



Australian Government  
Fisheries Research and  
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**IMAS**  
INSTITUTE FOR MARINE AND  
ANTARCTIC STUDIES



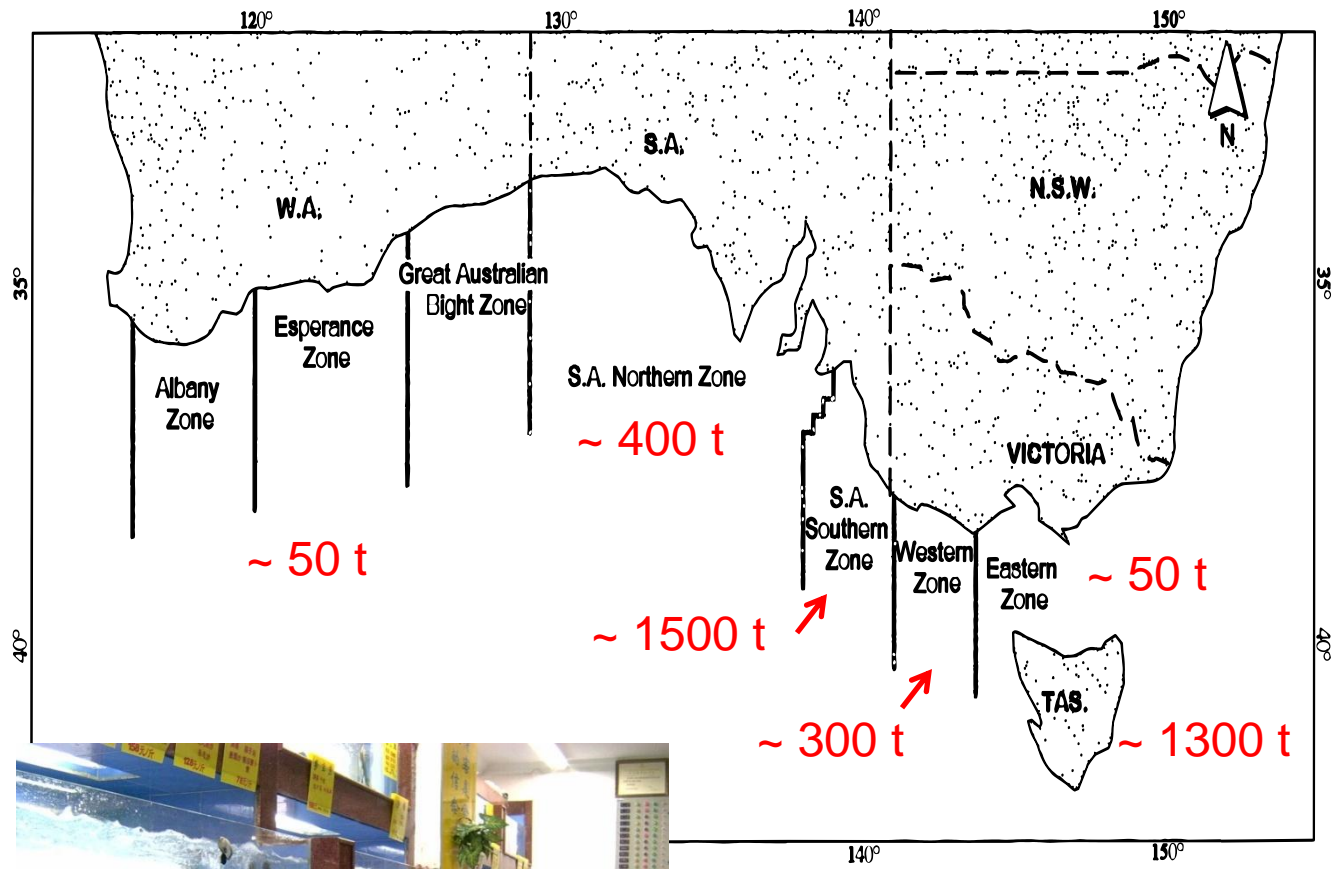
Tasmanian  
Rock  
Lobster  
Fishermen's  
Association  
Ltd



# Application of bioeconomic modelling in the management of southern rock lobster

Caleb Gardner, Klaas Hartmann, Bridget Green, Andre Punt, Ingrid van Putten, and the SPOC





# ITQs in State Fisheries

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- 43% national seafood production by gross value in 2007/08 was from State managed ITQ fisheries for abalone and rock lobster
- many additional smaller ITQ fisheries not included in this total (eg in Tas – giant crab, flat oyster, Venerupis clam, banded morwong, ~scallop)
- almost universally, TAC setting in state managed fisheries do not utilise economics

# ITQs in State Fisheries

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ITQs introduced with aim of increasing economic yield and business stability

Input controls relaxed to reduce costs

Quota is set with guidance from ???

