The impact of quota changes on the discrete fishing site choice of vessels in Irish demersal otter trawl fisheries

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Background

- In the last 30 years, particularly the second half of that period, a number of studies have analysed fishermen's fishing related choices/behaviour
  - E.g. Bockstael and Opaluch (1983/4); Ward and Sutinen (1994); Curtis and Hicks (2000); Mistiaen and Strand (2000); Smith (2005); Eggert and Tevertas (2004); Valcic (2008).
- These approaches:
  - Employ discrete choice econometric methods
  - Investigate how various biological, economic and regulatory changes affect the:
    - choice of fishery, entry exit decision, fishing location choice, gear choice etc.

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Background

- Significant and tangible uses:
  - Informs fishery managers of possible behavioural responses to policy measures, economic and biological events
  - Can guide fishery managers away from achieving success in a fishery in one instance but enduring pitfalls down the road (Texas closure: Ward and Sutinen, 1994)
    - Increased finfish bycatch and interaction with marine turtles
    - No understanding of what is driving choices/behaviour
  - If negative behavioural responses are foreseen, they can be dealt with pre-emptively rather than after the fact

The Research Focus

- The behavioural component being analysed in this study is location choice. Why?
  - Fishing gear in mixed species fisheries can be non-discriminatory
  - By-catch is then largely unavoidable *if* fishing takes place
  - It will vary however, based on *where* fishing takes place, if species harvest composition is location dependent (Davie and Lordan, 2011)
  - Due to benthic habitat variation, depth variation etc.

The Research Focus

- A barrier to studying fishing location choice in the past has been the difficulty of recording vessel location while fishing.
- Past examples either:
  - Involved time and cost intensive recording processes that were not applicable to routine fishing practice
    - (e.g. Eales and Wilen, 1986; Curtis and Hicks, 2000; Mistiaen and Strand, 2000; Valcic, 2008).
  - Analysed a fishery where discrete fishing locations were clearly defined and easily observable
    - (e.g. Dupont, 1993; Smith, 2005)
  - No clear definitions of discrete fishing locations while ‘at sea’

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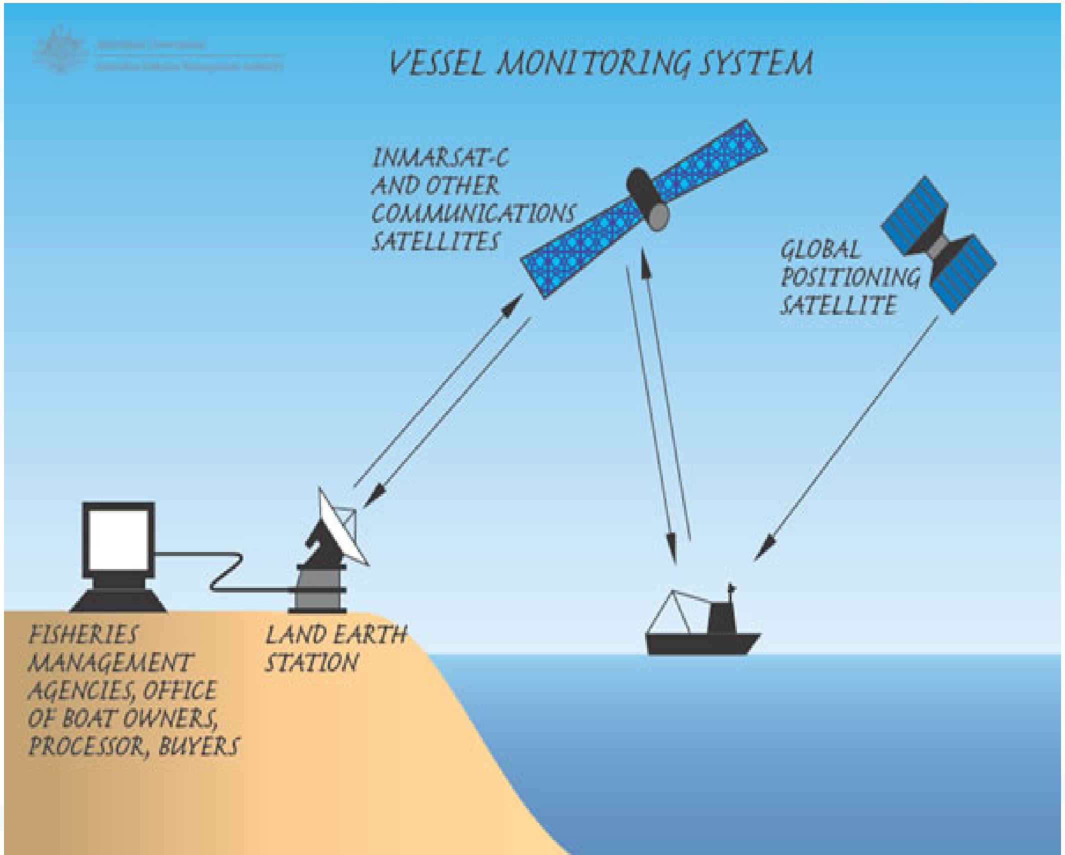
VMS data

