

Assignment problems and economic rent dissipation in quota-managed fisheries

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Managing *People* not *Fish*

- To effectively manage fisheries resources, we need to understand:
 - The biology of the stock
 - The impact of environmental and fishing effects on the stock
 - **The socio-economic behaviour of harvesters**

Quota management (e.g. ITQs)

- Attempt to account for human behaviour in decision-making by providing fishers with a secure, durable catch share which...
 - removes incentives to apply excessive capital and labour in order to maximise catch
 - replaces this with incentives to reduce costs and maximise profit

Quota management (e.g. ITQs)

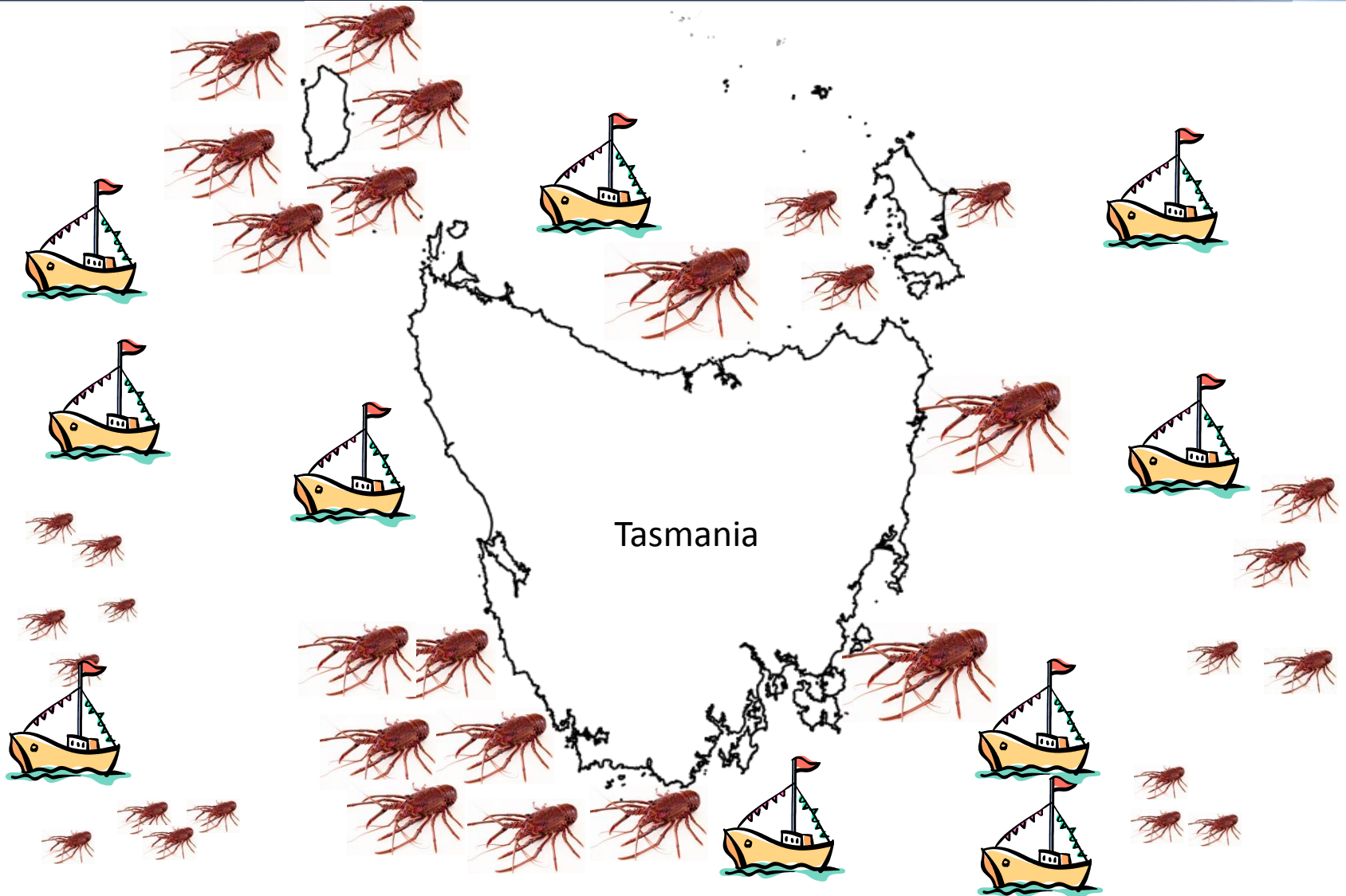
- HOWEVER catch shares don't resolve assignment problems, which may cause localised stock depletion and rent dissipation

What are assignment problems?

