NOTE: THESE RESULTS ARE PRELIMINARY AND MAY CHANGE AS MODELLING AND DATA ANALYSIS IS REFINED. CONTACT PROFESSOR NATALIE STOECKL FOR PERMISSION.

Socioeconomic Systems and Reef Resilience

Project 10.2

Social and economic values in the Wet Tropics World Heritage Area

Project 12.3

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**Project 10.2 Socioeconomic Systems and Reef Resilience: What do we seek to know and why?**

- The influence of socioeconomic variables (e.g. price, cattle numbers) on water quality/sediment

**Tells us about what the economy does to the GBRWHA**
(also provides an indication of whether market based policies are likely to achieve environmental goals)

- The relative ‘value’ (benefit) of the goods and services provided by the Reef World Heritage Area (WTWHA) to residents and visitors

**Tells us about what the WTWHA does to/for the economy**
(also provides indication of likely environment/economy trade-offs)

- Plus some ‘geeky’ science exploring new ways of estimating the ‘value’ of non market goods and services

- A continuation of the long-term monitoring of tourists as they leave Cairns airport (which Bruce Prideaux has been undertaking since 2007)

**Gives an indication of trends over time**
(program also provides opportunity for investigation of ‘pressing’ issues for industry)
Annual sediment loads, rainfall, extreme events, cattle numbers, price and wage data from 1938 +

2012 Survey of 1592 residents living adjacent to the GBR

2012/13 Survey of 2743 visitors to the GBR catchment area

2007 – 2014 8050 visitor exit surveys from Cairns airport
OVERVIEW OF PROJECT 12.3’S DATA

2013 Survey of residents
- 386 mail-out responses
- 160 from Indigenous households
  (partnership with RAP)

2013/14 Survey of tourists at lagoon and airport
- 621 responses
Annual sediment loads, rainfall, extreme events, cattle numbers, price and wage data from 1938 +

Of what import is the price of beef to the GBR?
The Price of Beef and Sediment

- One can use econometric techniques to model stream-flow rainfall relations and *vector auto-regressions* to model economy-environment interactions.

- Rainfall, extreme events, cattle numbers and various prices have impacted sediment loads in the Burdekin over the last 100 years or so.

- Rainfall and extreme events most significant drivers, but changes in the price of beef and gold affect the environment.

- Prices may be having a more significant impact nowadays than 50 years ago.
KEY MESSAGES...

• Prices (and costs) matter
  – May need to monitor macroeconomic trends

• Price-based environmental policies could be effective but ...
  – Unsure which types of policies (e.g. price/market based or others) most effective; likely to depend, in part, on ‘values’.
WHAT DO WE SEEK TO KNOW AND WHY?

• The influence of socioeconomic variables (e.g. price, cattle numbers) on water quality/sediment

Tells us about what the economy does to the GBRWHA
(also provides an indication of whether market based policies are likely to achieve environmental goals)

• The relative ‘value’ (benefit) of the goods and services provided by (a) the GBRWHA; and (b) the WTWHA to residents and visitors

Tells us about what these two world heritage areas do to/for the economy
(also provides indication of likely environment/economy trade-offs)

• Plus some ‘geeky’ science exploring new ways of estimating the ‘value’ of non market goods and services

• A continuation of the long-term monitoring of tourists as they leave Cairns airport
(which Bruce Prideaux has been undertaking since 2007)

Gives an indication of trends over time
(program also provides opportunity for investigation of ‘pressing’ issues for industry)
ONE WAY OF LOOKING AT THE RELATIVE ‘VALUE’ OF VARIOUS GOODS AND SERVICES ...
Project 10.2

Interim report; Larson et al (in review)

GBR Residents – How important are each of the following to your overall quality of life? (N=1001)

