Nature-based tourism in the Agulhas Plain: a vehicle for integrated biodiversity conservation

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for CAPE Landscape Initiatives Knowledge Exchange 2010

the context

Cape Action Plan for the Environment (CAPE)

- Nature-based tourism identified as key vehicle for meeting *both* the developmental goals of the local community *and* the conservation goals of CAPE

— Pronounced the Agulhas Plain as a terrestrial pilot region within the Cape Floristic Region

Integrated development and biodiversity conservation through nature-based tourism

"By 2020, the tourism industry is contributing significantly to the sustainability of the natural resources of the Cape Floral Kingdom. Nature-based tourism is attracting visitors to the region, and in turn is providing sustainable benefits to communities, increased incentives for on-going conservation, a contribution to the costs of managing the natural resource base of the industry, a stimulus to the regional economy and a world-class experience for tourists."

Integrated development and biodiversity conservation through nature-based tourism

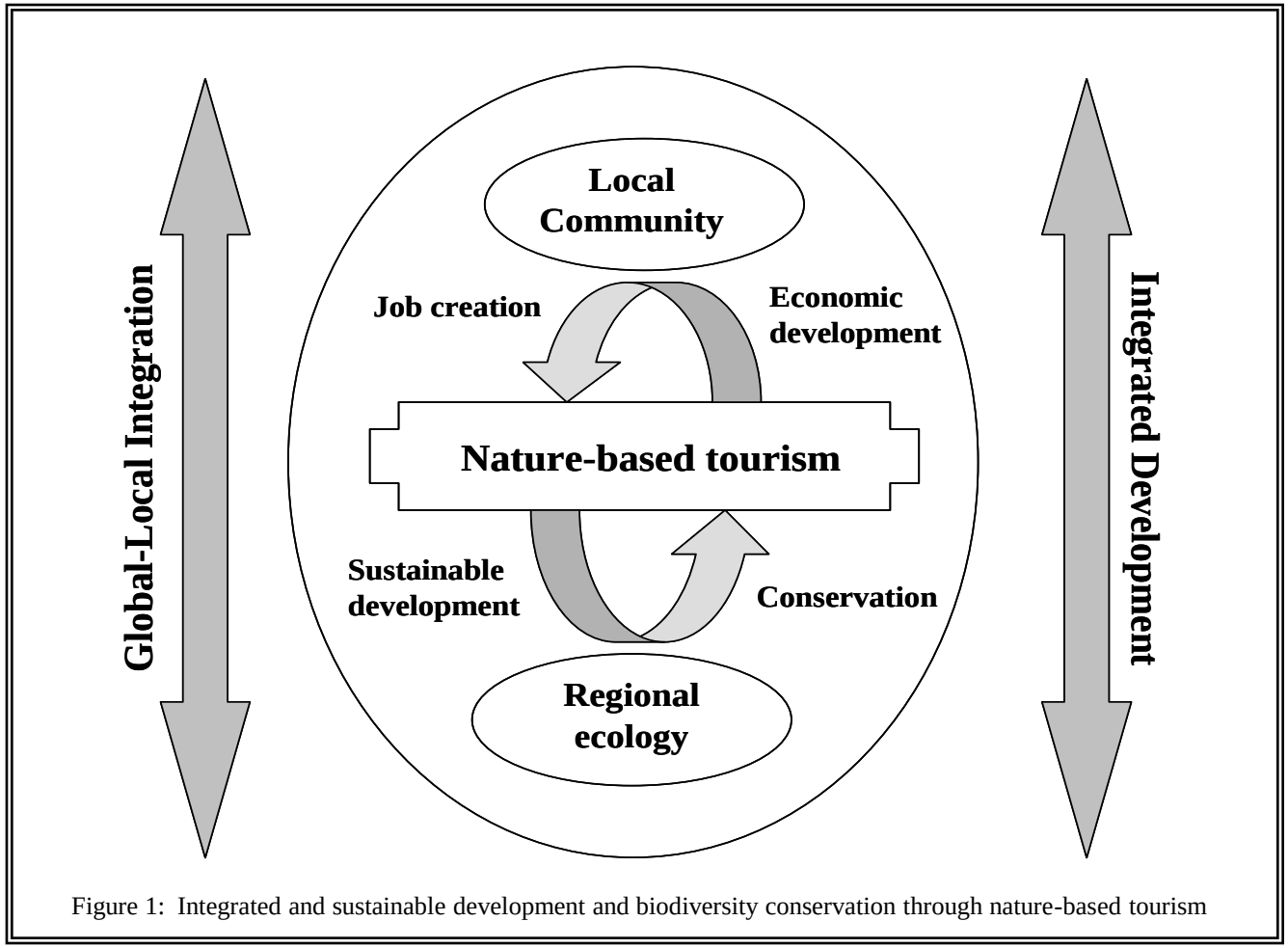


Figure 1: Integrated and sustainable development and biodiversity conservation through nature-based tourism

