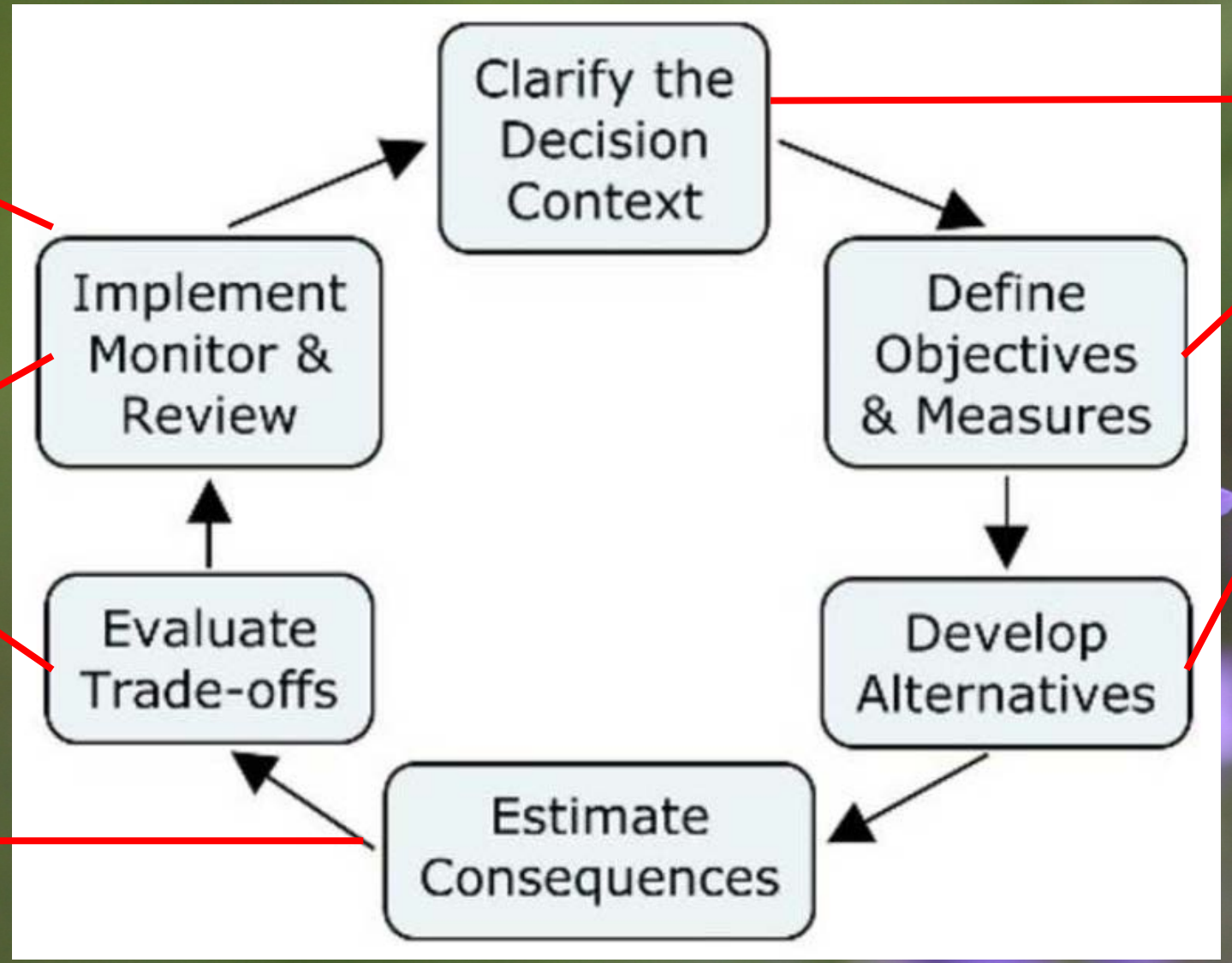
Applying Eco-health science in environmental decision making

Richard S Fulford and Rebeca De Jesus-Crespo
US EPA Office of Research and Development

How is science used to make decisions?

- Best available science
- Balancing policy and science
- Measurable objectives
- Dealing with uncertainty
- Translating science into useful terms
- Convincing decision makers the science is useful

