



**ProEcoServ**  
Project for Ecosystem Services

**A novel framework for optimising coral reef ecosystem service trade-offs to deliver benefits to people. A case study from the island of Tobago in Trinidad and Tobago**

***The non-use value of coral reefs as an indication of willingness to pay for ecosystem protection***

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# Background and justification



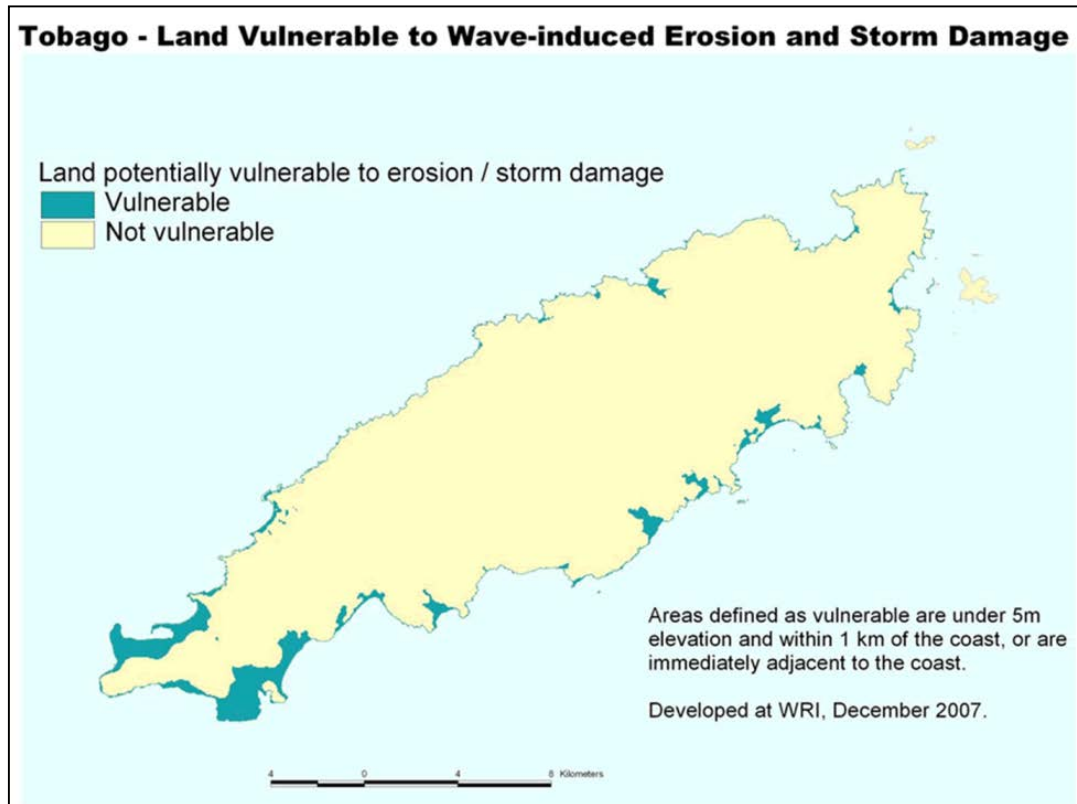
Trinidad and Tobago

- Oil and Gas
- Tourism
- Fisheries
- Real estate
- Agriculture



# Climate change concerns

- Sea Level Rise
- Mass coral bleaching and mortality
- Storm surge

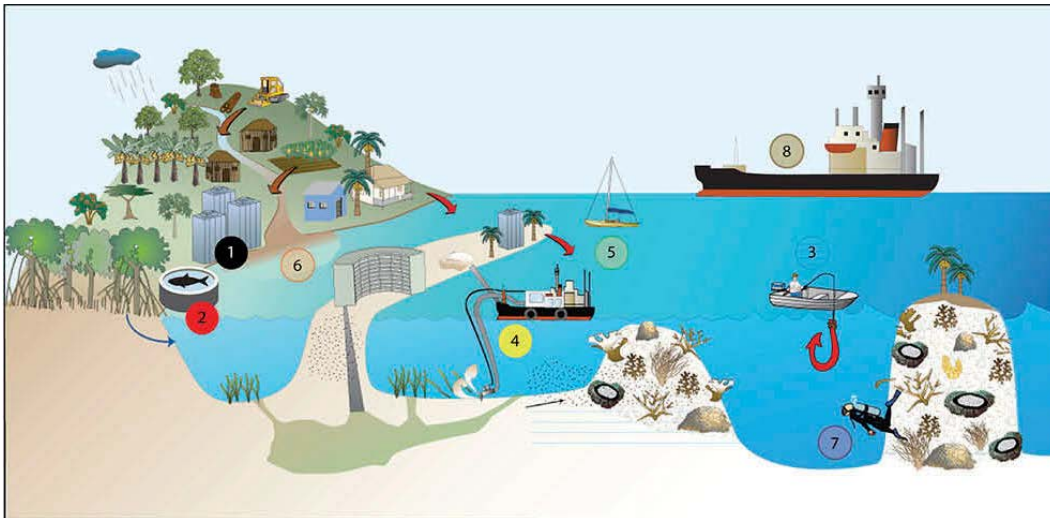


# Main objective

- National Spatial Development Strategy (2011-2014)
- Project for Ecosystem Services (2011-2016)
- ICZM policy (2013-2015)

**To quantifiably link the economy and coastal spatial planning to the ecosystem service production and benefits**



- To analyse stakeholder preferences for environmental quality and ecosystem service production
- To assess the value of coral reef ecosystem services for implementing ecosystem based management



# Method



- Choice experiment (funding future improvements) and payment card (max WTP/WTA)

Scenario	Option A	Option B	Option C
Water Quality	Very Good	Very Poor	<b>I prefer neither</b>
Reef Quality			