What is the value of tourism in Agulhas Plain?

- This study found that tourism in the region could reap between

  R64 to R123 million per annum

- Or R418 - R803 per hectare

- Range sits very well in the current South African literature, in particular valuations for tourism in the Cape Floristic Region (CFR) and Kruger National Park (KNP): R77-126 m

theoretical aspects

Non-market valuation

- No markets for environmental goods and services – therefore no ‘prices’ to signal scarcity or determine value
- Non-market valuation allows use and non-use values to be estimated using various techniques
- Travel Cost Method is one of them (TCM) & it estimates use value only

Travel cost method (TCM)

- Revealed preference valuation technique
- Estimates value of a location utilised for recreational or leisure purposes
- Basic concept: visitors incur expenses (both money and time) whilst visiting the recreational location – these expenses are used as a proxy for ‘price’

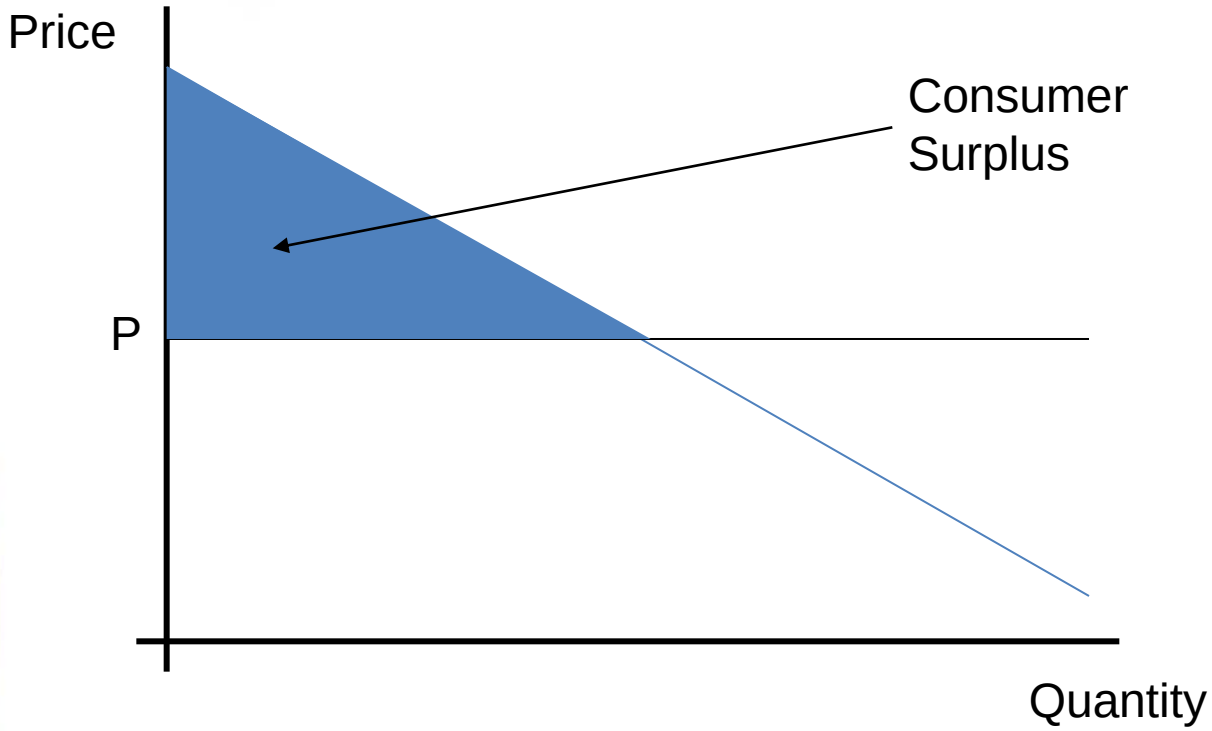
TCM – economic theory

- As price (travel and time costs involved in reaching a recreational site) *increases*
- Quantity demanded (number of visits in a year) *decreases*

