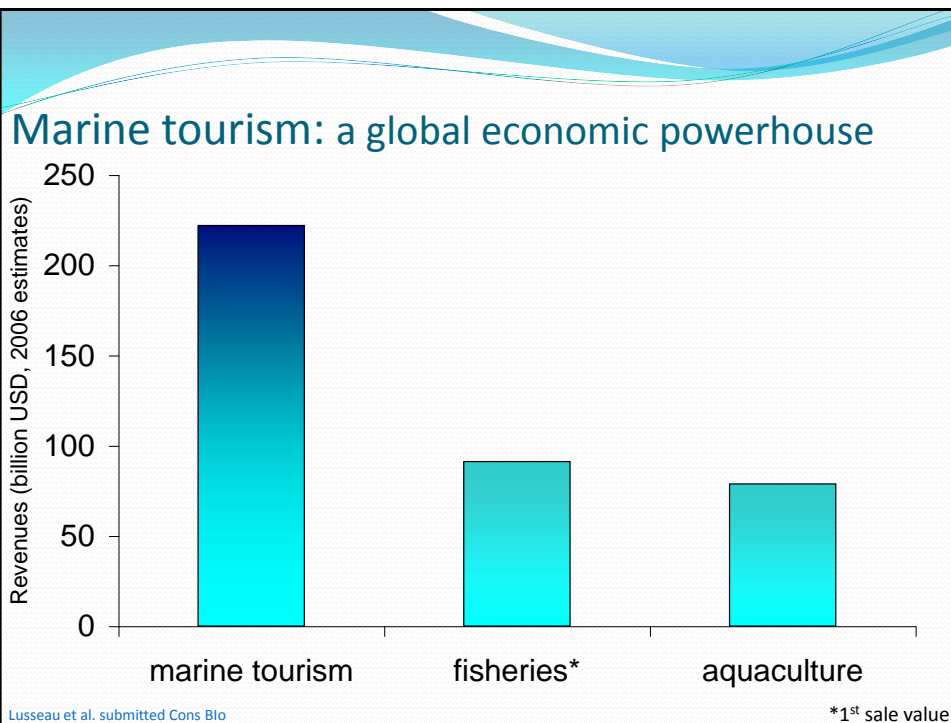


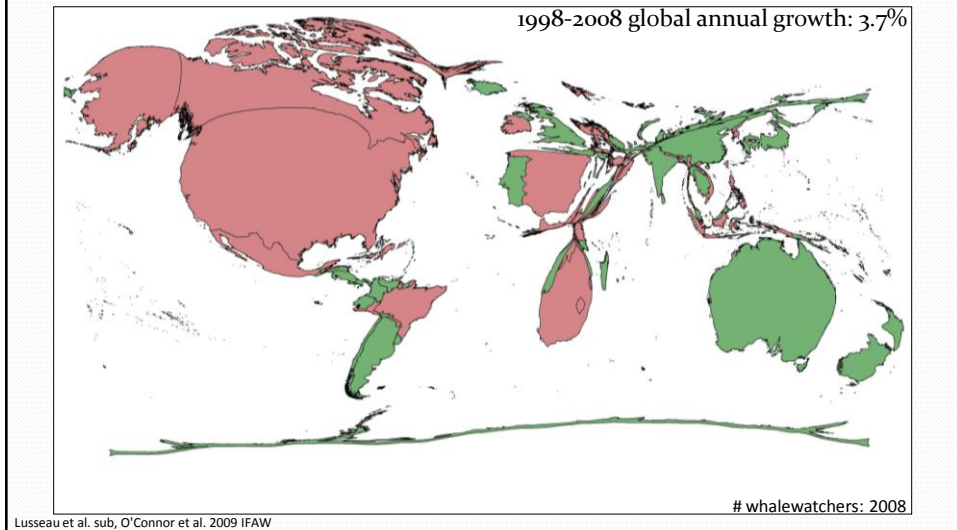
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# Population consequences of whalewatching disturbances on cetaceans