<table>
<thead>
<tr>
<th>Industry / Economy</th>
<th>Unimportant</th>
<th>Neutral</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>No visible rubbish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy reef fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy coral reefs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mangroves and wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iconic marine species</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear oceans</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preserving the GBRWHA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating seafood</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time on beaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undeveloped and uncrowded beaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishing and crabbing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining and Agricultural industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indigenous Culture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Fishing industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheap shipping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bragging rights</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RELATIONSHIP BETWEEN VALUES (GBR RESIDENTS)

KEY MESSAGE:
Collective value at least $16b probably in excess of $20b per annum, perhaps more

Non-use/Intrinsic values
(healthy coral reefs, reef fish, iconic marine animals and mangroves; clear oceans, beaches without visible rubbish and preserving the reef for its own sake or for future generations)

Undeveloped and uncrowded beaches

Recreational/Lifestyle values

Indigenous cultural values

Jobs and incomes from reef-based tourism

Jobs and incomes from mining and agriculture

Jobs and incomes from commercial fishing

Cheap shipping transport

Overall quality of life

“valued” at >= $4b per annum, each

Stoeckl et al., (in review)
KEY MESSAGES...

• Family and friends likely most important of all.

• After that, widespread agreement that ‘intrinsic’ (environmental) values are more important (to quality of life, or as a reason to visit the region) than other things.

• Recognition (even if only implicit) of important inter-relationships

• GBRWHA (and WTWHA) likely to be ‘worth’ significantly more than just the $ associated with tourism revenues
But it's about more than just 'importance' ....
**Importance & Satisfaction**

**WT Tourists**

- Very important / Very satisfied (2)
- Important / Satisfied (1)
- Neutral (0)
- Unimportant / Unsatisfied (-1)
- Very unimportant / Very Unsatisfied (-2)

### Importance (n=238)

- Safety of self & of travelling...
- Quality infrastructures such as...
- Undeveloped scenery
- GBRWHA
- Weather
- Iconic marine species
- Healthy native plants & animals
- Iconic land species
- Budget
- Protection of the WTWHA for...
- Relax & reflect
- Scenic beauty & peacefulness
- Waterfalls and swimming in clear...
- Proximity of GBRWHA & WTWHA
- Quality accommodations, shops &...
- Rainforest walks
- Walking tracks
- Uncrowded camping & picnic areas
- City entertainment
- Learn about culture & country
- Protection of places with other...
- Roads & bridges
- Rail & skyrail
- Proximity to home
- Business

### Satisfaction (n=238)

- Satisfaction with overall experience: 1.02 (n=578)

*’s indicate statistically significant differences
IMPORTANCE & SATISFACTION
INDIGENOUS WT RESIDENTS

Very important / Very satisfied
Important / Satisfied
Neutral
Unimportant / Unsatisfied
Very unimportant / Very Unsatisfied

Project 12.3

Importance & Satisfaction

Safety of family & friends
Healthy native plants & animals
Time with family & friends
Undeveloped scenery
Learn about culture & country
Relax & reflect
Unique & ancient Australian environment
Iconic species
Protection of places with Aboriginal cultural values
Waterfalls and swimming in clear, clean rivers
Scenic beauty & peacefulness
Proximity of GBRWHA & WTWHA
Rainforest walks
Uncrowded camping & picnic areas
Protection of the WTWHA for future generations
Quality infrastructures such as schools, hospitals
Some control over life
Walking tracks
Community activities
Other industries
Rail & skyrail
Roads & bridges
Agriculture
Tourism
City entertainment
Mining

Satisfaction with life overall: 0.69
(n=140)
### Socioeconomic Determinants of ‘Importance’ (I) and of the Gap between ‘Importance and Satisfaction’ (IDS) – GBR Residents