- Vehicle Monitoring Systems
  - Vessels positional data recorded every two hours during every fishing trip made
  - Travel speed rule can be used to differentiate fishing activity from other at sea activities (Gerritsen et al. 2012)
  - Combined with electronic logbook data, this allows for the creation of a detailed map of the spatial distribution of species catches



Source: National Geographic

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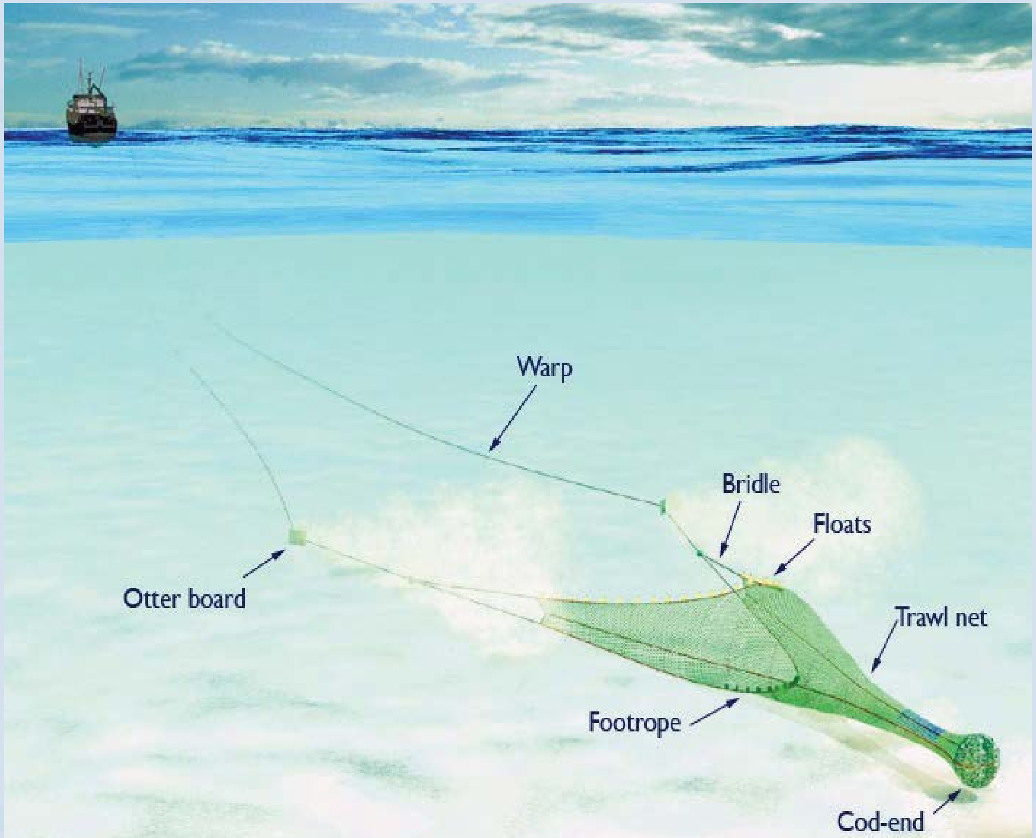
The Fishery

- Irish Demersal Otter Trawl Fleet
- 101 vessels in 2009
- Target demersal species that dwell on the sea floor
- Vessel lengths range from 15m – 40m but usually
- Account for 80% of fleet landings
- Highly mixed species fishery (Davie and Lordan, 2011)
- Species examples
- By catch a major issue