# TACC setting remains an arm wrestle...

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Management trying to constrain catch in relation to reproductive “sustainability” performance measures (egg production, biomass, CPUE thresholds)

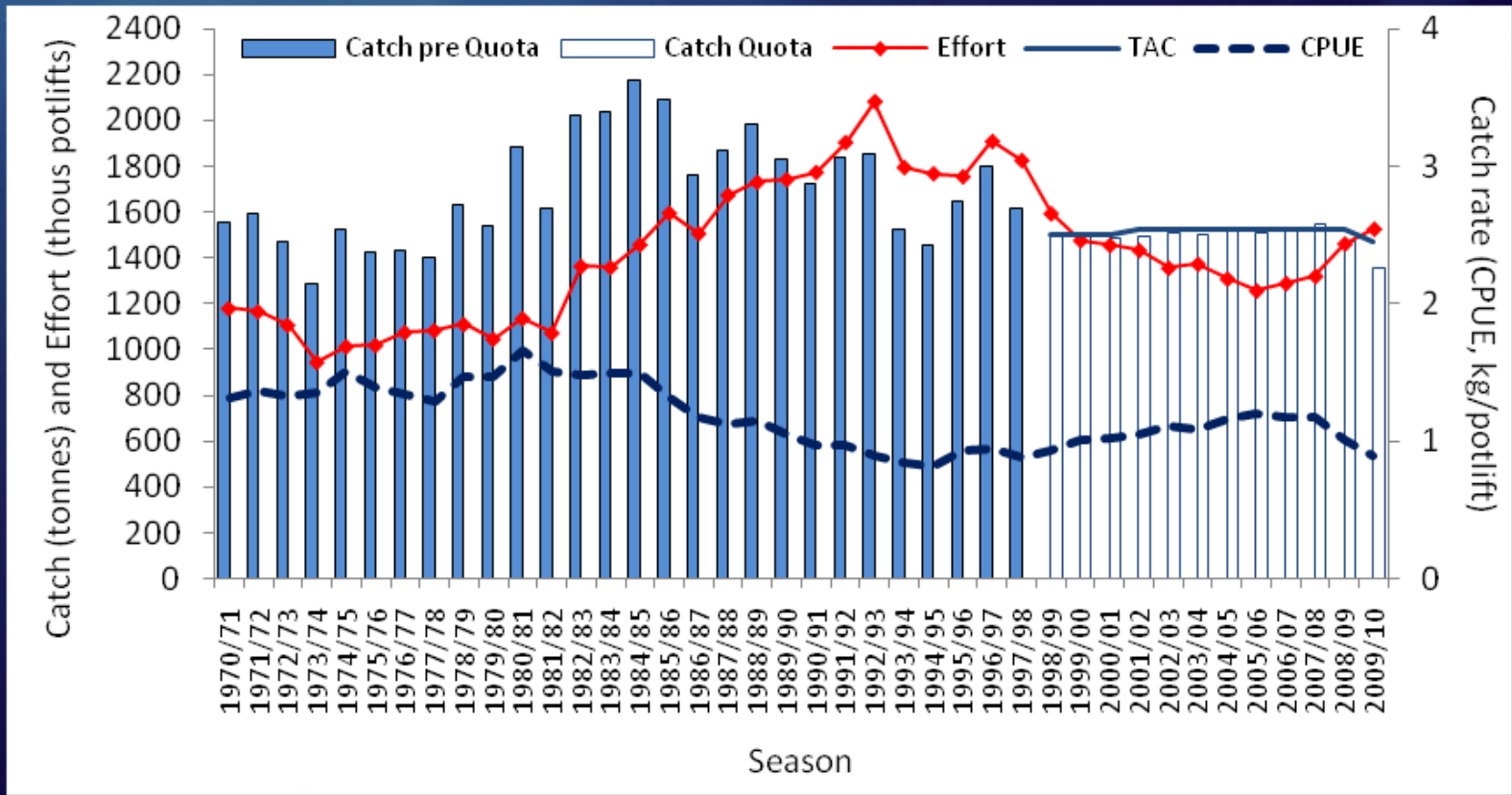
VS

Commercial sector pushing for larger TACCs