Price	USD \$40	USD \$30	
Fish Diversity	>30spp	21-30spp	
Lionfish	5-15	>25	

# Data analysis



Random utility theory:

$$U_{ij} = V_{ij}(X_{ij}) + \varepsilon_{ij} \quad V_{ij} + \varepsilon_{ij} = \beta X_{ij} + \varepsilon_{ij}$$

$$WTP = \beta_{\text{Attribute}} / \beta_{\text{Price}}$$

$$U_i = \beta_1(WQ_i) + \beta_2(RQ_i) + \beta_3(\text{Price}_i) + \beta_4(FD_i) + \beta_5(AIS_i)$$

- Modelling
  - Multinomial Logit (MNL)
  - Random Parameters Logit (RPL)
  - Latent Class Model (LCM)

# Results: Marginal preferences



	Reef quality	Fish Diversity	Water quality	Lionfish management
Diver	↗	↗	↗	↗
Snorkeler	↗	↗	↗	↘*

	Diver			Snorkeler	
Payment	-0.0082	-0.00831	-0.0084	-0.00919	-0.0091
AIS*Visitor	0.3059				
AIS*National		-0.00004			
AIS*Age			0.01505		
AIS*Education			0.17502		
Fish diversity*Gender				0.14519	
Fish diversity*Education				-0.07011	
Water quality_vg*Education					-0.1731

# Results: Sample characteristics



## Diver

Descriptors	n	Mean $\pm$ SD
Age	134	39.1 $\pm$ 14.2
Gender	134	51.5% male
Education	119	3.3 $\pm$ 1.0 (University)
Income (\$1000 USD yr <sup>-1</sup> )	134	\$93.9 $\pm$ 43.4
Experience	132	71.2%

## Snorkeler

Descriptors	n	Mean $\pm$ SD
Age	112	37.8 $\pm$ 12.1
Gender	114	54.4% male
Education	104	3.2 $\pm$ 1.1
Income (\$1000 USD yr <sup>-1</sup> )	113	\$80 $\pm$ 41.6
Experience	116	80.2%