Source: Irish Marine Institute

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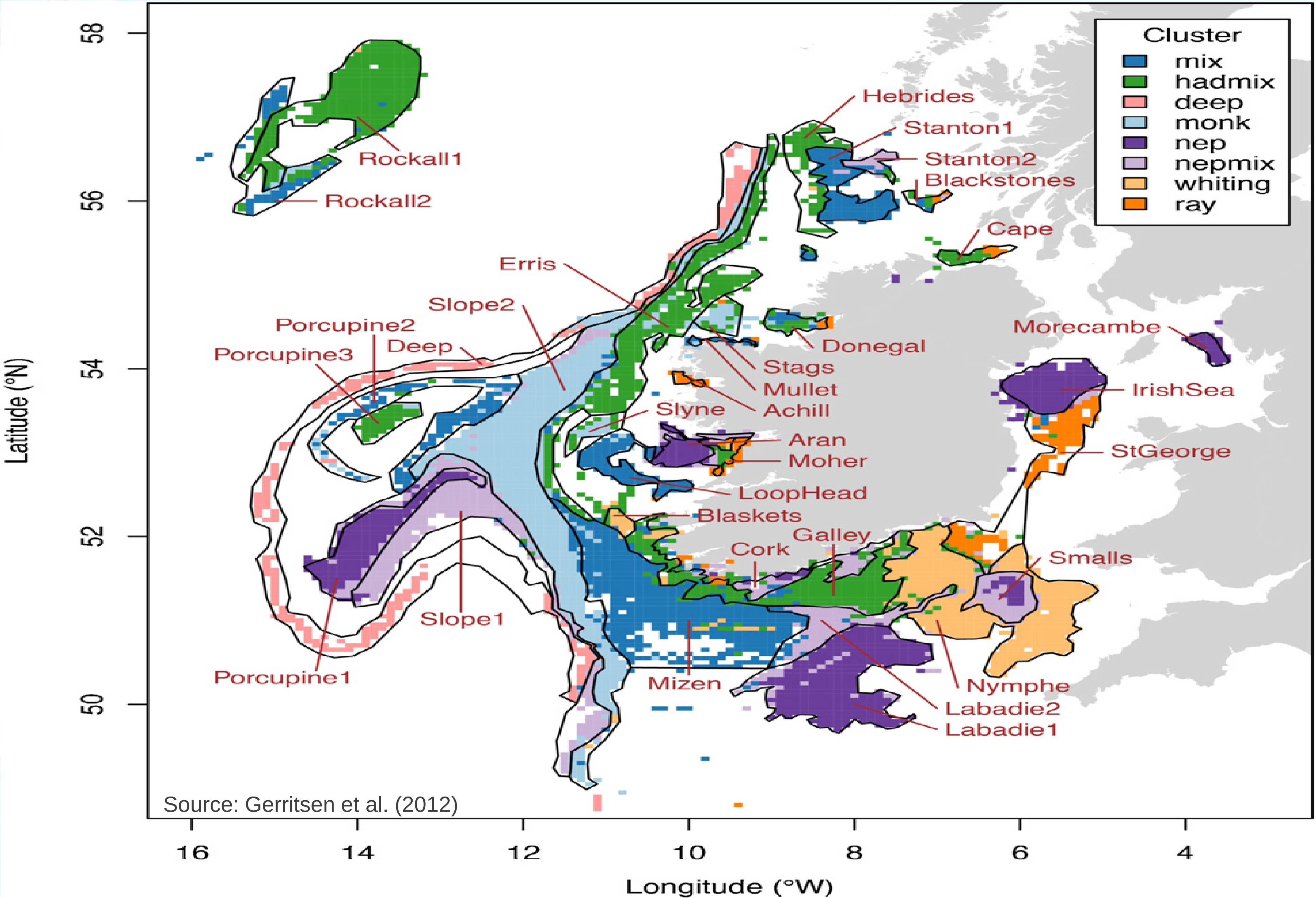
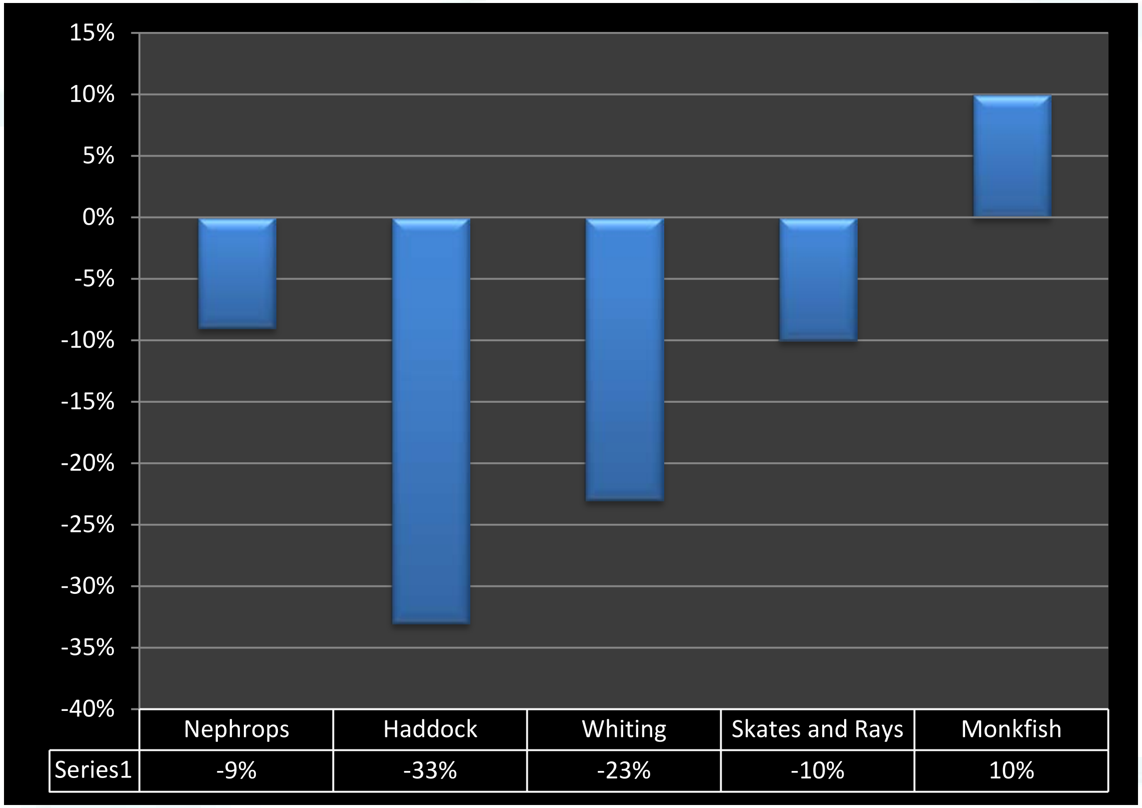
Discrete location alternatives (34)