➡ *downward sloping demand curve*

Those who live nearer to the site will visit more regularly in the year than those tourists that live farther away

TCM – economic theory



- Consumer Surplus = area under demand curve + above price paid = *VALUE*

Functional Form

$TV = f\ \{TC, I, X, L\}$

The direct demand function for *total visits per annum* (TV) is modelled as a function of independent variable, *total travel costs* (TC) and other factors such as income (I), tourist preferences (X) [such as *total party size, enjoy travel* & *larger trip*] and location specific factors (L) [such as *owning property*, *nature & biodiversity, shark-cage diving* & *activities*]

Functional Form

The models are shown below with specified functional forms for both TV and TC:

Model 1:	Reciprocal	$TV = 1/TC + f(I,X,L)$
Model 2:	Log-log	$\ln(TV) = \ln(TC) + f(I,X,L)$
Model 3:	Quadratic	$TV = \ln(TC) + [\ln(TC)]^2 + f(I,X,L)$
Model 4:	Log-linear	$\ln(TV) = TC + f(I,X,L)$
Model 5:	Linear-log	$TV = \ln(TC) + f(I,X,L)$

	Model 1 Reciprocal	Model 2 Log-log	Model 3 Quadratic	Model 4 Log-linear	Model 5 Linear-log
Dep var:	TV	Ln(TV)	TV	ln(TV)	TV
Indep vars:					
Total travel costs (tca1)	(1/TC) 443.826 *** [149.431]	Ln(TC) -0.1599 *** [0.034]	ln(TC) -9.6509 ** [4.017] $[\ln(tca1)]^2$ 0.7117 ** [0.306]	TC -0.0001 *** [0.000]	ln(TC) -0.8669 *** [0.262]
First visit	-1.8609 *** [0.483]		-2.7981 *** [0.548]		
Total party size	-0.6300 ** [0.268]		-0.6502 ** [0.275]		-0.3448 [0.269]
Enjoy travel	1.6301 *** [0.614]				1.4246 *** [0.545]
Larger trip	-1.2438 ** [0.516]	-0.3034 *** [0.095]		-0.3409 *** [0.098]	-2.0215 *** [0.572]
Owning property	5.0305 *** [1.182]	1.0574 *** [0.106]	5.0658 *** [1.171]	1.0807 *** [0.108]	5.6482 *** [1.180]
Nature & biodiversity	-3.1020 *** [0.770]	-0.3277 *** [0.101]	-3.4423 *** [0.864]	-0.3306 *** [0.103]	-2.8243 *** [0.831]
Shark-cage diving		-0.3700 *** [0.092]		-0.3586 *** [0.091]	
Activities influential			1.2552 *** [0.445]		