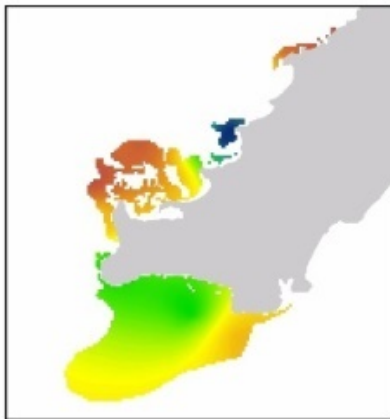


- **2016 direct estimate – USD\$4.65 mil**

- 4 dive shops (1,735) → USD\$0.17 mil
- 20/26 GBB snorkel operators (280,700) → USD \$4.3 mil
- 6/8 Private snorkel charters (520) → USD\$0.05 mil
- 2 water sports (900) → USD\$0.13 mil

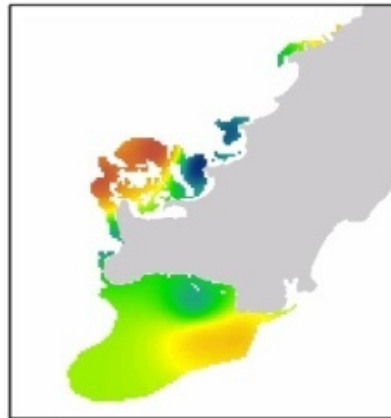
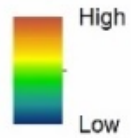
	<b>Diver 95% confidence interval with a one change toward a desirable state (USD\$)</b>		<b>Snorkeller 95% confidence interval with a one change toward a desirable state (USD\$)</b>	
	<b>Lower bound</b>	<b>Upper bound</b>	<b>Lower bound</b>	<b>Upper bound</b>
<b>Reef Quality</b>	<b>8.16</b>	<b>52.21</b>	<b>16.44*</b>	<b>58.25*</b>
<b>Fish diversity</b>	<b>1.42</b>	<b>44.71</b>	<b>10.32</b>	<b>52.29</b>
<b>Lionfish density<sup>1</sup></b>	<b>-</b>	<b>-</b>	<b>-71.50</b>	<b>-25.13</b>
<b>Lionfish density<sup>2</sup></b>	<b>-55.99</b>	<b>-7.86</b>	<b>12.14</b>	<b>53.77</b>
<b>Water quality</b>	<b>24.39</b>	<b>69.92</b>	<b>45.64</b>	<b>90.68</b>

# Next steps

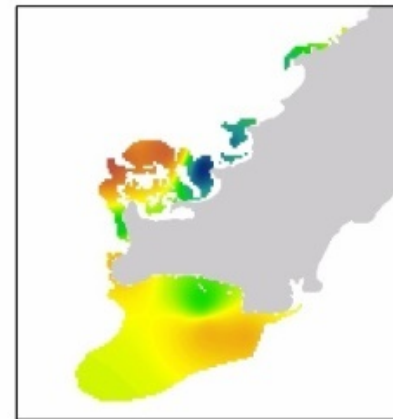


Ecosystem Integrity

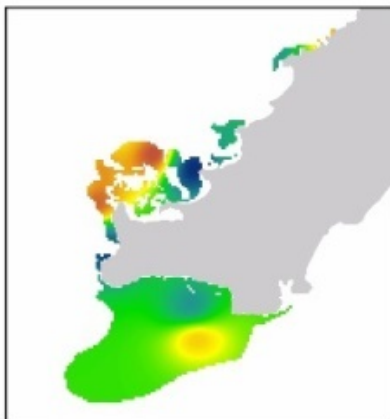
### Legend



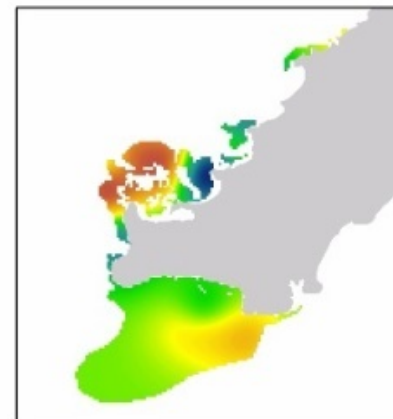
Aggregate



Shoreline Protection



Fisheries Production



Recreational Opportunity

# Initial conclusions



- Although divers and snorkeler share the same resource and utilise it similarly, each values it differently
- Preference for the maintenance for lionfish populations for recreational activities conflicts with existing and proposed management actions
- Water quality seems to be of the greatest concern among direct reef users



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**Thank you**

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