Source: Gerritsen et al. (2012)

Research question

- How will a proposed set of species quota changes effect the fishing location choice of vessels in the fishery?
- 2014 quota changes at time of writing (Brussels fisheries council meeting, 2014)



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Discrete Choice Model

- The RUM approach models the site choice from among a set of alternative fishing grounds as a utility-maximizing decision:

$$U_{njt} = V_{njt} + \varepsilon_{njt}$$

- Fisher *n* chooses location *i* from the set of *J* alternatives for trip *t* when $U_{nit} > U_{njt}\ \forall j \neq i$
- Probabilities:

$$P_{nit} = Prob(U_{nit} > U_{njt} \forall j \neq i)$$

$$Prob(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt} \forall j \neq i)$$

$$= \int_{\varepsilon} I\left(\varepsilon_{njt} - \varepsilon_{nit} < V_{nit} - V_{njt}\right) f(\varepsilon_{nt}) d\varepsilon_{nt}$$

Conditional Logit Model

	Coef. Est.	Std. Err.
Model Variable		
DIST	-0.0012263*	0.0000791
CODKG	0.0000071*	0.0000014
DEEPKG	-0.0006173*	0.0000494
HADKG	0.0000084*	0.0000009
HKEHG	-0.0000066*	0.0000010
MEGKG	0.0000026*	0.0000005
MONKG	0.0000124*	0.0000011
NEPKG	0.0000009*	0.0000001
RAYKG	0.0000126*	0.0000013
POKKG	0.0000123*	0.0000011
WHGKG	-0.0000013*	0.0000002
OTHERKG	-0.0000188*	0.0000027
Goodness of Fit		
Number of observations		205,564 (6,046 trips x 34 location-alternatives)
Log likelihood function (LL(β̂))		-17,728.779
Restricted log likelihood		-21,320.376
Chi-squared		7,183.15
LR Chi-squared (12) 1-LL(β̂)/LL(0)		0.16846

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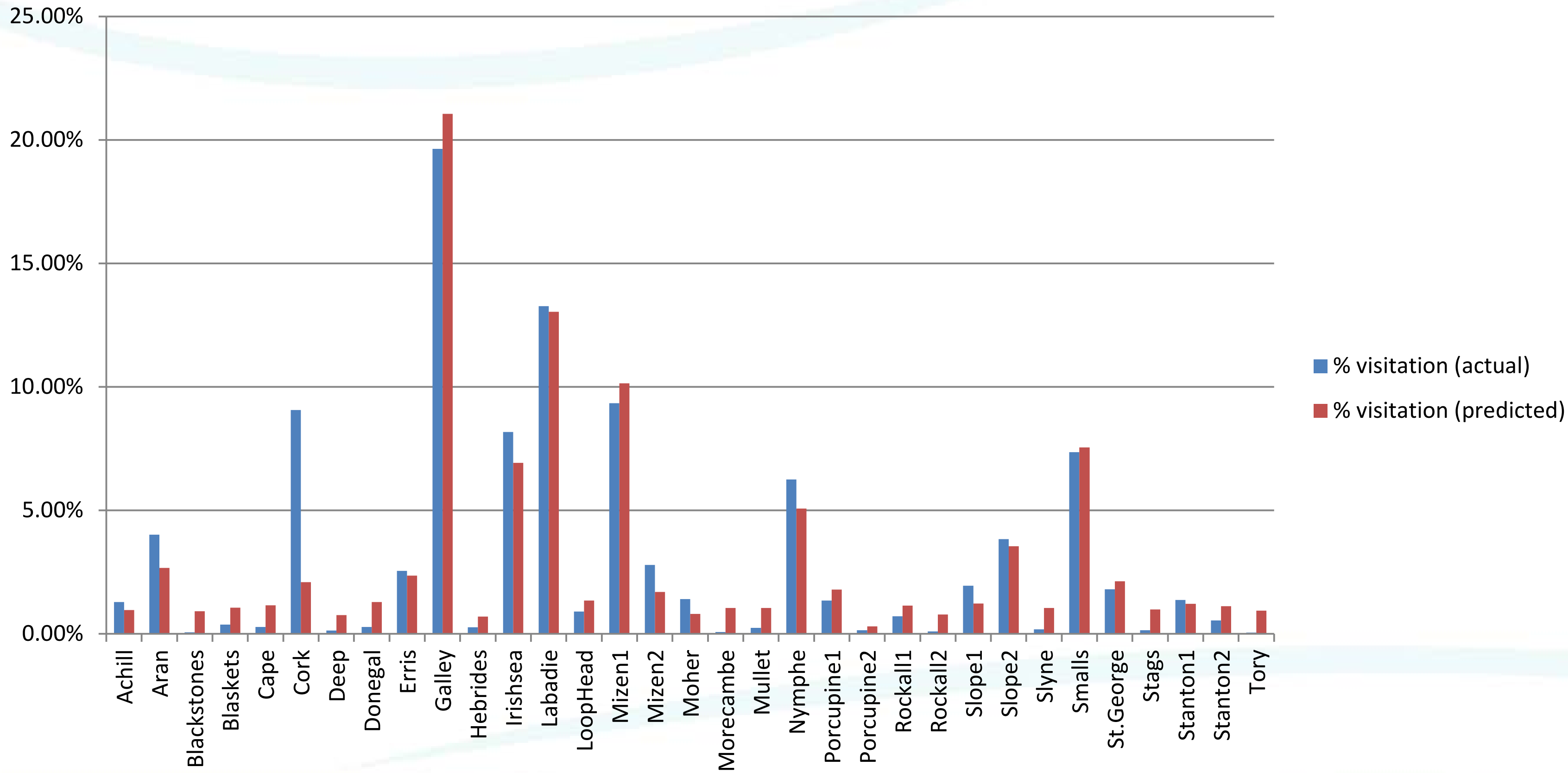
Accuracy of Cond. Logit Model