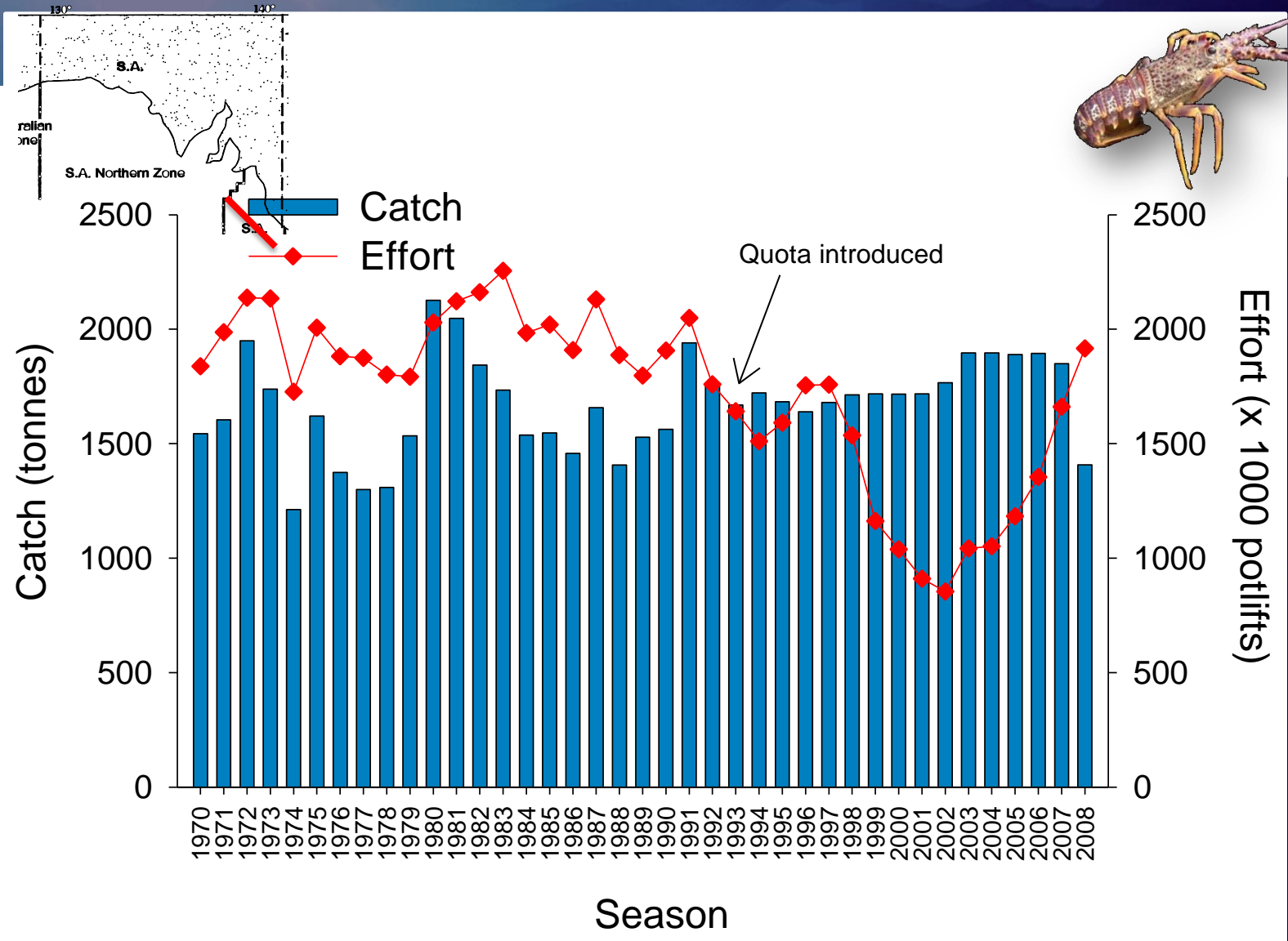
(...and compounded in unpredictable ways by recreational, indigenous and non-extractive lobbies)

# ..so TACC are pushed up fast and pulled back slowly

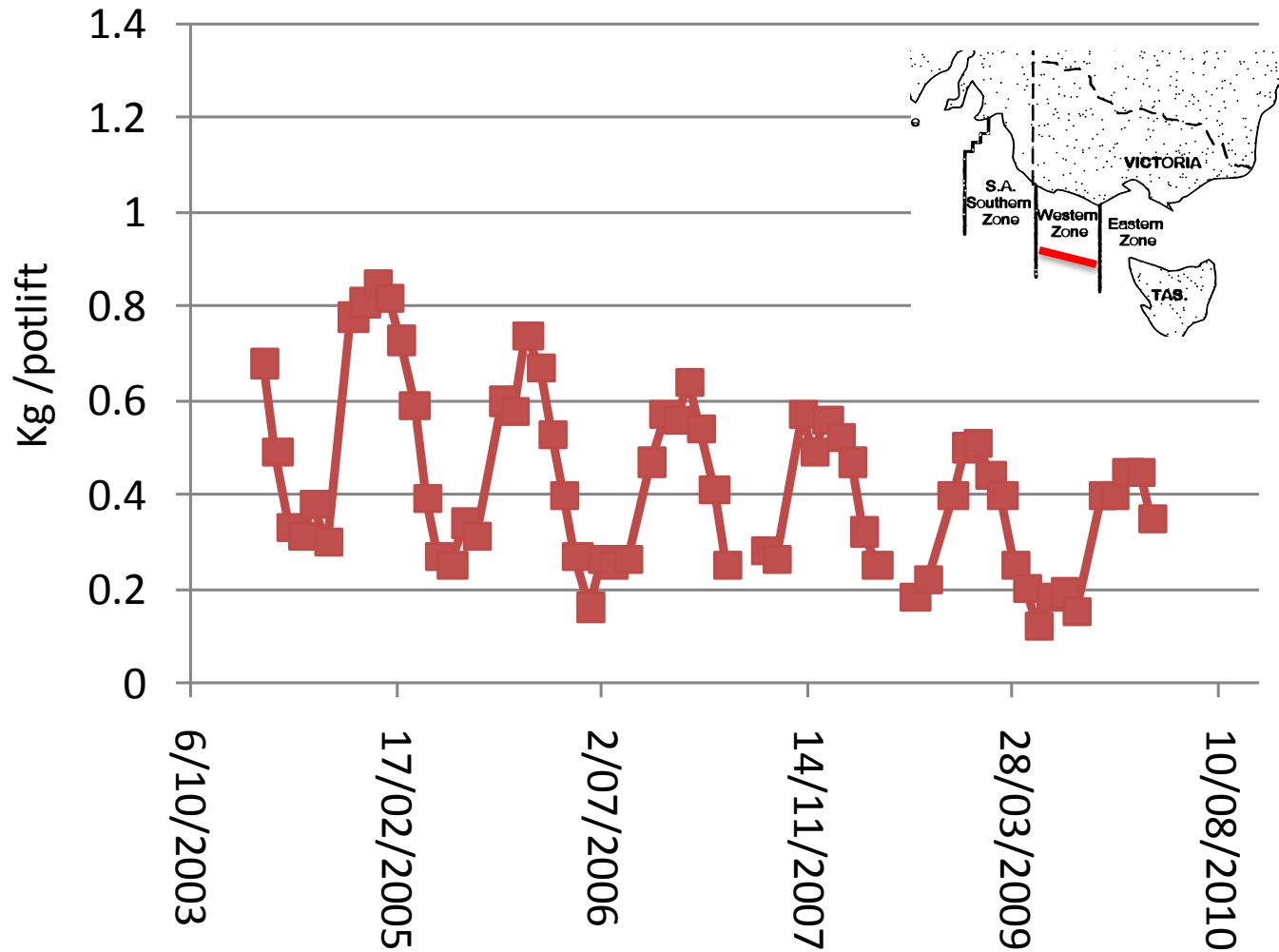
In Tasmania, TACC increased in 2002 as a “reward”, but not lowered despite poor assessments from 2006-2009