Structured Decision Cycle

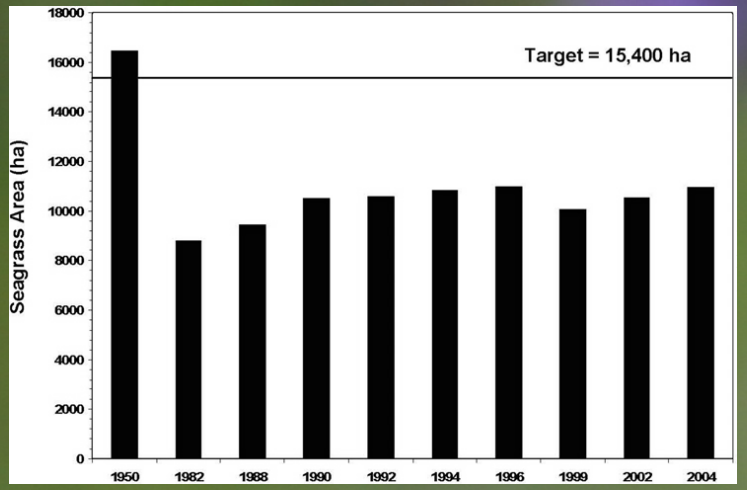


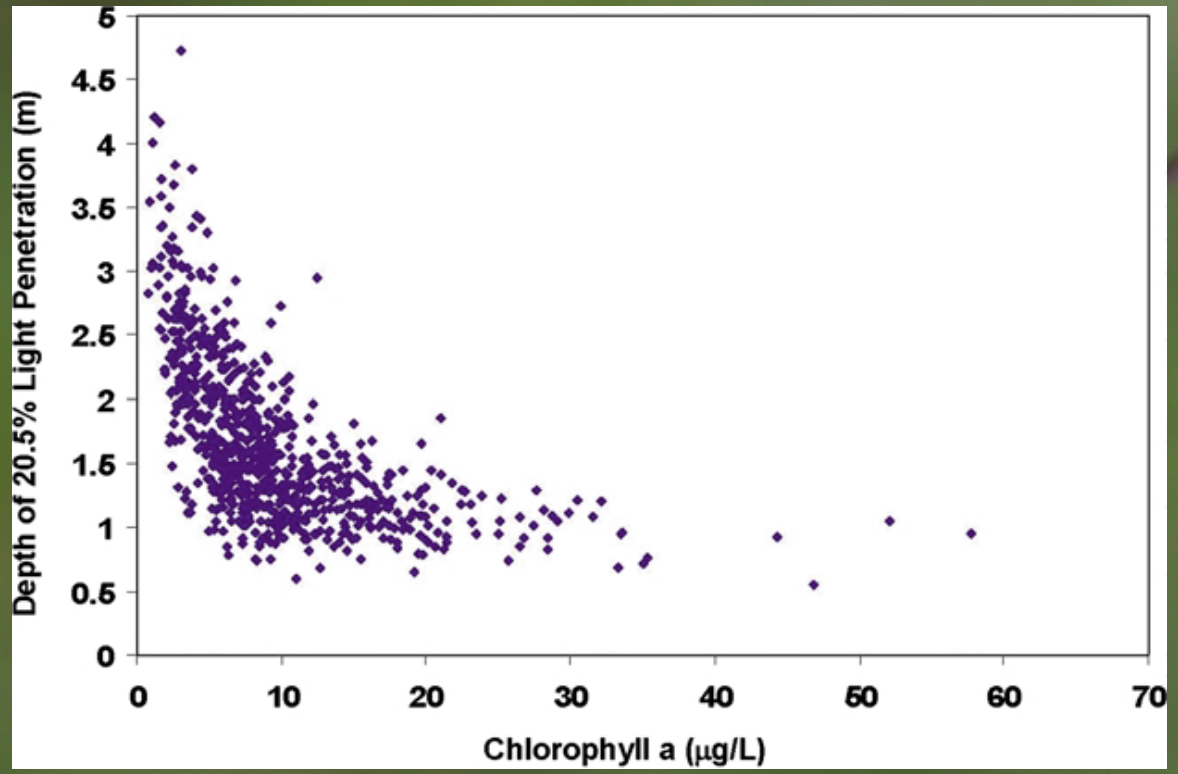
Policy

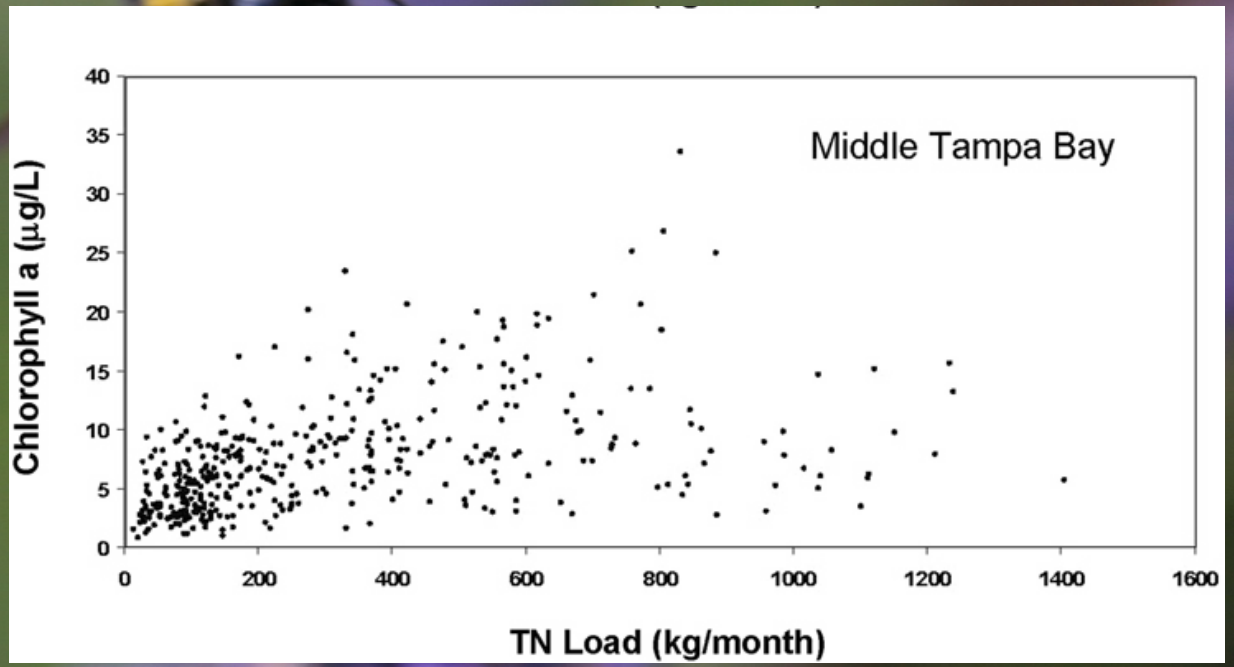
Science

Policy

Operationalizing science for decision making







Greening and Janicki 2006 Tampa Bay Estuary Program

Managing for Human benefit

Management decision

Quanti
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Report card approach

The Biological Condition Gradient: Biological Response to Increasing Levels of Stress

Levels of Biological Condition

Natural structural, functional, and taxonomic integrity is preserved.