Income1 (less than R4,999)	-0.8343 [0.738]	-0.3027 ** [0.139]	-0.3623 [0.785]	-0.3564 ** [0.150]	-1.2431 Δ [0.793]
Income2 (R5,000-9,999)	-2.7791 *** [0.816]	-0.4950 *** [0.117]	-2.1486 *** [0.741]	-0.5037 *** [0.119]	-2.7255 *** [0.854]
Income3 (R10,000-14,999)	-1.1933 [0.864]	-0.2152 * [0.119]	-1.0501 [0.836]	-0.2007 * [0.120]	-1.1400 [0.891]
Income4 (R15,000-19,999)	0.1027 [1.820]	-0.1724 [0.155]	0.7277 [1.794]	-0.1614 [0.157]	0.0630 [1.828]
Income5 (R20,000-24,999)	-1.8944 ** [0.919]	-0.1132 [0.166]	-1.3639 Δ [0.910]	-0.0914 [0.175]	-1.7476 * [0.960]
Income6 (R25,000-29,999)	-1.9425 ** [0.857]	-0.4478 *** [0.139]	-1.5276 ** [0.755]	-0.4725 *** [0.142]	-1.9941 ** [0.899]
Income7 (R30,000-39,999)	-1.2901 * [0.732]	-0.2882 ** [0.122]	-1.1030 Δ [0.735]	-0.3485 *** [0.122]	-1.9242 ** [0.836]
Missing expenses	-1.9190 *** [0.574]	-0.3101 *** [0.092]	-2.0454 *** [0.609]	-0.2949 *** [0.090]	-1.7607 *** [0.587]
Constant	5.9131 *** [1.547]	2.1554 *** [0.253]	39.5697 *** [13.611]	1.2748 *** [0.167]	11.3669 *** [2.183]
R^2-adjusted	**0.3501**	**0.5430**	**0.3403**	**0.5256**	**0.3106**
R^2 robust	**0.3815**	**0.5621**	**0.3721**	**0.5454**	**0.3416**
# Observations	**312**	**312**	**312**	**312**	**312**
Model Signf.	***	***	***	***	***

Key: *** significant at 1%; ** significant at 5%; * significant at 10%; Δ significant at 15%

Derivation of demand function

$$\hat{TV} = \beta 0 + \beta 1(1/TC) + \beta 2(\text{first visit}) + \beta 3(\text{total party}) + \beta 4(\text{enjoy travel}) + \beta 5(\text{larger trip}) + \beta 6(\text{property}) + \beta 7(\text{nature}) + \beta 8(\text{inc1}) + \beta 9(\text{inc2}) + \beta 10(\text{inc3}) + \beta 11(\text{inc4}) + \beta 12(\text{inc5}) + \beta 13(\text{inc6}) + \beta 14(\text{inc7}) + \beta 15(\text{misexp}) + \varepsilon$$

$$\hat{TV} = 5.913 + 443.826(1/TC) - 1.861(\text{first visit}) - 0.630(\text{total party}) + 1.630(\text{enjoy travel}) - 1.244(\text{larger trip}) + 5.030(\text{property}) - 3.102(\text{nature}) - 0.834(\text{inc1}) - 2.779(\text{inc2}) - 1.193(\text{inc3}) + 0.103(\text{inc4}) - 1.894(\text{inc5}) - 1.942(\text{inc6}) - 1.290(\text{inc7}) - 1.919(\text{misexp}) + \varepsilon$$

$$\hat{TV} = 5.913 + 443.826(1/TC) - 1.861(0.362) - 0.630(3.089) + 1.630(0.846) - 1.244(0.340) + 5.030(0.232) - 3.102(0.762) - 0.834(0.058) - 2.779(0.115) - 1.193(0.221) + 0.103(0.122) - 1.894(0.038) - 1.942(0.099) - 1.290(0.096) - 1.919(0.194) + \varepsilon$$

Derivation of demand function

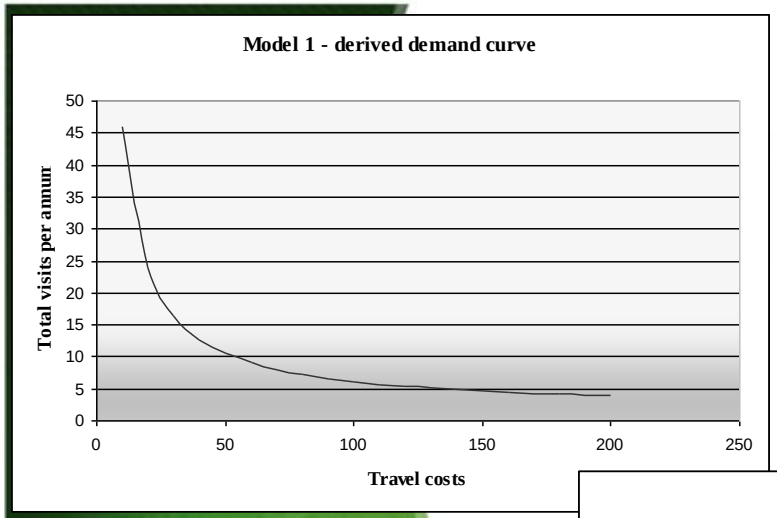
$$\hat{TV} = 1.670 + 443.826\,(1/TC) + \varepsilon \qquad \textbf{Model 1}$$