# South Australia, southern zone



# Victoria, western zone



# Why TACC setting remains an arm wrestle...

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1. Equity of quota owners is mobile
2. Fishers have a high discount rate
3. Fishers focus on revenue, not profit
4. Effect of TACC on revenue is more tangible than effect on cost
5. Industry peak bodies can represent both quota owners and fishers, with various (weird) vote systems
6. Weak stock effect on costs (of quota owner)
7. Benefits from stock rebuilding undermined by MPAs and recreational policy
8. Variation in costs (ability) within the fleet
9. Focus on the wrong objectives of Acts and Policy



# Why TACC setting remains an arm wrestle...

## 9. Focus on the wrong objectives of Acts and Policy

### **South Australia Fisheries Management Act 2007**

- 1. Protection of the resource from over-exploitation and ensuring that the resource is not endangered**
- 2. Optimum utilisation of the resource and equitable distribution of the benefit to the community**
- 3. Fostering recreational and commercial fishing activities for the benefit the whole community**

# The point here is...

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Large portion of Australian fisheries production utilise ITQs,  
ostensibly to manage economic yield

but

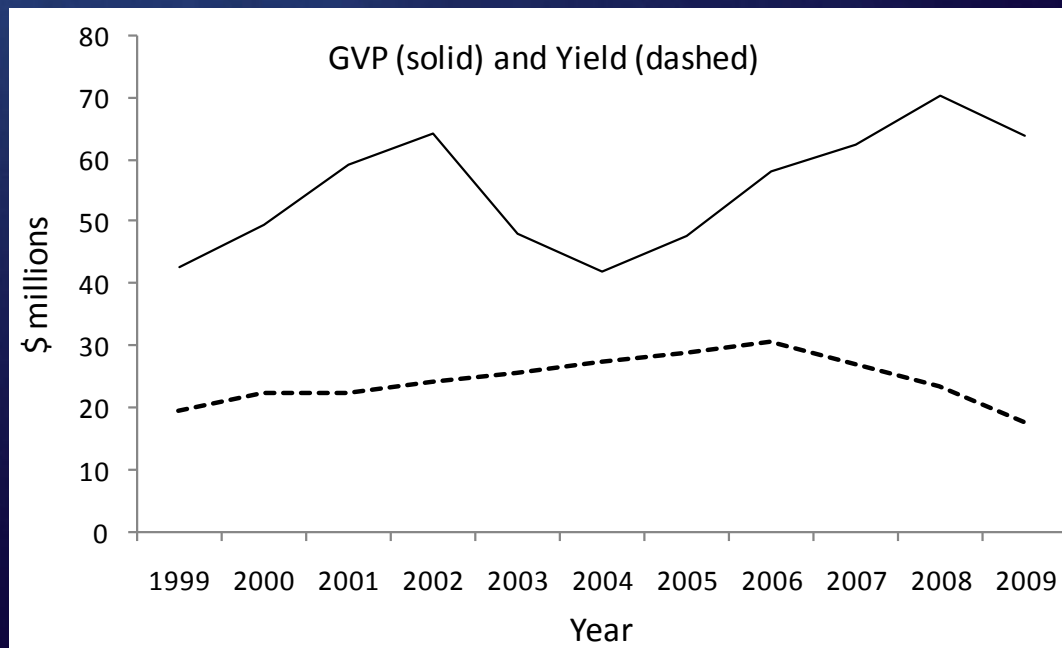
this isn't supported by formal economic research / guidance