David Lusseau, Rob Williams, Fredrik Christiansen, Lars Bejder



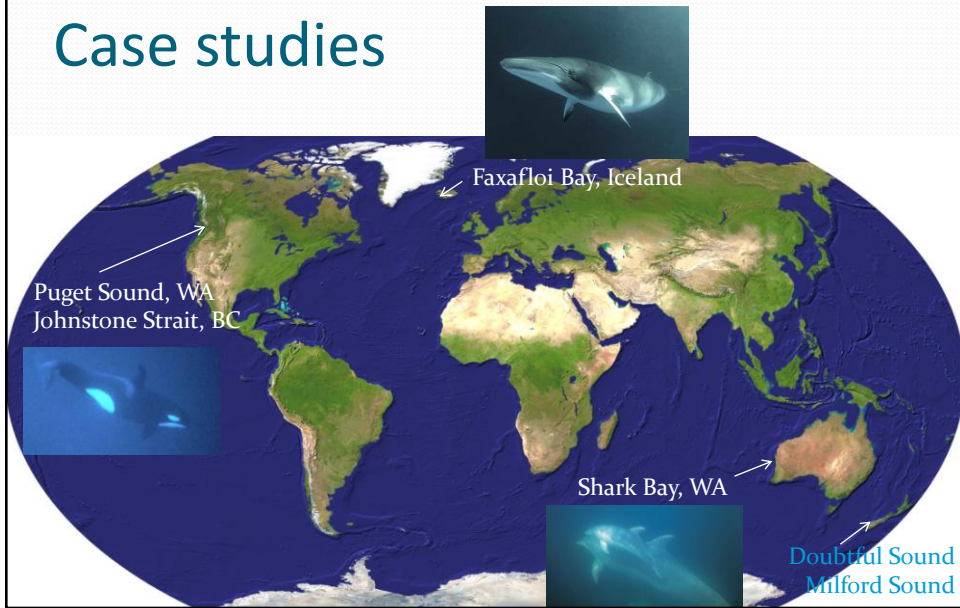
## Where whalewatching takes place



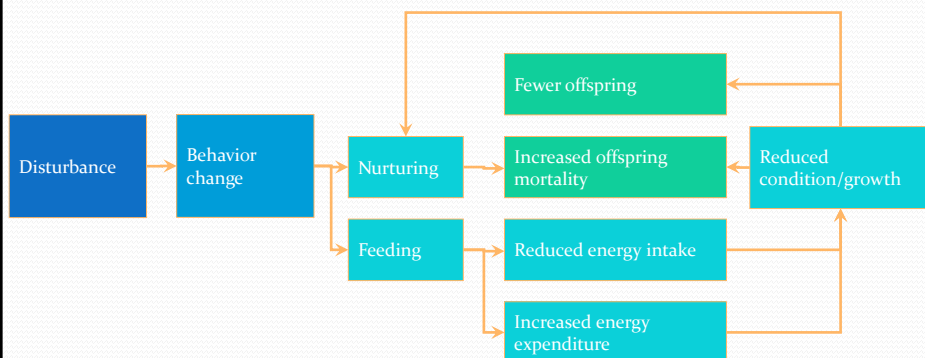
## Range of interactions



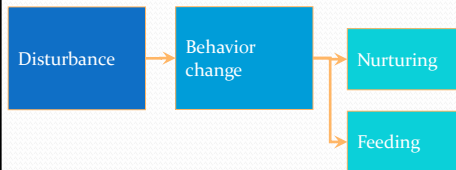
## Case studies



## PCAD model – coastal bottlenose dolphins



## PCAD model – coastal bottlenose dolphins



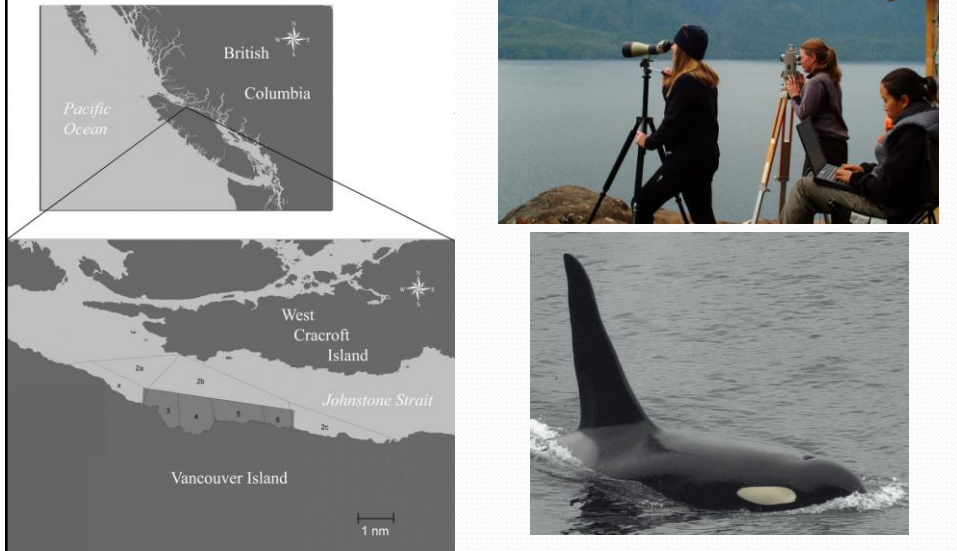
## Disrupted activity budget

- Fiordland **bottlenose dolphins**: significant changes in activity budget
  - ↑ travelling
  - ↓ resting
  - ↑ travelling bout duration
- **Minke whales**: foraging disruption on feeding grounds
- **Killer whales**: feeding disruption
