoring
Millennium Development Goals
Regional Monitoring
Healthy Reefs Initiative
Local Monitoring
MPA effectiveness
Contaminants
Bleaching events
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