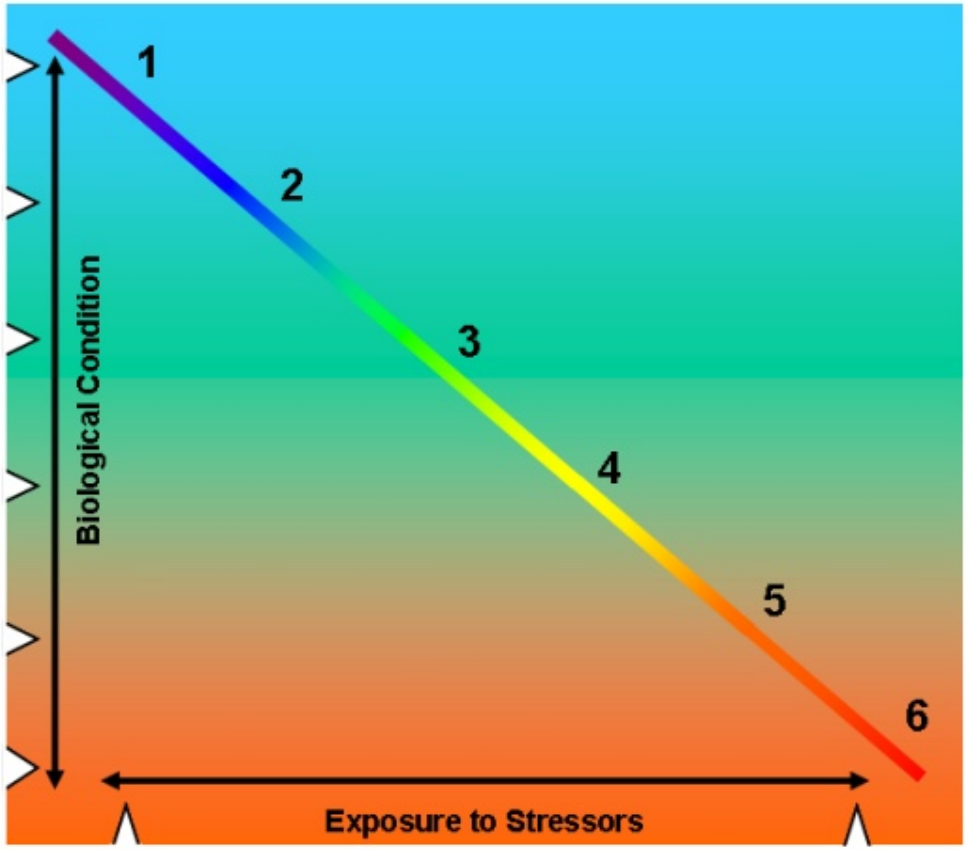
Structure: Similar to natural; some additional species & biomass;
Function: Fully maintained; some increase in production.

Structure: Some highly sensitive species lost; shifts in relative abundance.
Function: Fully maintained.

Structure: Replacement of sensitive ubiquitous species by more tolerant species;
Function: Largely maintained; some reduction.

Structure: Loss of sensitive species; unbalanced distribution of major organism groups
Function: Reduced complexity & redundancy.

Structure: Wholesale changes in composition; extreme alterations of biomass & density
Function: Functional breakdown



Watershed, habitat, flow regime and water chemistry as naturally occurs

Chemistry, habitat, and/or flow regime severely altered from natural conditions.

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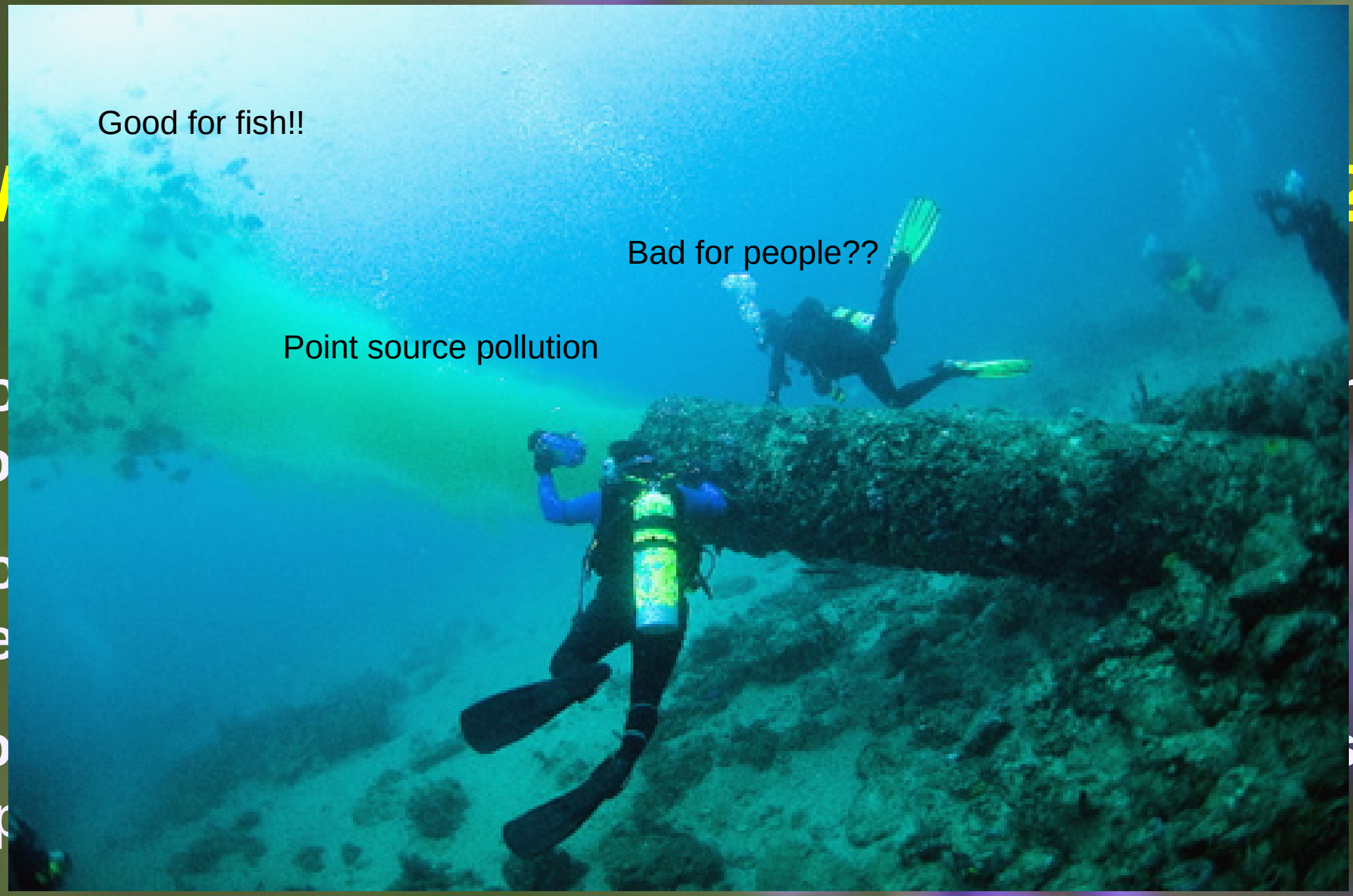
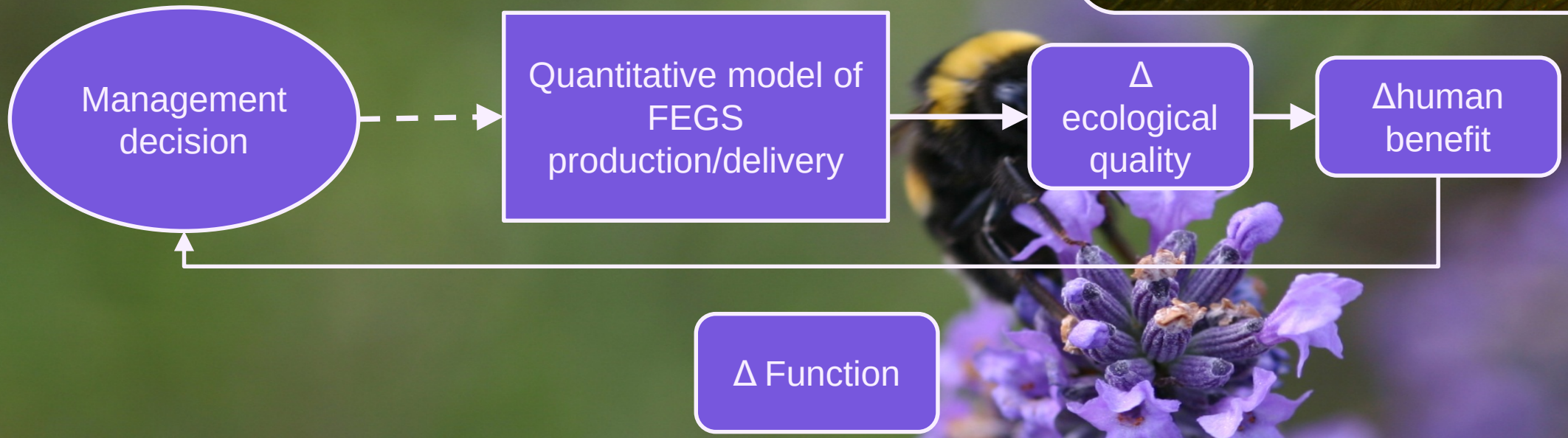