- Caused by variation in economic value of quota units due to...
 - Heterogeneity in the temporal and spatial productivity of a stock (e.g. patchy stock distributions)
 - Variation in the proximity of fishing grounds to ports/markets
- Results in competition among fishers for the most valuable portions of the stock, dissipating economic rent







Solving assignment problems

- Full spatial and temporal delineation of quota units
- OR
- Fishers agree to coordinate their effort

Solving assignment problems

- We took an experimental economic approach to investigate
- *Could coordination be achieved among groups of heterogeneous fishers?*
- *Would the presence/absence of communication improve coordination?*

What is Experimental Economics?

- Method of examining human behaviour under controlled (i.e. lab) conditions
- Computer simulation examines alternative policy directives/institutional settings
- Participants make decisions in simulation that impact their final individual and group income
- Can reduce uncertainty in management outcomes by predicting behaviour

Experimental Design

- Modified version of repeated fishery game developed *Cardenas et al., (2013)*
- Computer simulation incorporated key ecological dynamics of the resource and socio-economic environment including:
 - Fisher heterogeneity
 - Non-linear payoffs
 - Path-dependency of previous use

Fisher Heterogeneity

Quota owner



Receive quota
package
each round



Income =
catch revenue



Communication =
if allowed then
always



Lease fishers



Bid for quota
package
each round



Income =
catch revenue –
quota bid price



Communication =
if allowed then only if
have quota package



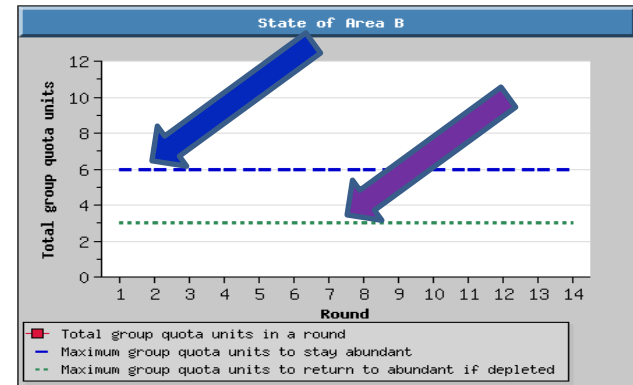
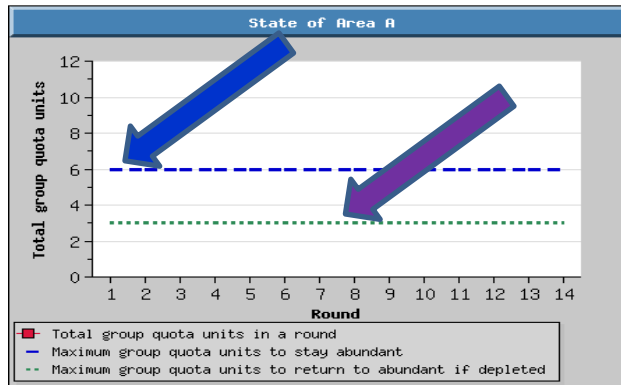
Non-linear payoffs

- Two areas to allocate quota: A and/or B
- Area A more profitable
- Two resource states (“abundant” & “depleted”).
When resource is depleted in A and/or B revenue is reduced

		Area A						
		Abundant			Depleted			
		Units	0	1	2	0	1	2
Area B	Abundant	0	\$ 20.00	\$ 107.00	\$ 200.00	\$ 20.00	\$ 27.00	\$ 50.00
		1	\$ 53.00	\$ 160.00		\$ 53.00	\$ 80.00	
		2	\$ 100.00			\$ 100.00		
	Depleted	0	\$ 20.00	\$ 107.00	\$ 200.00	\$ 20.00	\$ 27.00	\$ 50.00
		1	\$ 40.00	\$ 147.00		\$ 40.00	\$ 67.00	
		2	\$ 75.00			\$ 75.00		

Path-dependency of previous use

- Decisions in round t impact revenue in $t+1$
- Social optimal decision is for all 6 participants to fish 1 quota unit in A and B
- If > 6 quota units allocated to an “abundant” area in t then area becomes “depleted” in $t+1$
- If “depleted”, an area can only shift back to “abundant” if < 4 quota units allocated to area for 2 consecutive rounds.