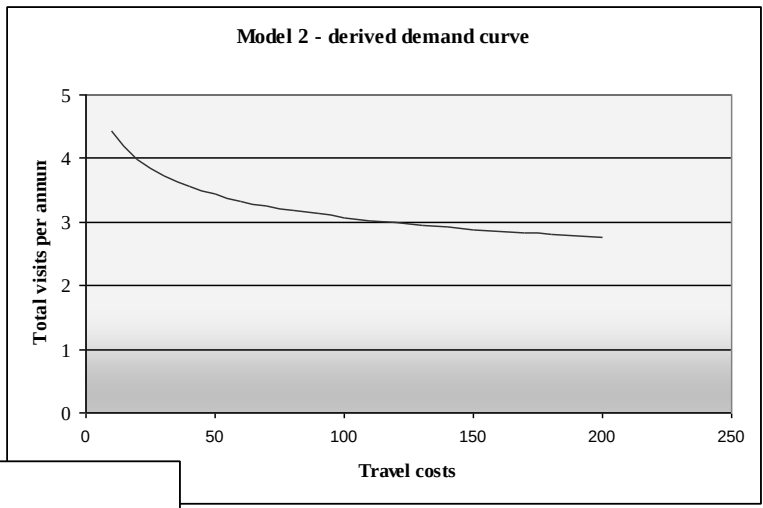
$$\ln(\hat{TV}) = 1.673 - 0.160(\ln(TC)) + \varepsilon \qquad \textbf{Model 2}$$

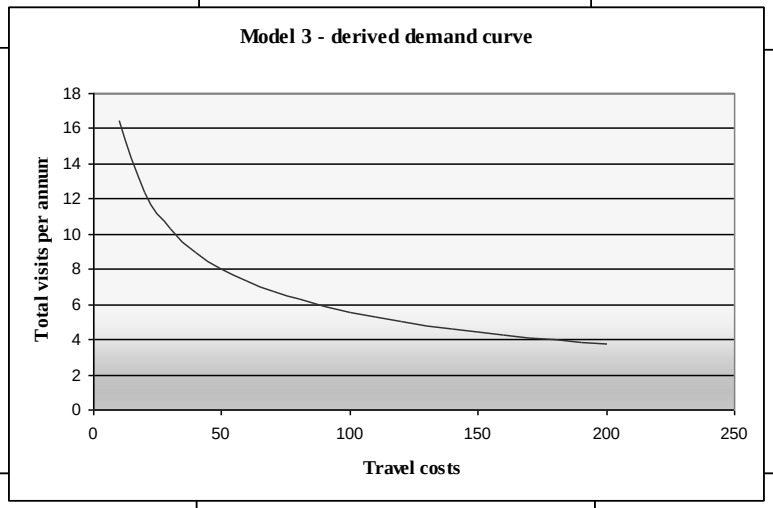
$$\hat{TV} = 34.904 - 9.651(\ln(TC)) + 0.712(\ln(TC))^2 + \varepsilon \qquad \textbf{Model 3}$$

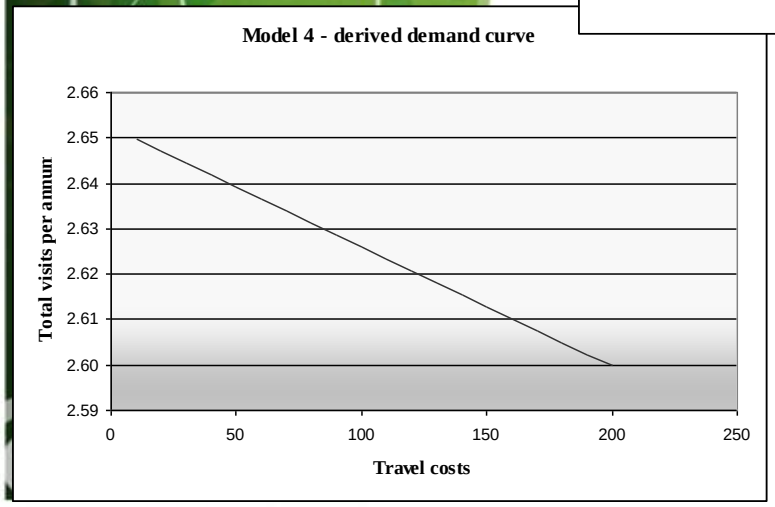
$$\ln(\hat{TV}) = 0.782 - 0.0001(TC) + \varepsilon \qquad \textbf{Model 4}$$