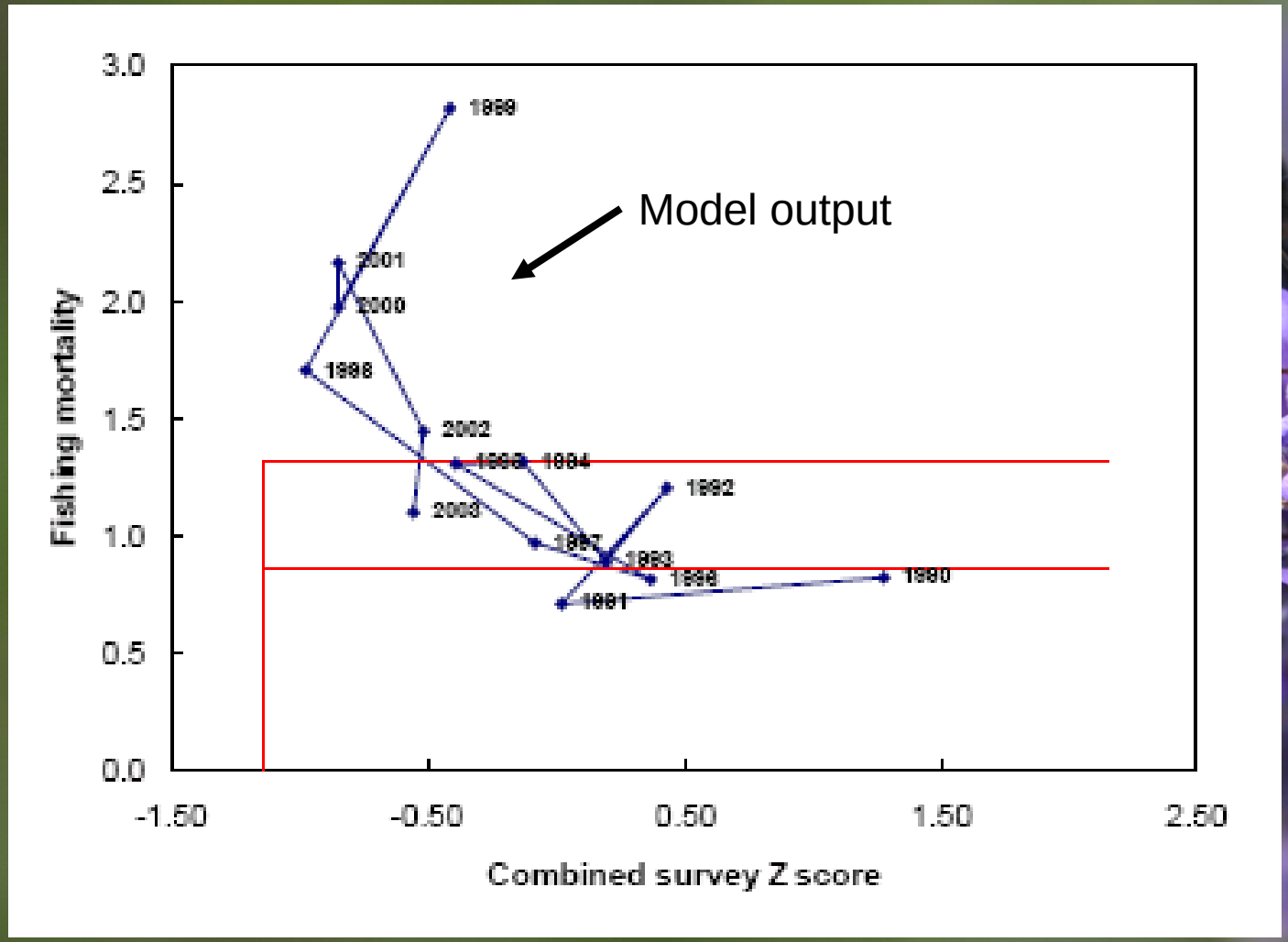
Managing for Human benefit

When does change matter?