<table>
<thead>
<tr>
<th>Non-Use (I, IDS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-,-</td>
</tr>
<tr>
<td>Education</td>
<td>+, +</td>
</tr>
<tr>
<td>Single</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Household income</td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td></td>
</tr>
<tr>
<td>Born in QLD</td>
<td></td>
</tr>
<tr>
<td>Main household income from:</td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>°, +</td>
</tr>
<tr>
<td>Fishing</td>
<td>°, +</td>
</tr>
<tr>
<td>Government</td>
<td>°, +</td>
</tr>
<tr>
<td>Tourism</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
</tr>
</tbody>
</table>
**Which type of people engage in with the environment most/least frequently? – GBR Residents**

### Characteristics of most frequent users

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Indigenous</th>
<th>Degree</th>
<th>Non QLD</th>
<th>QLD Born</th>
<th>M or Ag</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaches</td>
<td>Males $</td>
<td>Indigenous</td>
<td>Degree</td>
<td>Non QLD</td>
<td>QLD Born</td>
<td>M or Ag</td>
<td>F</td>
</tr>
<tr>
<td>Fishing</td>
<td>Males $ Single</td>
<td>Indigenous</td>
<td>No Degree</td>
<td>QLD Born</td>
<td>Tourism or Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor boat</td>
<td>Males $</td>
<td>Indigenous</td>
<td>No Degree</td>
<td>Non QLD</td>
<td>Tourism or Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Islands</td>
<td>Males $ Single</td>
<td>Young</td>
<td>Not Indigenous</td>
<td>Non QLD</td>
<td>Not M or Ag; F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reef trips</td>
<td>Males $</td>
<td>Young</td>
<td>No Degree</td>
<td>Non QLD</td>
<td>Not M; Tourism or Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snorkelling</td>
<td>Males $ Single</td>
<td>Young</td>
<td>Non QLD</td>
<td>Not M</td>
<td>Not M; Tourism or Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sailing</td>
<td>$</td>
<td>Young</td>
<td>Degree</td>
<td>Non QLD</td>
<td>Not M; F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paid boat</td>
<td>$</td>
<td>Young</td>
<td>Not Indigenous</td>
<td>Non QLD</td>
<td>Not M; F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KEY MESSAGES...

• GBR and WT – significant gaps between importance and satisfaction for Intrinsic/environmental values for tourists and residents

• Gap relatively small for tourists, larger for non-Indigenous residents; largest for Indigenous residents
  • A case of different or shifting baselines?

• Likely to get changes in ‘values’, ‘concerns’ and activities
  • If attitudes of existing population change
  • As population grows (different demography and/or economic focus)

Which is likely to have most significant impact?
Are people willing to pay to help improve the things they ‘value’?
Willingness to Pay (WTP), per annum, for improvements...

GBR Residents

- Improving ocean water quality
- Protecting top predators
- Reducing the risk of shipping accidents

Percent of respondents

0% 10% 20% 30% 40% 50%

- Up to $5
- $5 - $10
- $10 - $30
- $30 - $50
- $50 - $100
- $100 - $250
- $250 - $500
- More than $500

Project 10.2 Interim report
**Which GBR tourists are WTP to improve water quality (WQ)?**

WTP linked to a variety of factors:

- Questionnaire design
- Socio-economic and demographic variables
  - Income: +ve
  - Age: –ve
  - Education: +ve
  - Origin: –ve if from China
  - Plans to return to the region: +ve
- Feelings of ‘equity’ and fairness
- **Perceptions** of the importance, and satisfaction with, water quality
THE LINK BETWEEN WTP, IMPORTANCE AND SATISFACTION

Farr et al, (in review)
KEY MESSAGES...

• WTP linked to income, questionnaire design, and many other things --- but also linked to ‘importance’ and to perceived (not actual) satisfaction with state of environment.