and

autonomous processes of TACC optimisation rarely work

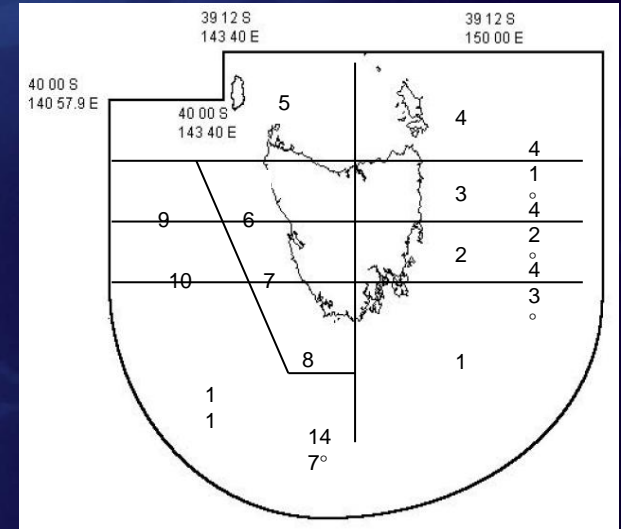
# Bioeconomic modelling in Tasmania

1. Wanted stock rebuilding to reduce exposure to recruitment
2. Wanted to restore value of quota units
3. Less concern about number of operators
4. Industry asked for economic analysis of fishery (by vote !)
5. Either apply the quota system or get rid of it...



# Used length/sex based bioeconomic model ...

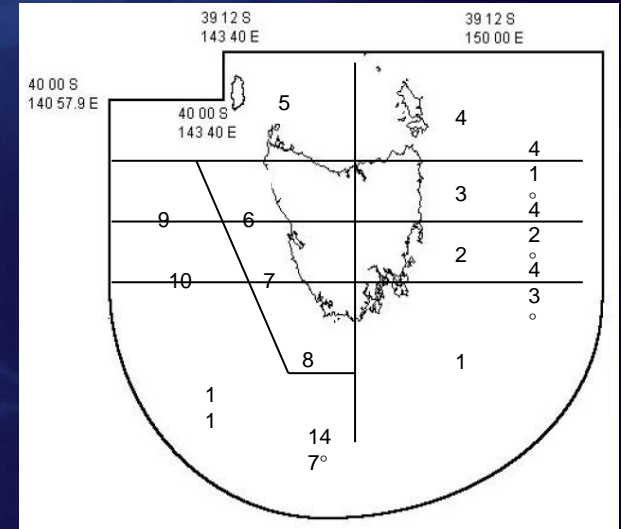
1. Spatially (11 areas) and temporally (8 periods p.a.) structured
2. Number of animals of each sex in 5 mm size bins specified taking account of natural mortality, fishing mortality and growth
3. Objective function had contributions from catch, catch rate (kg / potlift), average weight, and length frequency data with maximum likelihood estimation



$$N_{y,i+1,l}^{s,z} = \sum_{z'} Y_i^{s,z,z'} \left[ \sum_{l'} X_{l',l,i}^{s,z'} N_{y,i,l'}^{s,z'} e^{-Mt_i} \{1 - \tilde{H}_{y,i,l'}^{s,z'}\} + \Omega_i^{s,z'} \Phi_l^s R_y^{z'} \right]$$

# Harvest strategy evaluation by model projection

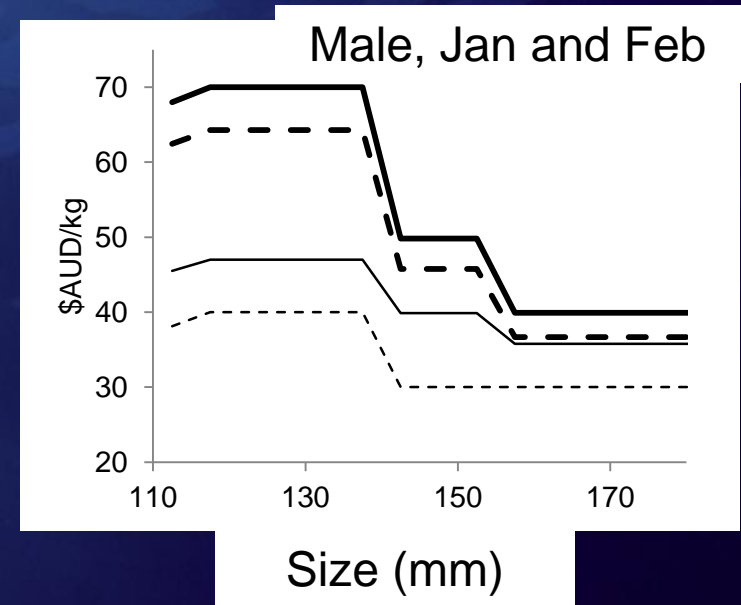
1. Assumed constant estimated illegal and recreational catch and distribution (also constant biology and no SRR)
2. Specified size of commercial catch (TACC) and distributed spatially by effort dynamic model (in response to CPUE)
3. Recruitment by region drawn randomly from that estimated over the last decade