Actual and predicted percentage share of trips to each site for sample period



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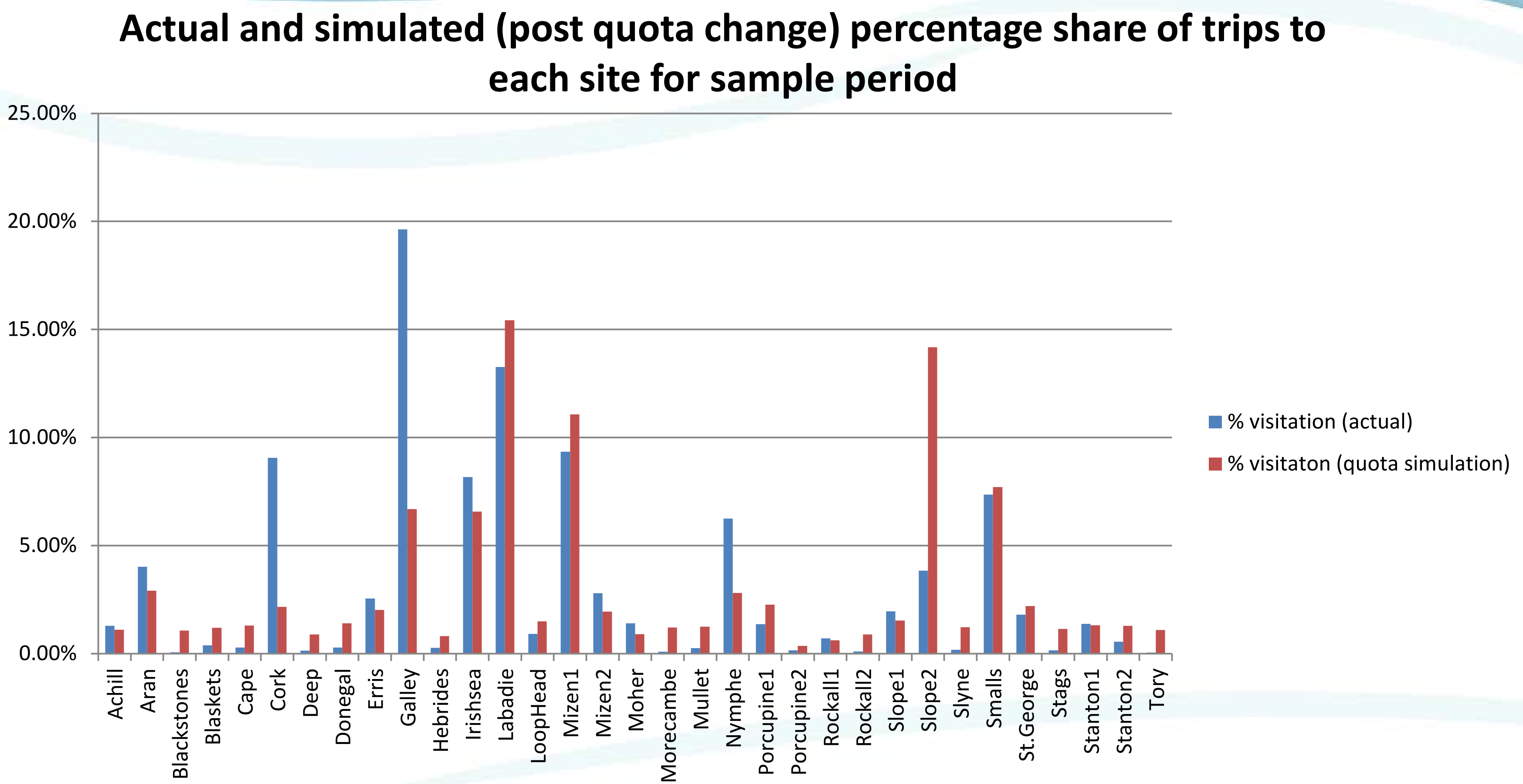
Impact of quotas on site choice