Experimental summary

		<i>Communication</i>		
<i>Factor</i>		<i>Communication</i>	<i>Non-communication</i>	<i>Definition</i>
<i>Type of fishery</i>	<i>Lease-dominated</i>	3 sessions (12 rounds)	3 sessions (12 rounds)	6 lease quota fishers 2 quota owners
	<i>Owner-dominated</i>	3 sessions (12 rounds)	3 sessions (12 rounds)	3 lease quota fishers 4 quota owners
	<i>Owner-controlled</i>	3 sessions (12 rounds)	3 sessions (12 rounds)	6 quota owners

Session summary

- *Prior to session*
 - Volunteers sought through advertising at university
- *Start of session*
 - Participants randomly allocated either quota owner or lease fisher
 - Participants read instructions and complete quiz
- *During session*
 - 12 rounds in each session involving...
 - Closed-call market for quota package (lease and owner-dominated fisheries only)
 - Fishing decision
- *End of session*
 - Participants are paid their earnings (up to US \$50)

Non-communication treatments

- In all fisheries participants made non-cooperative decisions in order to maximise short-term revenue
- Cyclical pattern of resource depletion and dissipation of economic rent

Probability of non-cooperative decisions (non-communication)

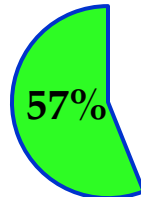
Fishery

Resource state

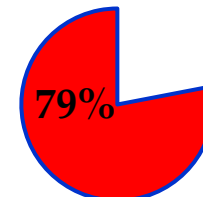
Lease-dominated



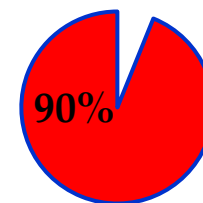
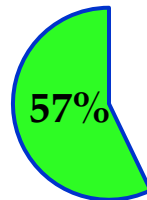
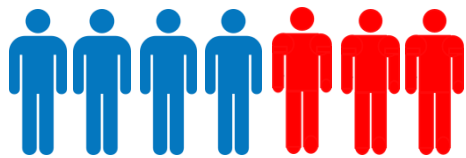
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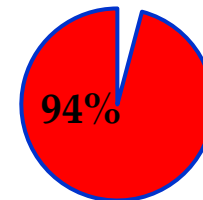
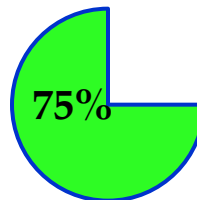
Depl/Depl



Owner-dominated



Owner-controlled



Communication treatments

- Coordination did not significantly improve in either the lease or owner – dominated fisheries
- Coordination significantly improved in the owner-controlled fishery

Probability of non-cooperative decisions (non-communication)

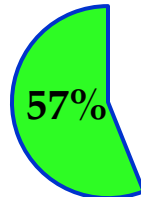
Fishery

Resource state

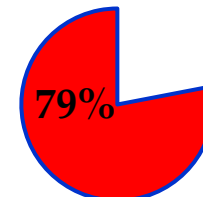
Lease-dominated



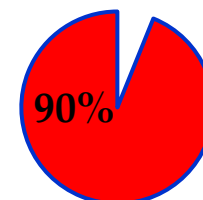
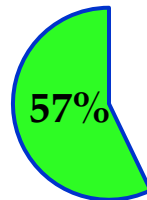
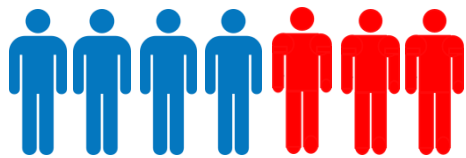
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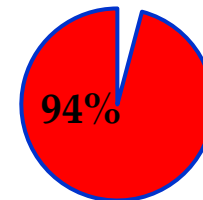
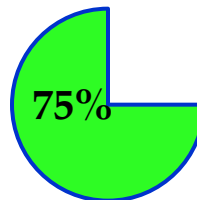
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Owner-dominated



Owner-controlled



Probability of non-cooperative decisions (communication)