# Cost and price data

1. Price varied by region, size, sex and period (from processor invoices)

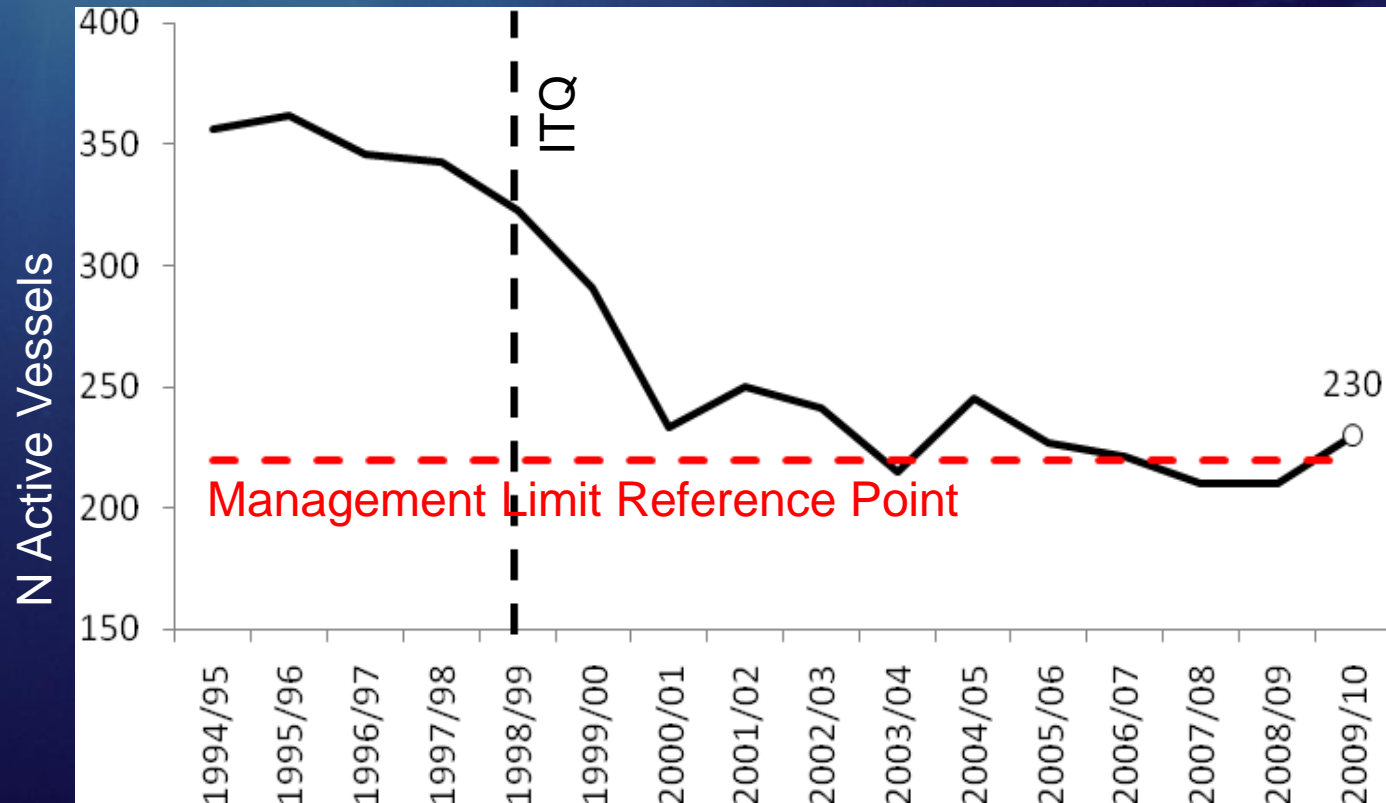
2. Costs from survey, hooked into model via potlifts (so projections are long run) , constant by period



Area	1	2	3	4	5	6	7	8	9	10	11
Cost / potlift	\$34.19	\$34.19	\$34.19	\$33.70	\$33.70	\$33.63	\$33.63	\$33.63	\$33.26	\$33.26	\$33.26