Functional equivalency approach

Functional equivalency in Fisheries management – Decision thresholds



Target – Sustainable harvestable fish stock

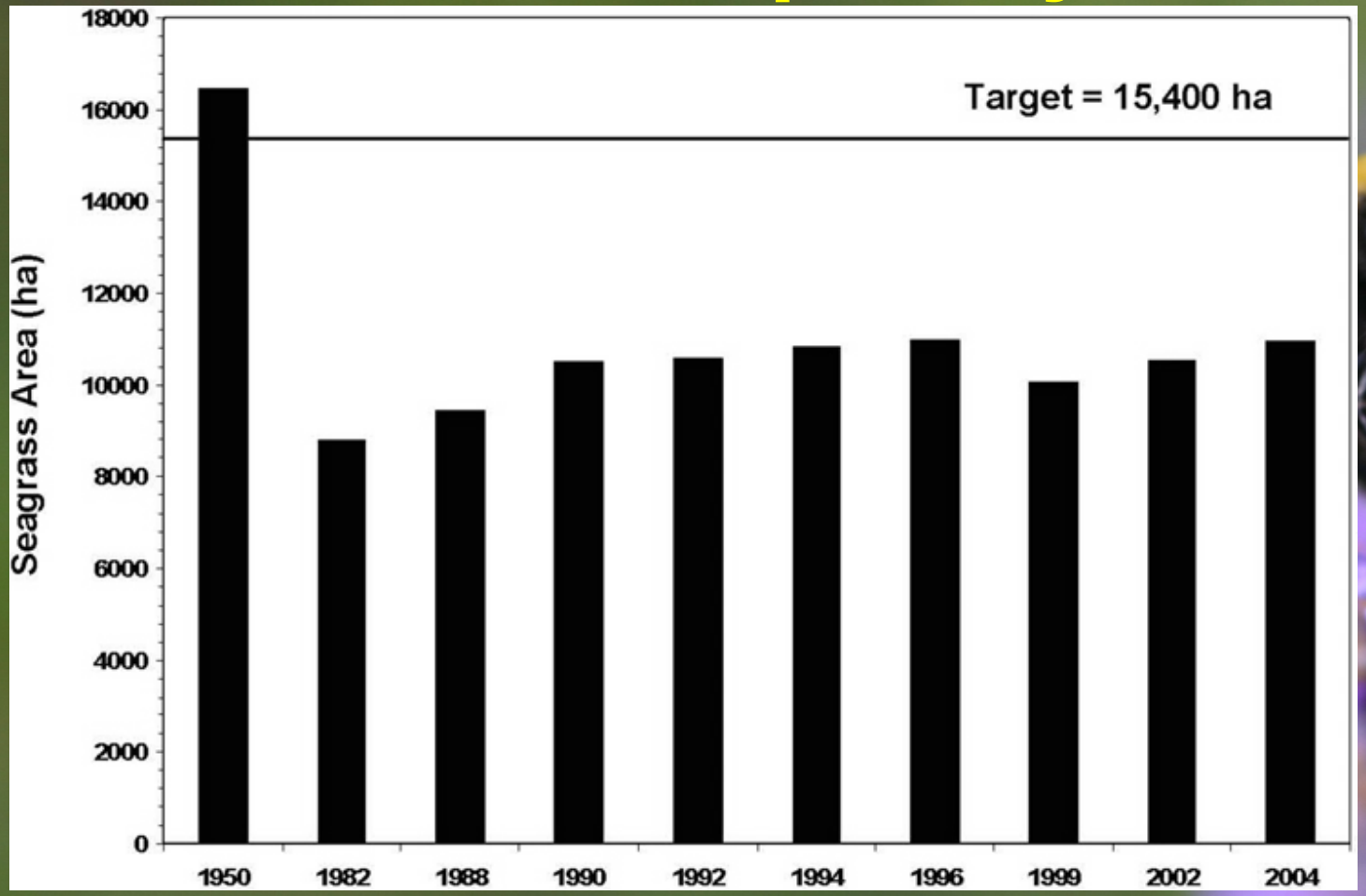
Data Tool – SCAA model

Output metrics– fishing mortality rate, spawning stock biomass

Functional equivalency threshold for management - mortality and reproduction

Equivalency defined based on sustainability of harvestable stock

Seagrass Restoration targets for Tampa Bay, FL



Taken from Greening and Janicki 2006 Figure 3

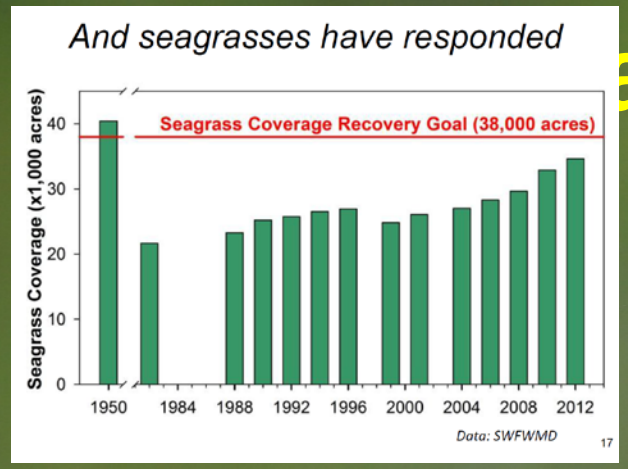
Green – Chl a and light targets met

Yellow – Either Chl a or light targets met

Red - Relatively large or long-term deviations from targets are observed

Year	Old Tampa Bay	Hillsborough Bay	Middle Tampa Bay	Lower Tampa Bay
1974	No	No	No	Yes
1975	No	No	No	Yes
1976	No	No	No	Yes
1977	No	No	No	No
1978	No	No	No	Yes
1979	No	No	No	No
1980	No	No	No	No
1981	No	No	No	No
1982	No	No	No	No
1983	No	No	No	No
1984	Yes	Yes	No	Yes
1985	No	No	No	Yes
1986	No	No	Yes	Yes
1987	No	Yes	No	Yes
1988	Yes	Yes	Yes	Yes
1989	No	Yes	Yes	Yes
1990	No	Yes	Yes	Yes
1991	Yes	Yes	Yes	Yes
1992	Yes	Yes	Yes	Yes
1993	Yes	Yes	Yes	Yes
1994	No	No	No	No
1995	No	No	No	Yes
1996	Yes	Yes	Yes	Yes
1997	Yes	Yes	Yes	Yes
1998	No	No	No	No
1999	Yes	Yes	Yes	Yes
2000	Yes	Yes	Yes	Yes
2001	Yes	Yes	Yes	Yes
2002	Yes	Yes	Yes	Yes
2003	No	Yes	Yes	Yes
2004	No	Yes	Yes	Yes
2005	Yes	Yes	Yes	No
2006	Yes	Yes	Yes	Yes
2007	Yes	Yes	Yes	Yes
2008	Yes	Yes	Yes	Yes
2009	No	Yes	Yes	Yes
2010	Yes	Yes	Yes	Yes
2011	No	Yes	Yes	Yes
2012	Yes	Yes	Yes	Yes

Functional thresholds for aking



Functional metric: % daily N load accounted for as denitrification in seagrass beds

Functional equivalency thresholds:

Target 30%

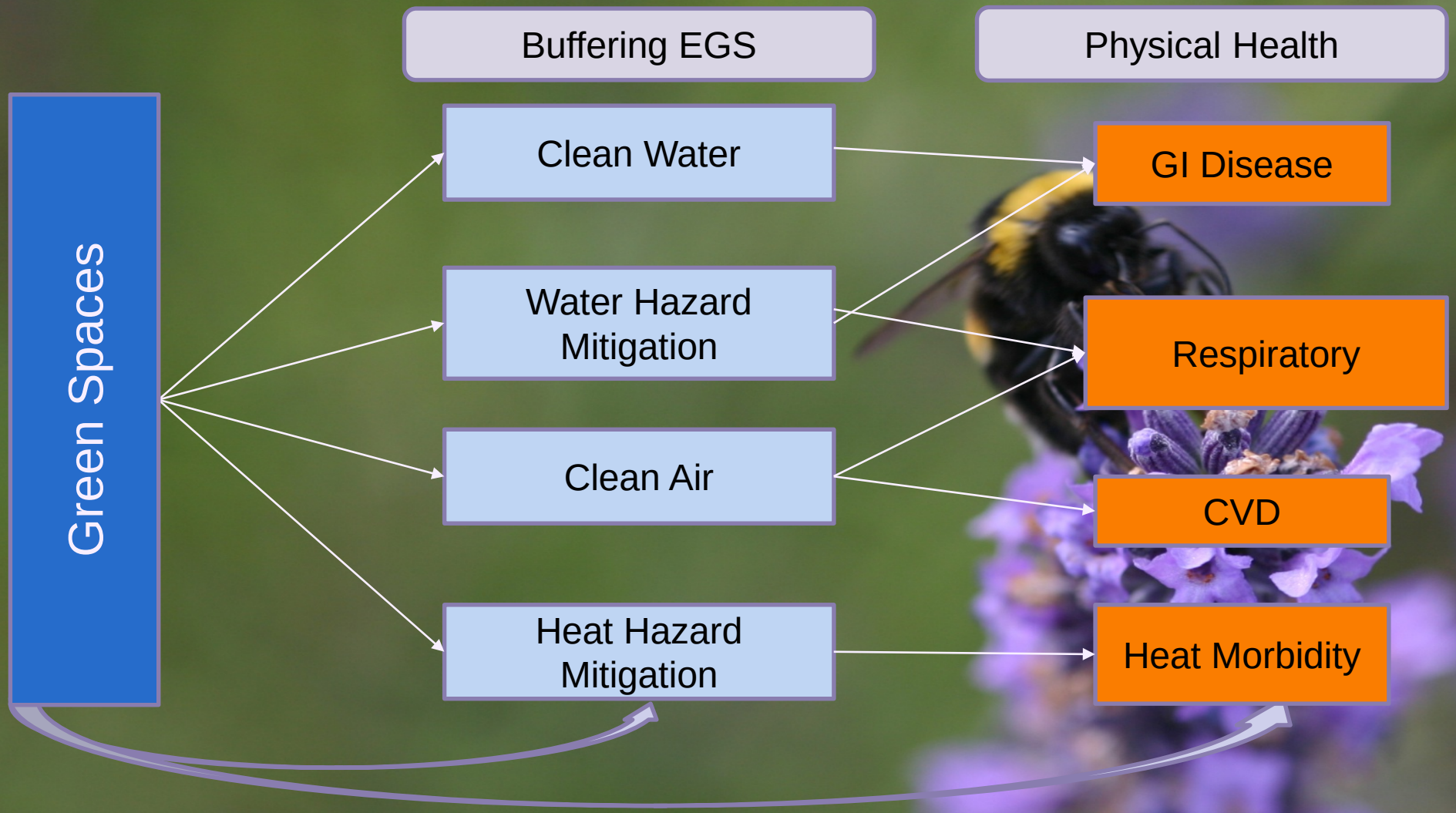
Minimum 20%

1976 – 10%

Mean since 1990 – 22%

1950 (est) – 46%

EGS – Human Health Links



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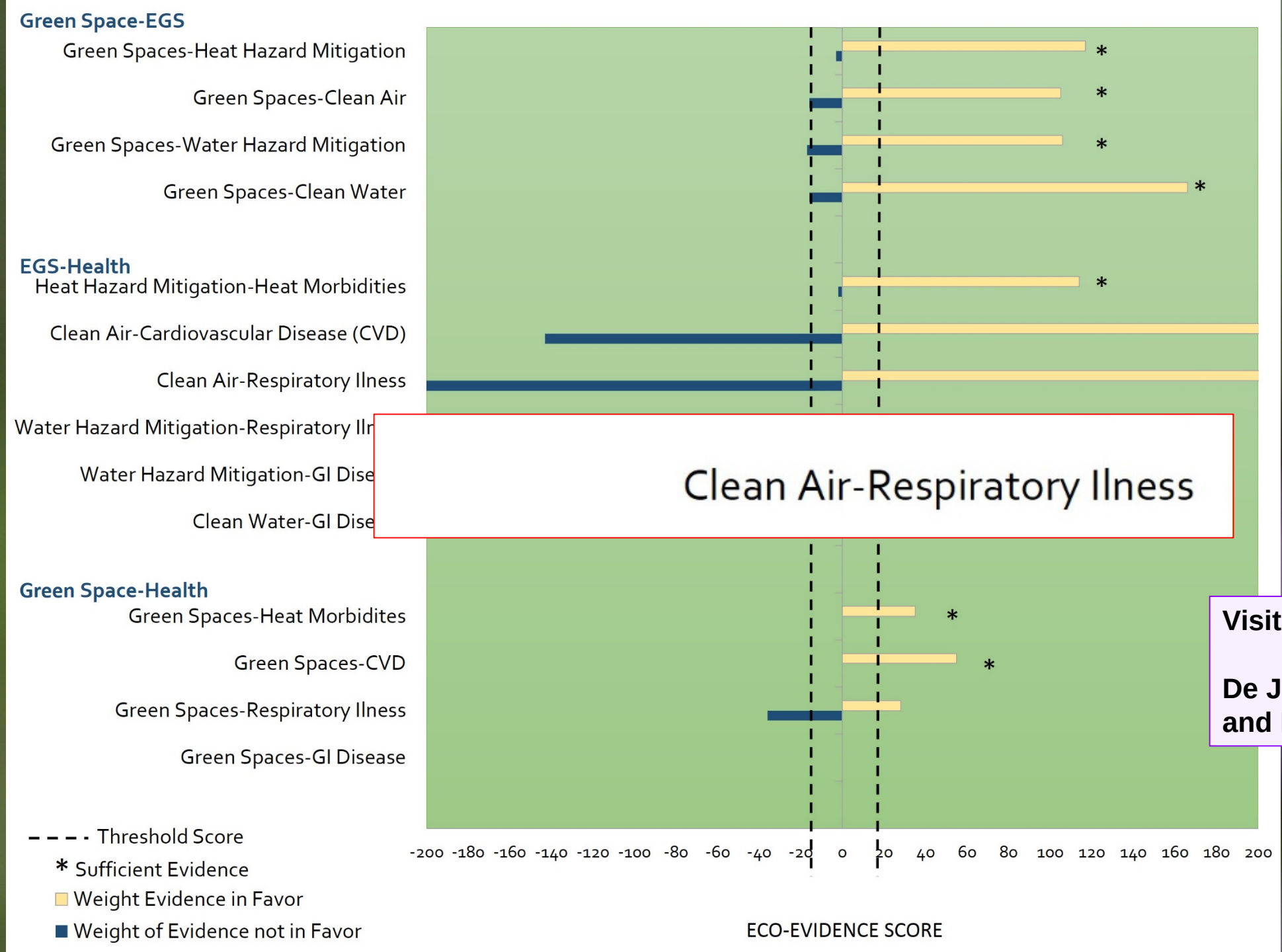