  - ↓ energetic gain > ↑ energetic demand



Christiansen et al. 2011 IWC/62/WW2; Lusseau 2003 Cons Bio; Lusseau 2004 Eco Soc; Lusseau 2004 MEPS; Williams et al. 2006 Bio Cons; Lusseau et al 2009 ESR

## Pacific Northeast killer whales



## Boat interactions are incorporated as a risk factor in the population's landscape

- Effect is tuned to boat type



Lusseau et al in prep; Williams et al. In prep; Williams et al. 2011; Williams et al. 2006; Lusseau et al. 2009

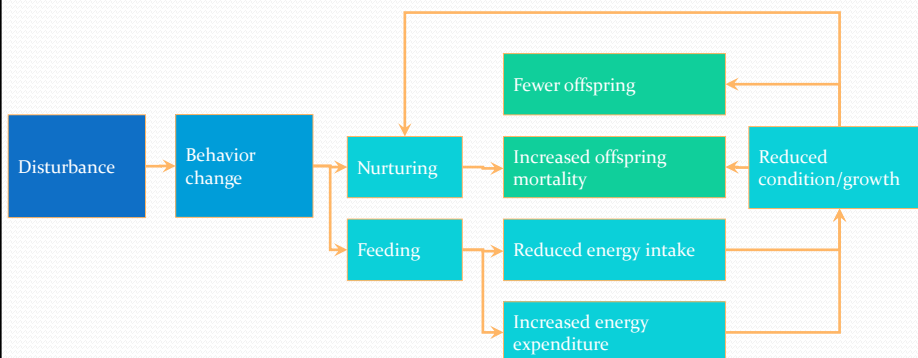
## Effect size varies with prey availability

Killer whales, Robson Bight: 1995-2004



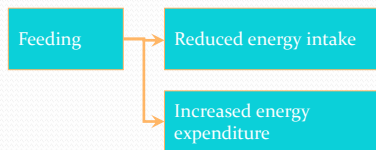
Lusseau et al in prep; Williams et al. 2011