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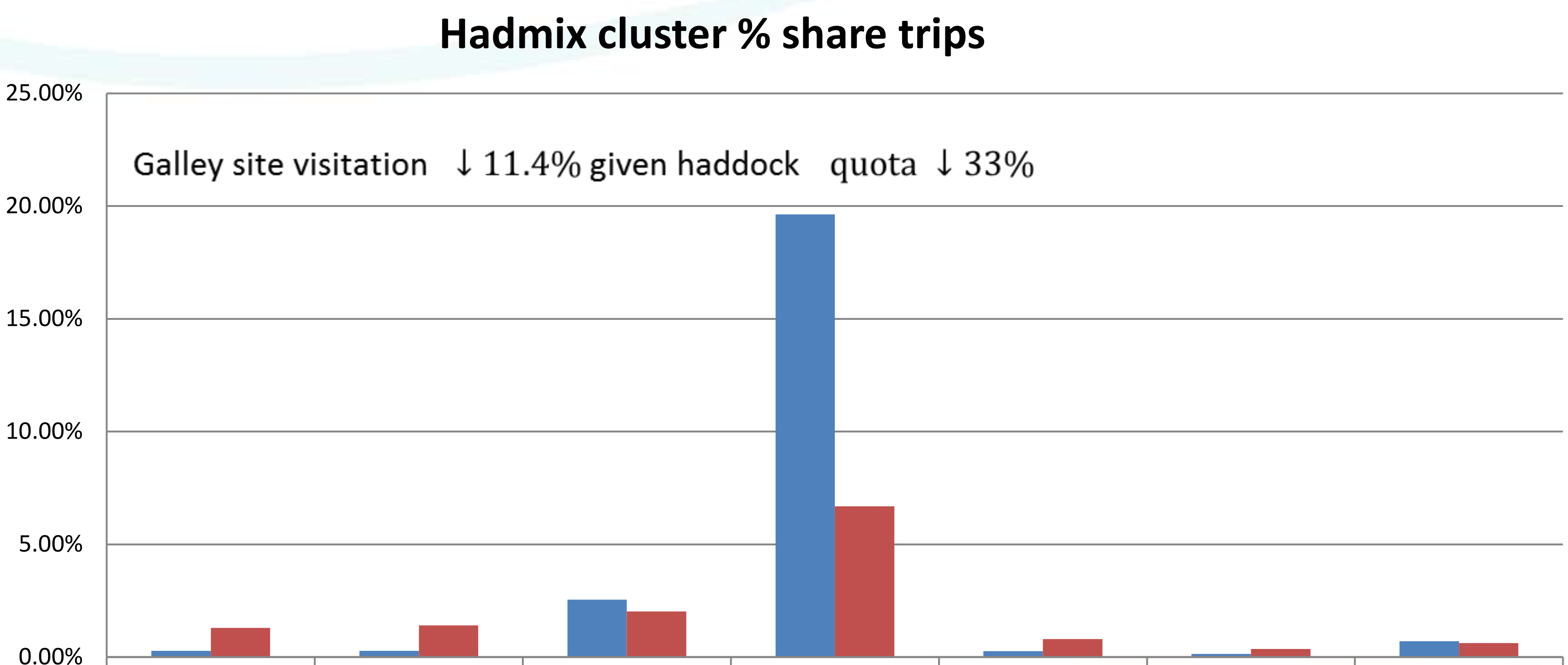
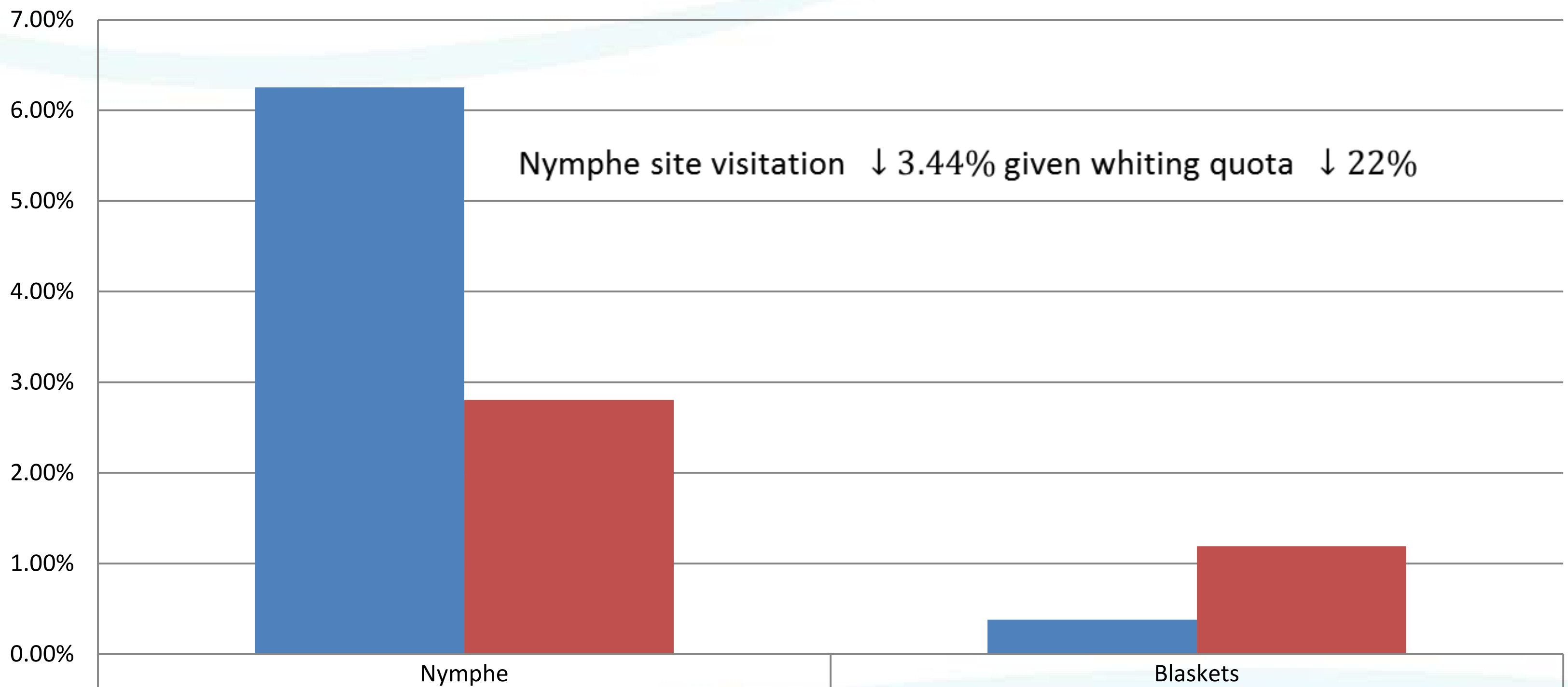
Impact on haddock dominant areas