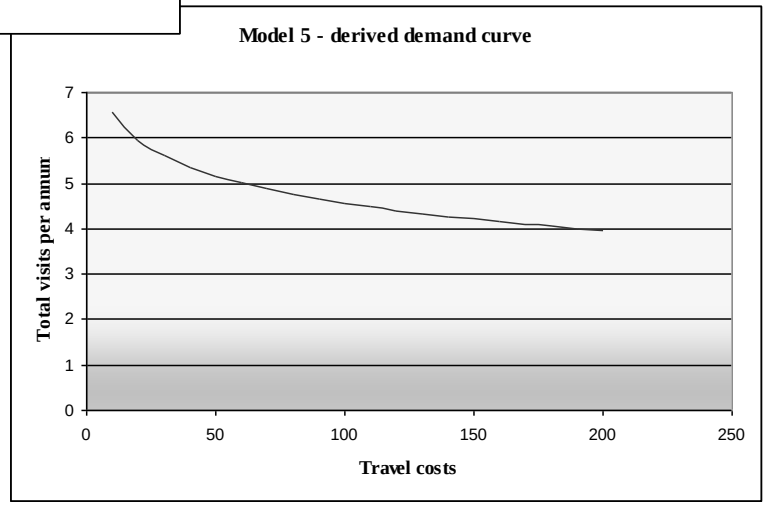
$$\hat{TV} = 8.555 - 0.870(\ln(TC)) + \varepsilon \qquad \textbf{Model 5}$$


Model 1 - derived demand curve
Total visits per annum
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
Travel costs


Model 2 - derived demand curve
Total visits per annum
0
1
2
3
4
5
0
50
100
150
200
250
Travel costs


Model 3 - derived demand curve
Total visits per annum
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
Travel costs


Model 4 - derived demand curve
Total visits per annum
2.59
2.60
2.61
2.62
2.63
2.64
2.65
2.66
0
50
100
150
200
250
Travel costs