## PCAD model – coastal bottlenose dolphins

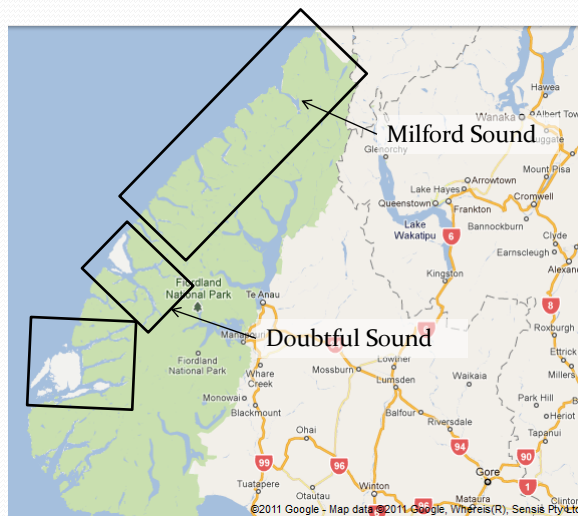




## PCAD model – coastal bottlenose dolphins

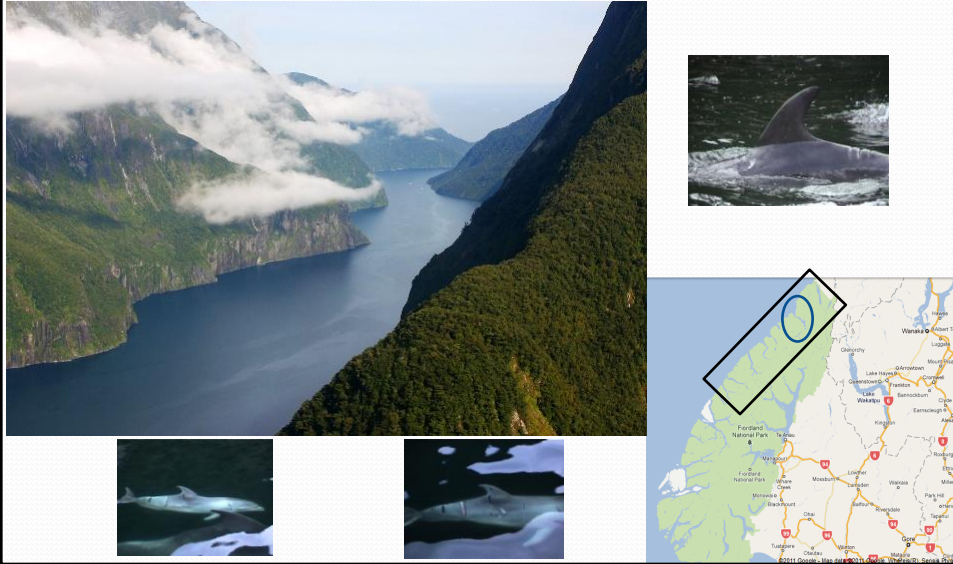


## Fiordland, New Zealand

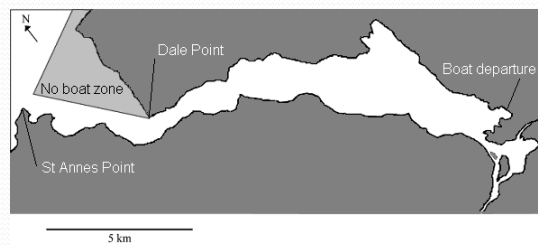
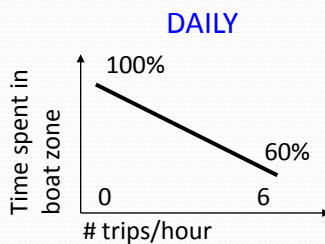
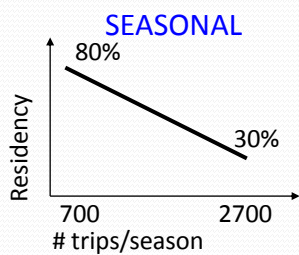




## Fiordland: Milford Sound



### Threshold in Milford Sound: habitat abandonment

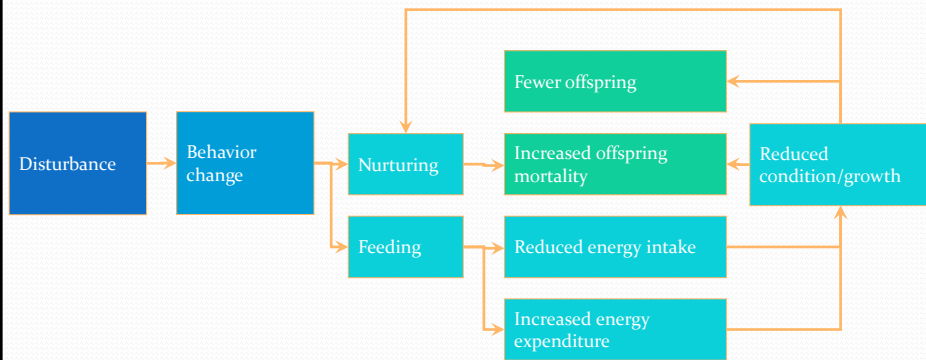


If time elapsed between boat interactions < 70min then leave

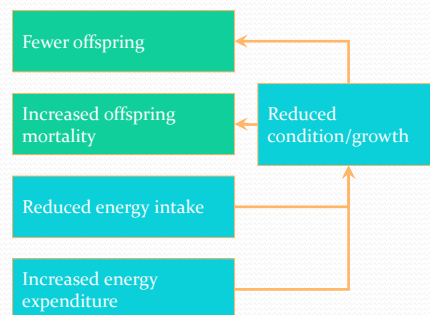
Lusseau 2005 MEPS, Lusseau 2004 Eco Soc, Lusseau et al. 2006 TIME