	Cape	Donegal	Erris	Galley	Hebrides	Porcupine2	Rockall1
Actual % share	0.28%	0.28%	2.55%	19.63%	0.26%	0.15%	0.71%
Simulated % share	1.30%	1.40%	2.02%	6.69%	0.81%	0.36%	0.62%

Impact on whiting dominant areas

Whiting cluster % share of trips



	Nymphe	Blaskets
Actual % share	6.25%	0.38%
Simulated % share	2.81%	1.19%

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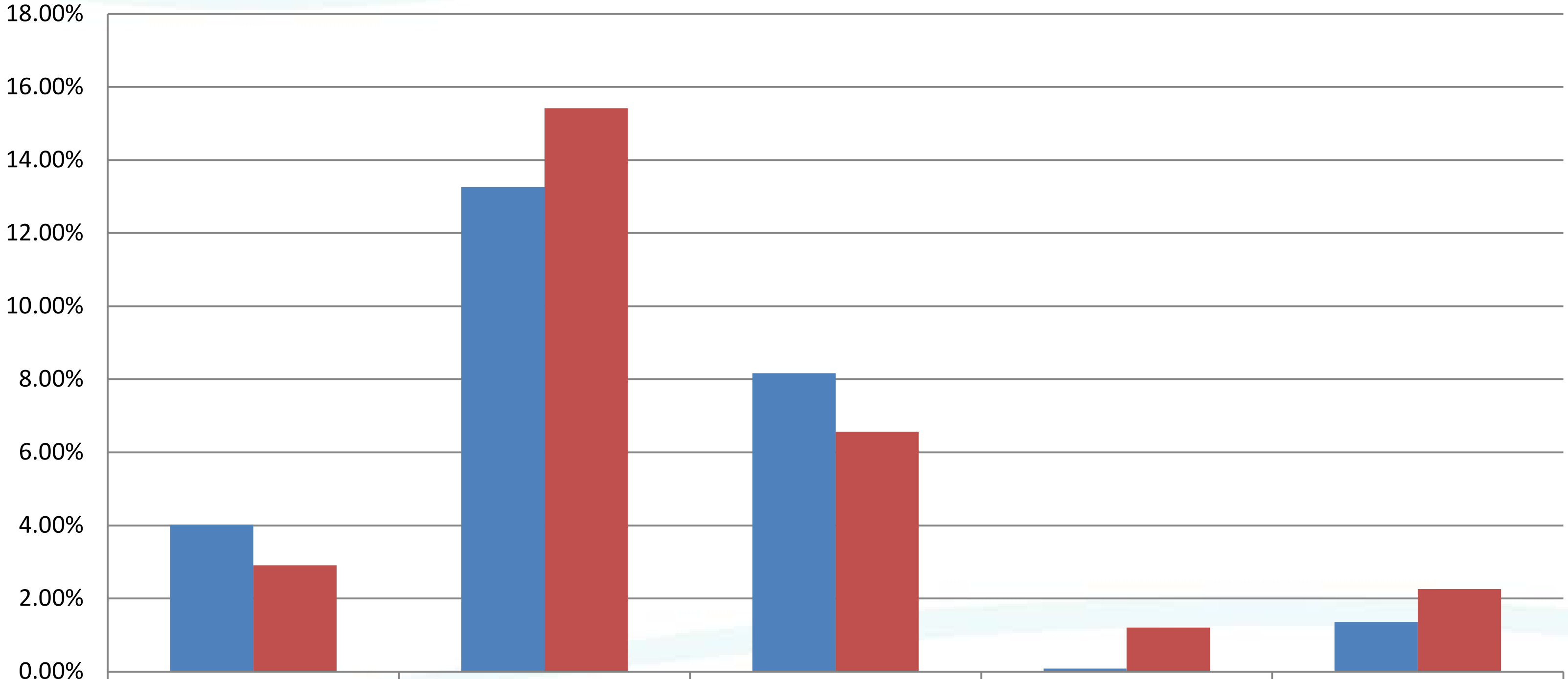
Impact on nephrops dominant areas