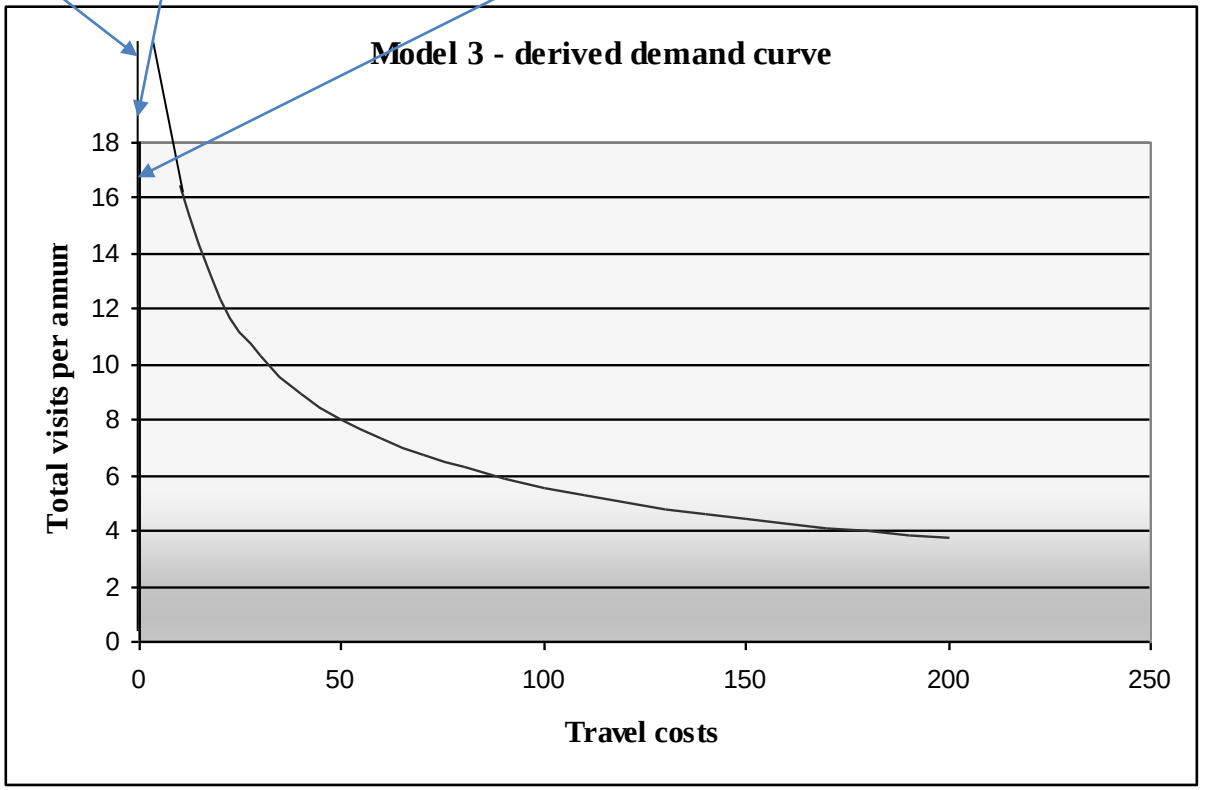

Model 5 - derived demand curve
Total visits per annum
0
1
2
3
4
5
6
7
0
50
100
150
200
250
Travel costs

Choke price

97th percentile

95th percentile

90th percentile



Consumer surplus: value calculation

$$\text{Individual CS} = \int_{(TC)_i}^{choke} TV \; d(TC)$$

$$\text{Individual CS} = \int_{(TC)_i}^{choke} \beta 0 + \beta 1(1/TC) + \beta 2(\text{first visit}) + \beta 3(\text{total party}) + \beta 4(\text{enjoy travel}) + \beta 5(\text{larger trip}) + \beta 6(\text{property}) + \beta 7(\text{nature}) + \beta 8(\text{inc1}) + \beta 9(\text{inc2}) + \beta 10(\text{inc3}) + \beta 11(\text{inc4}) + \beta 12(\text{inc5}) + \beta 13(\text{inc6}) + \beta 14(\text{inc7}) + \beta 15(\text{misexp}) \; d(TC)$$

$$\text{Individual CS} = \left[(\beta 0 + \beta 2(\text{first visit}) + \beta 3(\text{total party}) + \beta 4(\text{enjoy travel}) + \beta 5(\text{larger trip}) + \beta 6(\text{property}) + \beta 7(\text{nature}) + \beta 8(\text{inc1}) + \beta 9(\text{inc2}) + \beta 10(\text{inc3}) + \beta 11(\text{inc4}) + \beta 12(\text{inc5}) + \beta 13(\text{inc6}) + \beta 14(\text{in7}) + \beta 15(\text{misexp})) * (TC) \right]_{(TC)_i}^{choke} + \left[\beta 1(\ln(TC)) \right]$$

$$\text{Individual CS} = [(\beta 0 + \ldots.. + \beta 15(\text{misexp}))*(\text{choke} - TC_i)] + [\beta 1((\ln(\text{choke}) - \ln(TC_i))]$$

Consumer surplus: value calculation

Individual consumer surplus aggregated by number of visitors to the region in the previous year: in the year between July 2009 and June 2010 = approximately 105,000 visitors