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Greenspace – Clean air – Respiratory illness

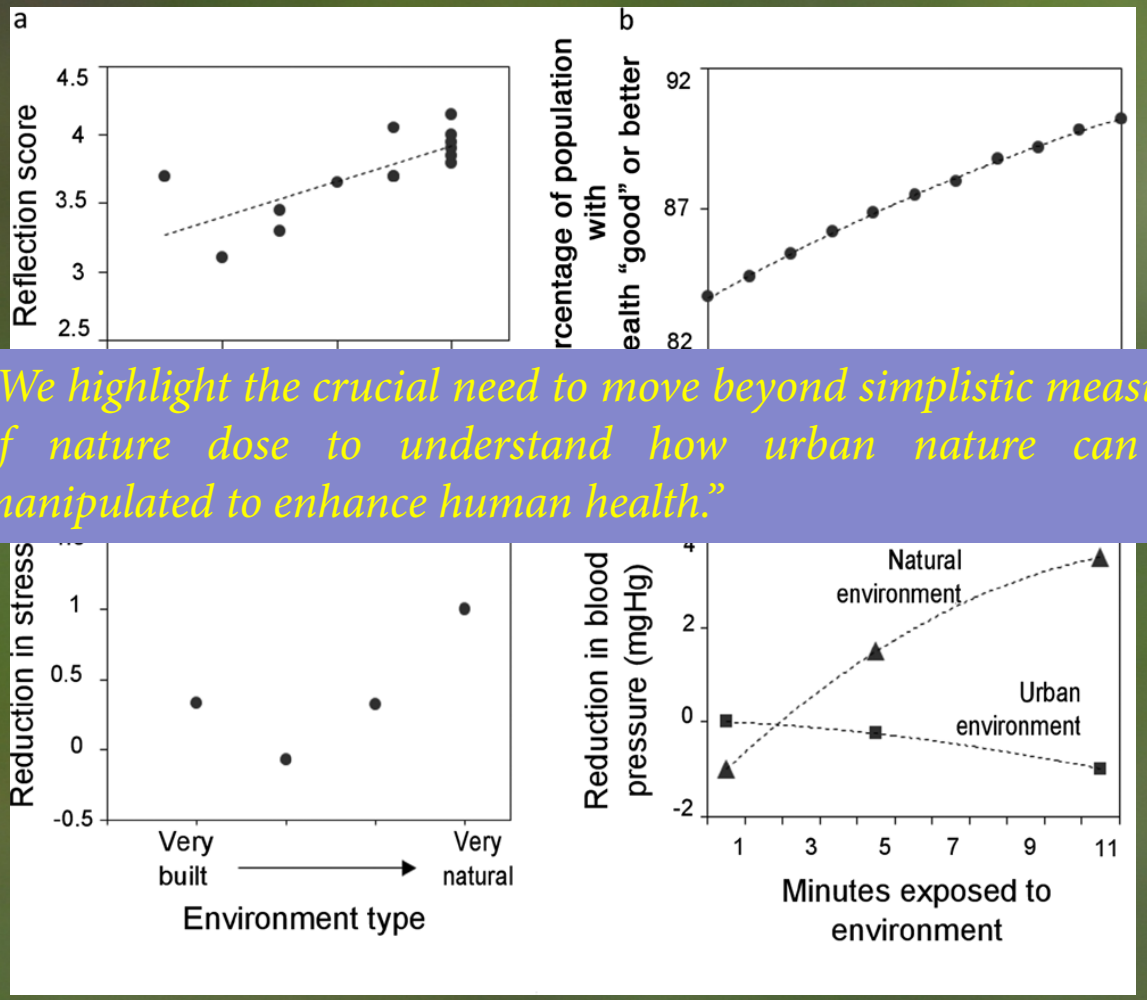
Table 6
Reduction in number of incidences and associated dollar value for various health effects due to $PM_{2.5}$ reduction from trees.