Nephrops cluster % share of trips



	Aran	Labadie	Irishsea	Morecambe	Porcupine1
Actual % share	4.02%	13.26%	8.17%	0.08%	1.36%
Simulated % share	2.91%	15.42%	6.57%	1.21%	2.26%

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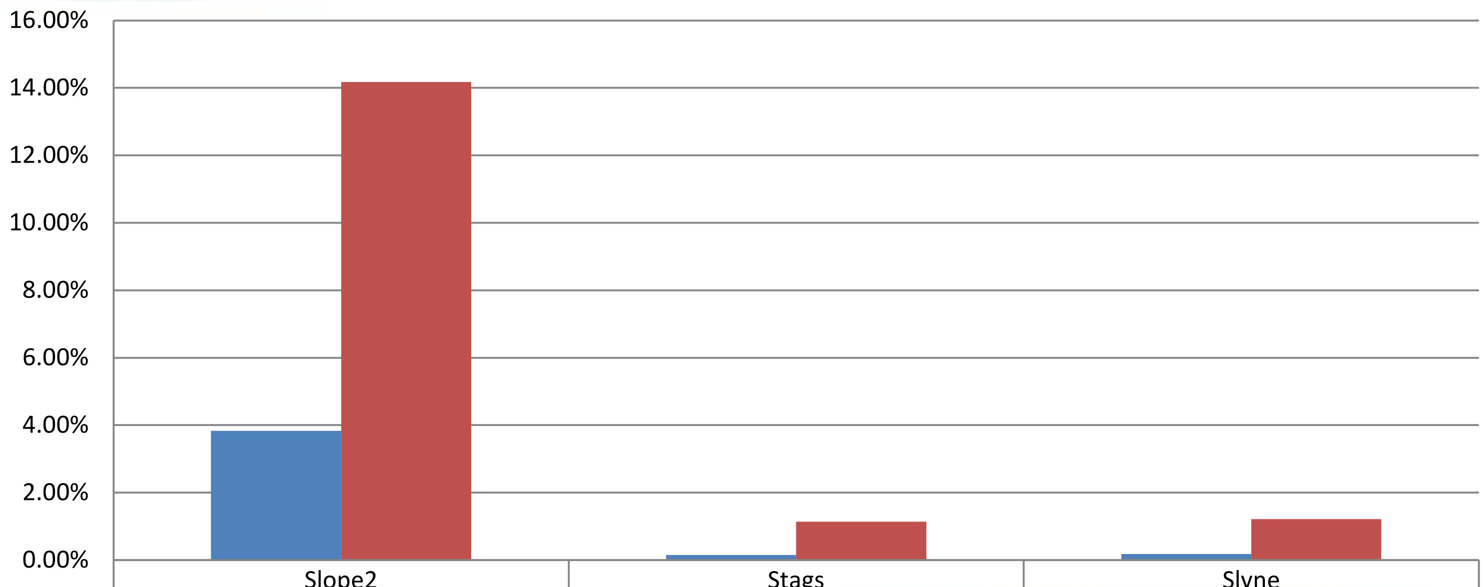
Impact on monk dominant areas

Monk cluster % share of trips



	Slope2	Stags	Slyne
Actual % share	3.84%	0.15%	0.18%
Simulated % share	14.18%	1.14%	1.22%

Impact of quotas on by-catch levels

- Next step is to estimate changes in bycatch rates given the predicted changes in the percentage share of trips to each site
- This will be a case of applying the estimated relationship between effort and bycatch (Shepard et al., 2014) of various species to the before and after cases and calculating the change

Conclusions

- Changes in location choice correspond to changes in quota of species by which locations are categorised
- Potential behavioural changes can inform managers about potential changes in by-catch levels or other location dependent negative externalities
- VMS data is already routinely collected for fishing vessels and coverage is increasing so methodology could be routinely applied to evaluate behavioural impact of various changes in fishery regulation methods (e.g. creation of marine protected areas)
- Improved data collection and estimation of negative externalities per unit of fishing effort (e.g. interaction with marine mammals) would improve potential usefulness of any such analysis
- Better data on fisher characteristics and site characteristics will benefit such analysis
- Highlights the usefulness of using economic theory to evaluate behavioural impacts of management measures in the short term, not only for determining optimal rates of resource extraction

Thank you

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