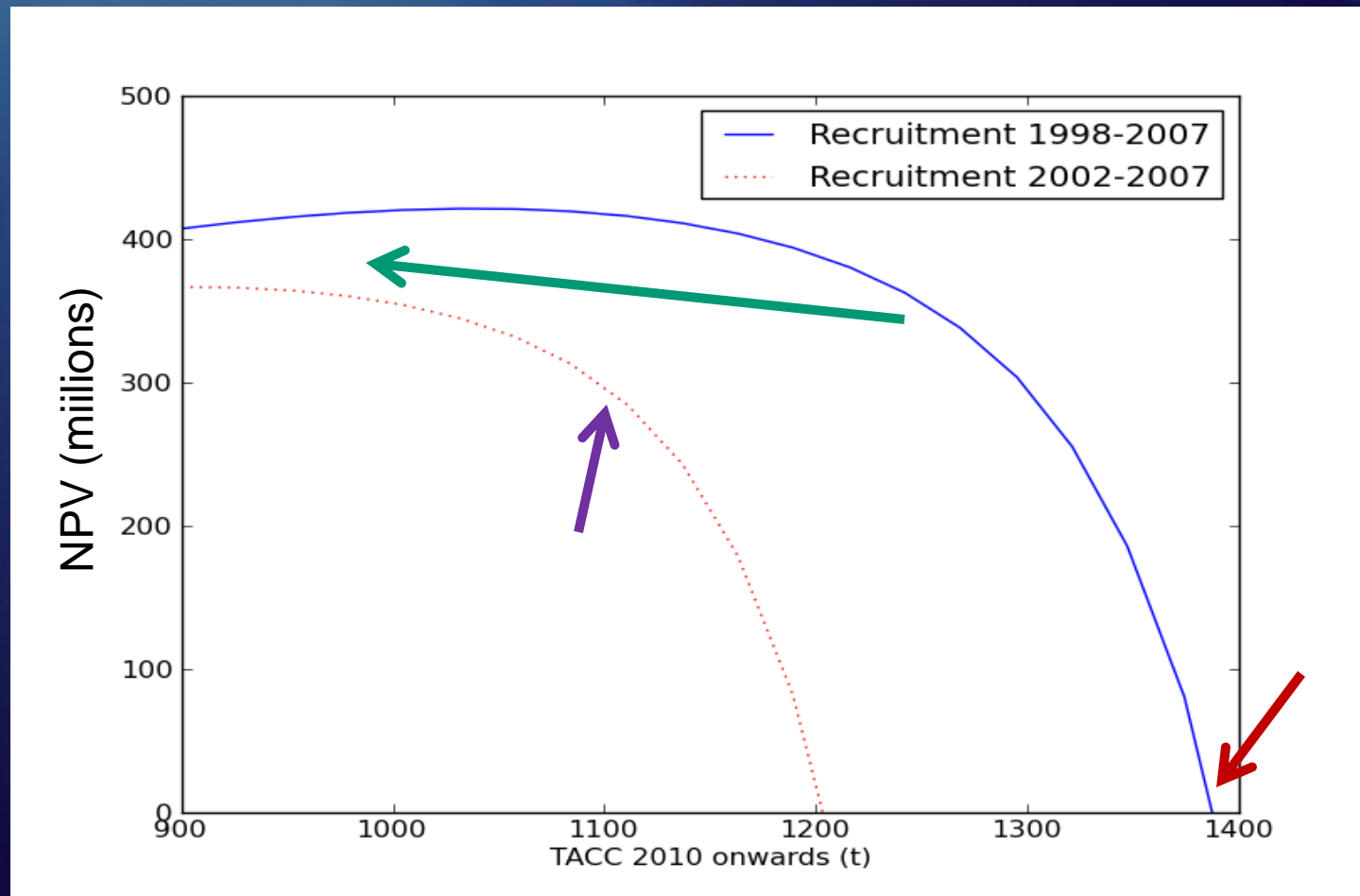
# Cost and price data

...projections are long run... but vessel number is dynamic and responds to CPUE



# Economic yield

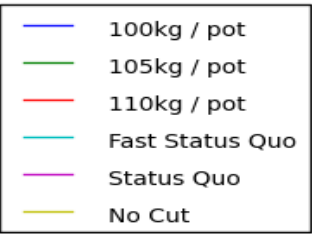
Scenario 1. effect of different levels of recruitment (good/bad vs only bad).