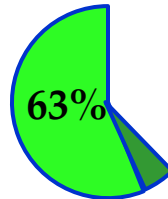
Fishery

Resource state

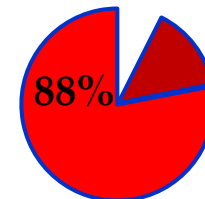
Lease-dominated



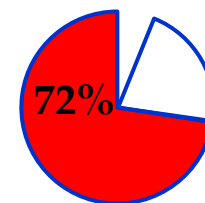
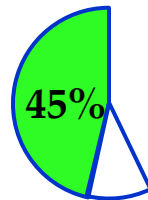
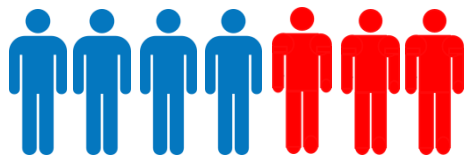
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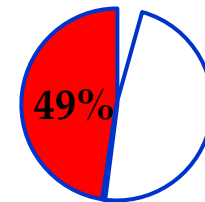
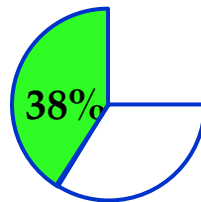
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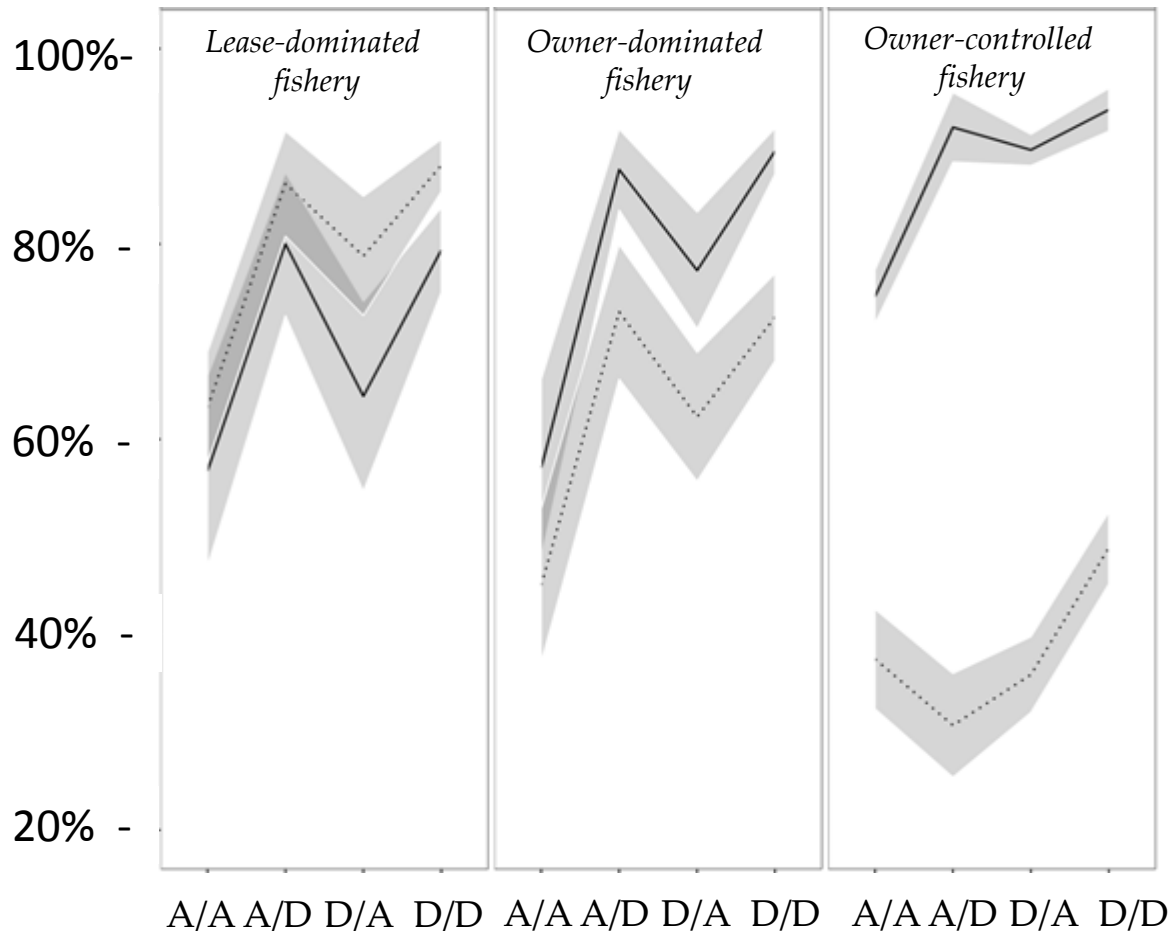
Owner-dominated



Owner-controlled



Mean \pm 95% CI probability of non-cooperative decision by resource state and fishery



Heterogeneity

- Lease fishers less likely to make a socially-optimal decision due to...
 - Inequality in wealth
 - Insecurity in tenure
 - Asymmetric information exchange

Heterogeneity

- Perceived lack of reciprocity by lease fishers was a deterrent for quota owners to coordinate
- For example...quota owners made significantly more non-cooperative decisions through rounds

*"Who
messed
up?"*

*"Probably the
guy who had to
bid for quota!"*

*"Maybe the person
who needed to bid
didn't buy that!"*



Summary

- Coordination difficult without communication
- Coordination benefits elicited by communication were moderated by heterogeneity among harvesters
- Difficult to elicit trust, a sense of group identity and maintain cohesion in heterogeneous groups

Outcomes

- Quota management (e.g. ITQs) introduced to regulate behaviour of quota owners
- Many ITQ fisheries dominated by lease fishers
- Lease fishers may have different incentives and behaviours to quota owners
- Spatially and temporally delineated quotas may be more effective option for reducing rent dissipation among heterogeneous harvesters
- Findings simplified but provide some insight and prediction into difficulties of eliciting cooperation to reduce assignment problems

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