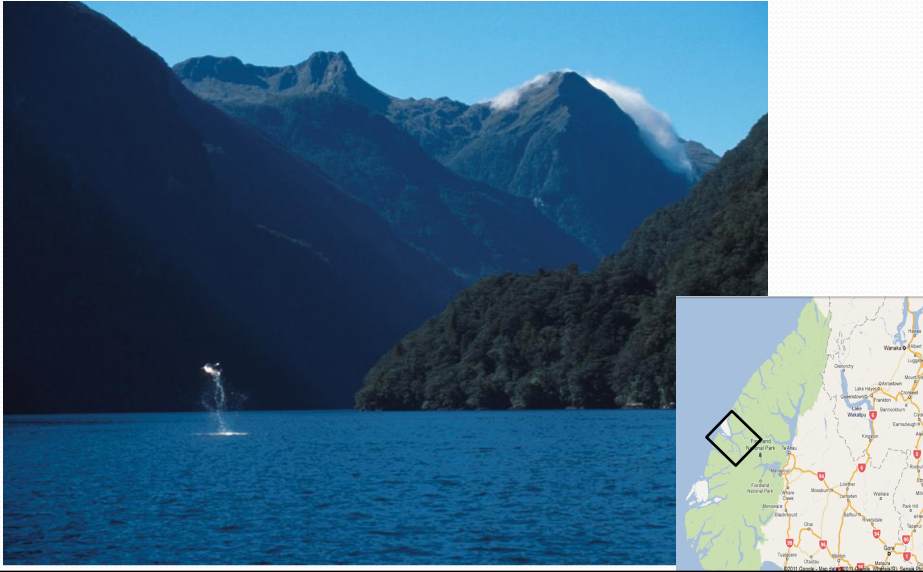
## PCAD model – coastal bottlenose dolphins



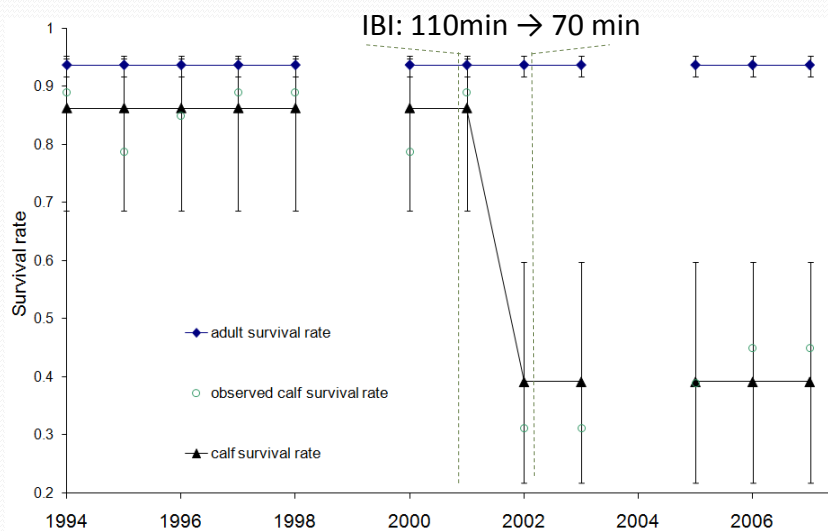
## PCAD model – coastal bottlenose dolphins



## Fiordland: Doubtful Sound

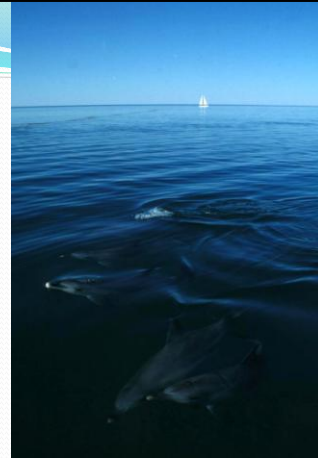
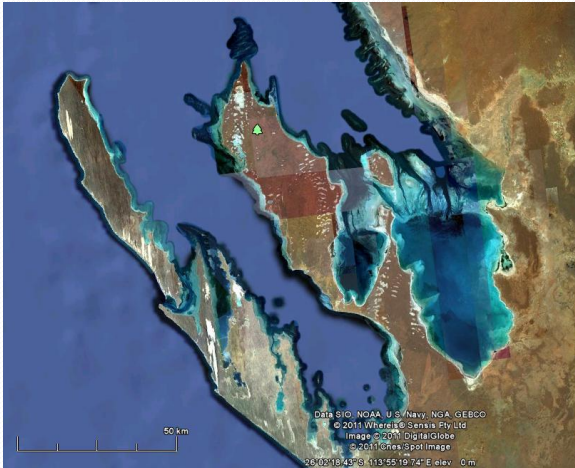