• Many people not WTP anything to protect environment:
  
  Many ‘not wanting to pay unless others pay too’

A la Adam Smith’s ‘pure’ public goods and the important role of government (for collective funding and protection)
So how would people react if the things they value deteriorated?
IMPACT OF HYPOTHETICAL CHANGES ON OVERALL QUALITY OF LIFE... GBR RESIDENTS

- Twice as many oil spills, groundings, and waste spills
- Ocean changed from clear to murky
- Half as much live coral
- Half as much variety of fish to look at
- Local prices rise by 20% compared to other places in Australia
- Half as much chance of catching fish
- Twice as many tourists
- Much more satisfied
- Much less satisfied
- More satisfied
- Less satisfied
- No affect
IMPACT OF HYPOTHETICAL CHANGES ON DECISION TO COME TO THE REGION - WT TOURISTS
Estimated expenditure loss (AUD) per person per trip

Business visitors -
adjusted for hypothetical bias
Non-business visitors -
adjusted for hypothetical bias
Business visitors -
stated intentions
Non-business visitors -
stated intentions

Potential financial impact of ‘changes’ on GBR Tourism Industry

Mustika et al (in prep)

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KEY MESSAGES...

• Deterioration of WHA’s could have bigger impact (on quality of life of residents or decisions of tourists to visit region) than a 20% increase in prices

• Deterioration thus likely to have regional economic impact due to
  - Fewer tourists
  - More difficult to attract skilled labour to the region?
AND FOR THOSE UNCOMFORTABLE WITH ‘HYPOTHETICAL’ SCENARIOS ....
WATER CLARITY AND THE (GBR) TOURISM INDUSTRY ...

Probability that a tourist will RETURN, depends on

- Their origin (North America, Asia or Europe: negative)
- The number of previous visits to GBR: positive
- Trip satisfaction: positive

Trip satisfaction depends on:

- Tourist income: positive
- Spent 1 or less nights: negative
- Tourist visited reef at least once: positive
- Belief that lost wallet would be returned: positive
- Intensity of construction works: negative
- Rainfall: negative
- Water Turbidity (predicted value*): negative

Could potentially ‘lose’ up to $400k per annum in tourist revenues (across entire GBR catchment) if a 10% increase in turbidity

* To control for endogeneity, we used predicted values from the regression of water turbidity (at specific time and location) against rainfall + TSS from closest river + wind speed
Factors associated with a higher level of satisfaction with overall quality of life

- Age: positive
- Gender: Female - positive
- Marital status: Married positive
- Education: University degree - positive
- Income: Higher - positive
- Satisfied that the GBRWHA will be there for future generations to enjoy: positive.

As you move from south to north

- Income becomes less important, and ‘bequest’ more important
KEY MESSAGES...

• Analysis of ‘non hypothetical’ data confirms importance of environment.

• Specifically establishing a link between
  – environmental quality and tourist satisfaction
  – (perceptions of) ‘bequest’ values and resident life-satisfaction
Overall Empirical Punchlines

Multiple lines of evidence to suggest that

- “Intrinsic” environmental values are significant for tourists, non-indigenous and indigenous residents in this region.

But .... there are differences

– Between socioeconomic and demographic groups
    - Age, gender, Indigeneity, education and industry matters.

– Between regions
    - the further north one goes, the stronger are environmental values

– Over time
    - Suggestions of ‘shifting’ baselines
    - Trends evident from Cairns Airport exit surveys
Changes in the economy affect the environment. These changes feed back and affect people and economy.

Changes in one part of the economy can impact other parts of the economy and/or multiple environments.

Social and environmental values are important to people: deterioration thus has a real impact on the economy and on well-being.
Emerging body of literature on life satisfaction offers promising new way of ‘valuing’ non-market goods, assessing:
- Total values (how important is x compared to, say, y?)
- Marginal values (how would a change in x affect you?)

Irrespective of whether or not these values have $ attached, these quantitative measures likely to be useable in integrated modelling exercises.

But need long term data across the region- ideally ‘matched’ to biophysical data so can do ‘proper’ (spatial and dynamic) integrated modelling.
THANK YOU
COMMENTS, IDEAS AND SUGGESTIONS WELCOME 😊

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