Health effect[a]	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
	Atlanta, GA		Baltimore, MD		Boston, MA		Chicago, IL		Los Angeles, CA	
Acute bronchitis	0.6	60	0.4	30	0.5	50	1.8	160	2.1	180
Acute myocardial infarction	0.3	26 300	0.2	14 600	0.3	28 400	0.9	78 800	0.6	49 300
Acute respiratory symptoms	488.7	47 900	240.9	23 600	502.5	49 200	1125.2	110 300	1263.6	123 900
Asthma exacerbation	243.8	19 800	138.3	11 200	243.0	19 800	770.0	62 600	936.4	76 100
Chronic bronchitis	0.4	104 000	0.2	[illegible]	[illegible]	[illegible]	[illegible]	247 000	1.0	285 000
Emergency room visits	0.4	180	0.9	[illegible]	[illegible]	[illegible]	[illegible]	510	1.1	470
Hospital admissions, cardiovascular	0.2	7700	0.2	[illegible]	[illegible]	[illegible]	[illegible]	17 400	0.3	12 700
Hospital admissions, respiratory	0.1	4400	0.1	[illegible]	[illegible]	[illegible]	[illegible]	13 800	0.3	9000
Lower respiratory symptoms	7.2	400	4.4	[illegible]	[illegible]	[illegible]	[illegible]	1200	25.5	1300
Mortality	1.2	8 940 000	1.0	[illegible]	[illegible]	[illegible]	[illegible]	25 300 000	3.0	23 000 000
Upper respiratory symptoms	6.4	300	3.7	200	5.2	200	18.3	800	21.0	900
Work loss days	84.8	16 300	40.8	6000	87.5	15 300	192.1	35 000	217.4	37 000
Total	na	9 170 000	na	7 780 000	na	9 360 000	na	25 900 000	na	23 600 000

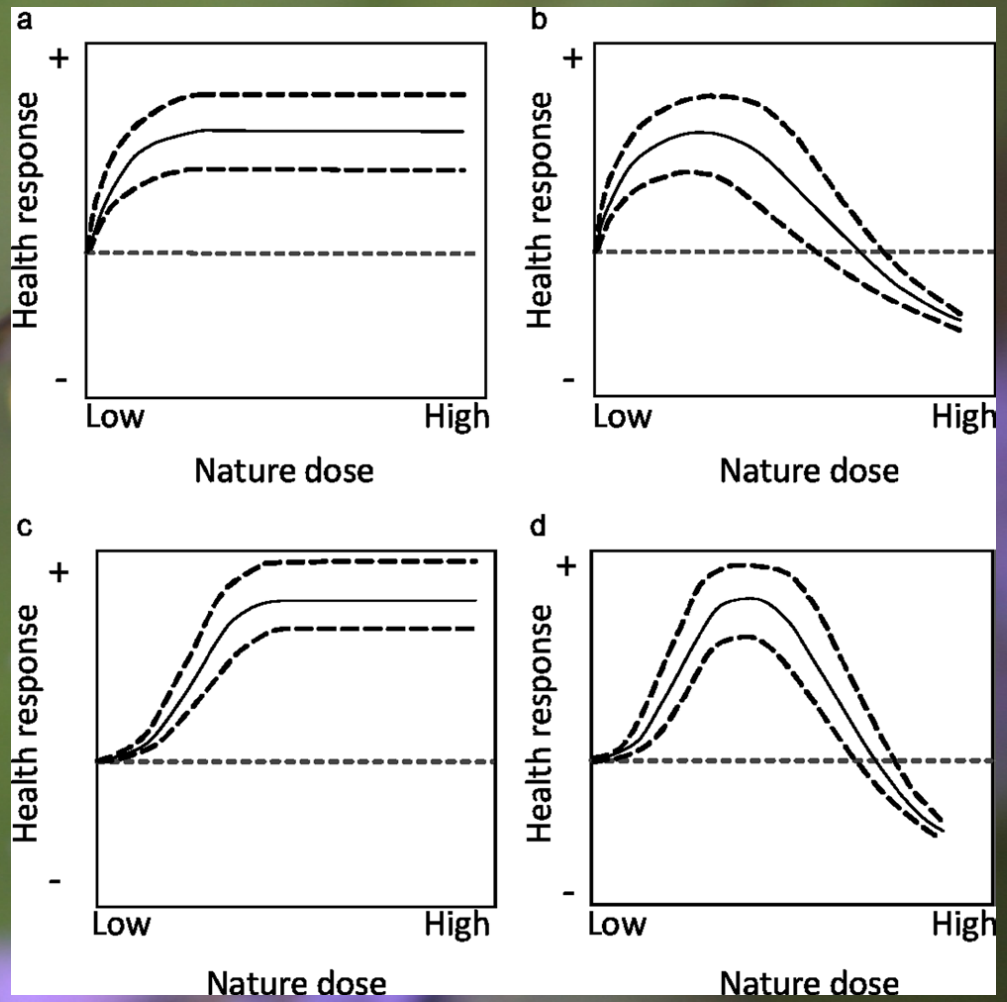
9 170 000

Nowak et al. 2013 Environmental Pollution 178: 395-402

Greenspace – Health/wellbeing



"We highlight the crucial need to move beyond simplistic measures of nature dose to understand how urban nature can be manipulated to enhance human health."



Shanahan et al. 2015 Bioscience 65: 476-485

Conclusions and future challenge

- Bridge science and policy as a part of research
- Incorporate uncertainty and trade-offs into decision making
- Maximize use of models
- Risk-based thresholds for decision making
- Translating science into useful terms


I do All the work and get NONE of the credit!