## Reduced calf survival

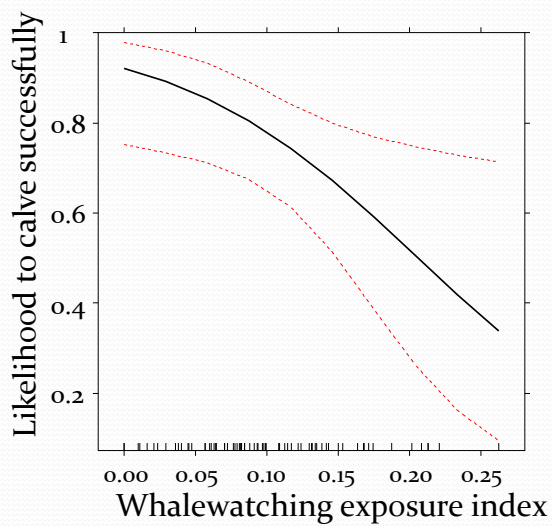


Currey et al 2011; Currey et al. 2007 P Con Bio; Currey et al. 2008 Aq Cons; Currey et al. 2009 Bio Cons; Lusseau et al 2006 TIME; Lusseau 2004 MEPS

# Shark Bay

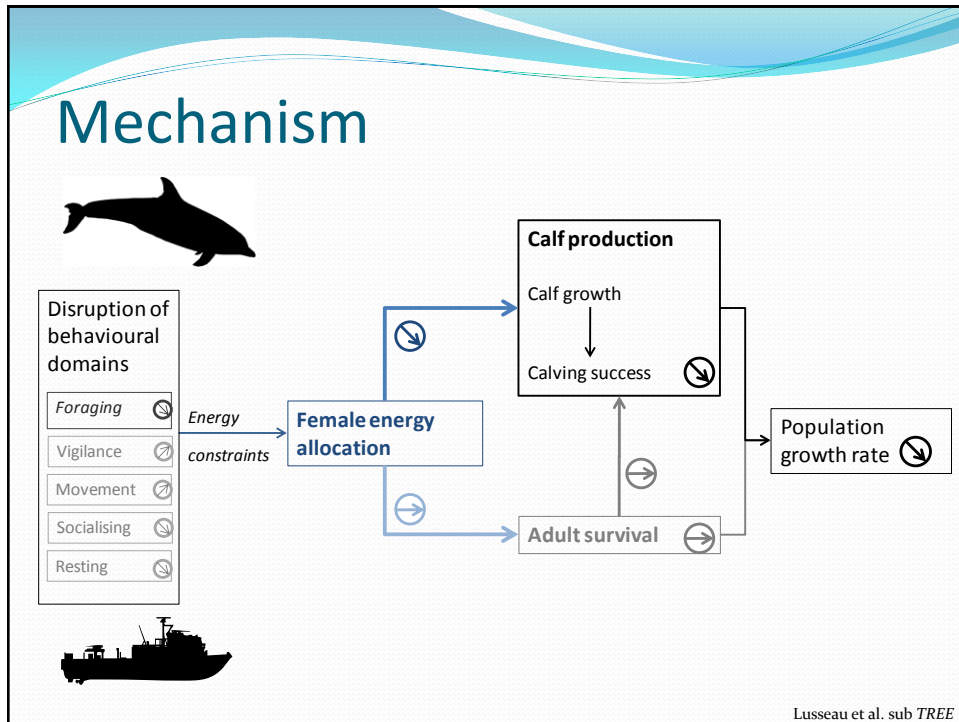


## Calving success of individual females Shark Bay



Bejder 2005.





## Sustainable disturbance management

- Whalewatching is an excellent way of making use of whale and dolphin resources because of its potential associated direct and indirect benefits.
- While it does not have a direct lethal effect on cetacean populations, disturbances can still consume that resource.
- Challenge: the pathway to population consequences is not via adult female survival.
- Most coastal cetacean populations are exposed to tourism. Let's not get it wrong.