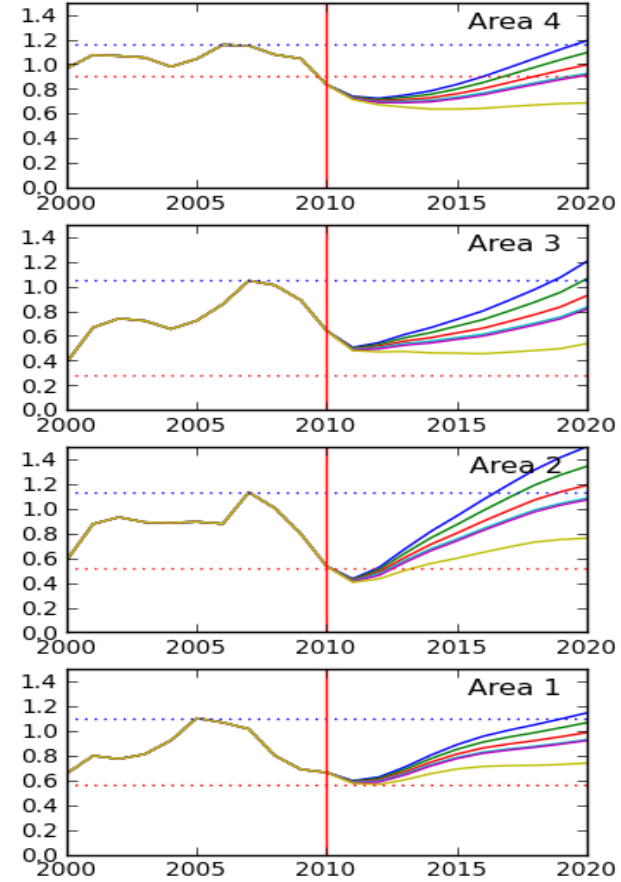
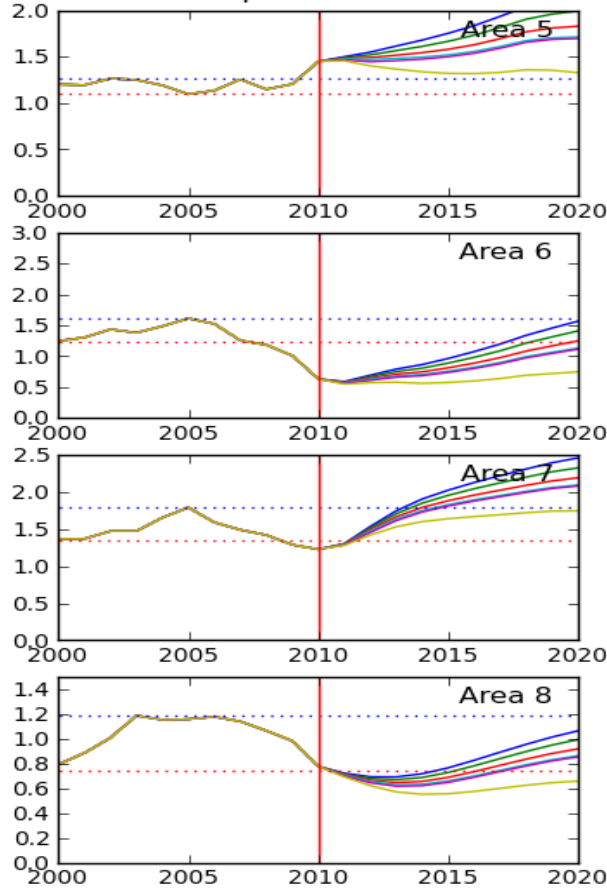
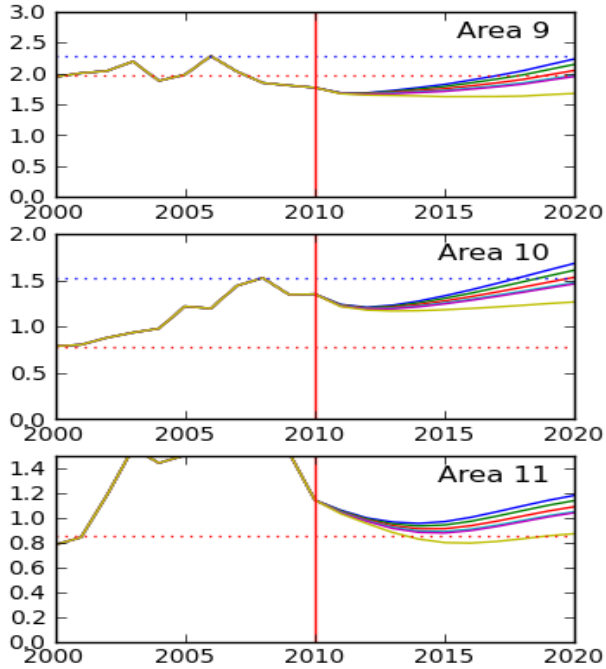
# Industry use CPUE as a proxy for an economic target reference point

Target of 1.3 kg/potlift led to industry recommending TACC cuts ..from 145 kg / unit to 105 kg/unit

State-wide CPUE	Status Quo	110 kg / pot	105 kg / pot	100 kg / pot
2010	0.87	0.87	0.87	0.87
2011	0.78	0.79	0.80	0.81
2012	0.77	0.80	0.82	0.84
2013	0.79	0.84	0.87	0.91
2014	0.82	0.88	0.93	0.98
2015	0.87	0.93	1.00	1.07
2016	0.92	0.99	1.07	1.15
2017	0.97	1.06	1.15	1.24
2018	1.03	1.12	1.23	1.33
2019	1.08	1.18	1.29	1.41
2020	1.12	1.22	1.35	1.48



### Catch per Unit Effort



1998-2007 Recruitment Time Series (10 y)

Area	No Cut	Status Quo	Fast Status Quo	110kg / pot	105kg / pot	100kg / pot
1	82	94	94	96	97	99
2	58	81	85	88	92	97
3	75	93	95	97	99	100
4	7	13	14	18	28	31
5	76	94	94	96	100	100
6	5	8	8	13	18	22
7	85	97	97	97	98	100
8	4	17	20	24	36	53
9	5	11	14	14	18	22
10	100	100	100	100	100	100
11	21	61	72	85	93	97
State-wide	27	64	66	77	88	<b>96</b>

Probability based performance measures for assessment against policy

# How TACC setting has become less of an arm-wrestle...

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- Engaged industry and managers in economic thinking (eg Master classes)
- Keep asking what do they want from the ITQ system?
- Used the opportunity of recent crash in asset values
- Change came through industry meetings led by industry champions (SPOC)
- Related projects now underway through the AS-CRC on Morton Bay Trawl, Abalone, Southern Rock Lobster, and Western Rock Lobster.

**Need to get more fisheries economics into the decision making process**