	Average Individual CS	**Average CS Per visit**	**Average Total WTP Per visit**	**Aggregated Average Total WTP <u>per annum</u>** (millions)	**Aggregated Average CS <u>Per annum</u>** (millions)
Model 1: Reciprocal	R 1,566	R 444	R 1,243	R 130.6 m	**R 46.7 m**
[90th percentile]	R 2,754	R 781	R 1,580	R 166.0 m	**R 82.0 m**
[95th percentile]	R 4,406	R 1,250	R 2,049	R 215.2 m	**R 131.3 m**
[97th percentile]					
Model 2: Log-log	R 1,974	R 560	R 1,359	R 142.7 m	**R 58.8 m**
[90th percentile]	R 3,833	R 1,088	R 1,887	R 198.1 m	**R 114.2 m**
[95th percentile]	R 6,403	R 1,817	R 2,616	R 274.6 m	**R 190.7 m**
[97th percentile]					
Model 3: Quadratic	R 5	R 1	R 800	R 84.0 m	**R 0.14 m**
[90th percentile]	R 3	R 1	R 800	R 84.0 m	**R 0.10 m**
[97th percentile]					
Model 4: Log-linear	R 2,327	R 660	R 1,459	R 153. 2 m	**R 69.3 m**
[90th percentile]	R 4,458	R 1,265	R 2,064	R 216. 7 m	**R 132.8 m**
[95th percentile]	R 7,281	R 2,066	R 2,865	R 300.8 m	**R 216.9 m**
[97th percentile]					
Model 5: Linear-log	R 2,356	R 668	R 1,467	R 154.1 m	**R 70.2 m**
[90th percentile]	R 3,838	R 1,089	R 1,888	R 198.2 m	**R 114.3 m**
[95th percentile]	R 5,504	R 1,562	R 2,361	R 247.9 m	**R 164.0 m**
[97th percentile]					

Consumer surplus: value calculation

Model 1:	R 47 m to 131 m
Model 2:	R 59 m to 191 m
Model 3:	R 0.10 m to 0.14 m
Model 4:	R 69 m to 217 m
Model 5:	R 70 m to 164 m

Model 3 rejected for inadequate functional form and 97th percentile upper limits of range discarded for practical reasons

Consumer surplus: value calculation - a more conservative and practical valuation

Model 1:	R 47 m to 82 m
Model 2:	R 59 m to 114 m
Model 4:	R 69 m to 132 m
Model 5:	R 70 m to 114 m

Consumer surplus: narrowing the value range down

overall range R 47 - 123 m

maximin – minimax: R 70 - 82 m

min – min: R 47 - 82 m (model 1)

“Averages”: R 61 - 110 m (models 2 & 4 closest to this range)

Models 2 & 4 most robust statistically

Consumer surplus: narrowing the value range down

Model 2: R 59 - 114 m

Model 4: R 69 - 132 m

Average of these 'selected' models & FINAL valuation of tourism in Agulhas Plain:

R 64 - 123 m

Very close to "averages" approximation {R61-110m} and CFR / KNP estimates {R77-126m}

practical application

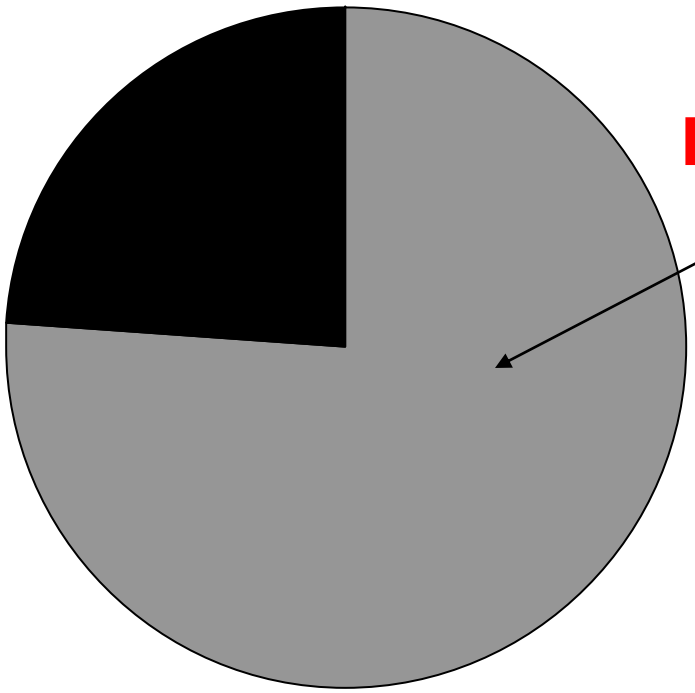
Nature-based tourism

76% of respondents said nature and biodiversity were influential in their decision to visit the region :-

- *extremely influential* 34%

- *quite influential* 42%

Value attributable to *nature-based tourism*



Thank you.

Any questions ?