Experimental analysis of coordination of fishing effort to reduce dissipation of economic rent in stock enhancement

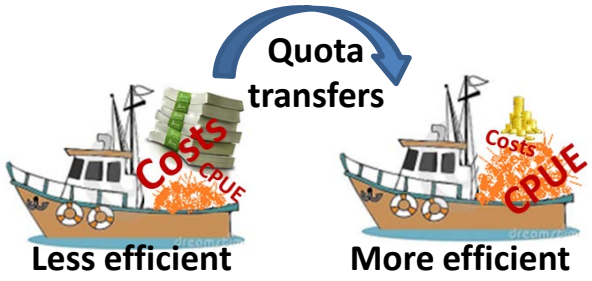
Rafael León (PhD Candidate)
John Tisdell
Caleb Gardner
Klaas Hartmann
Ingrid van Putten
Timothy Emery

UNIVERSITY of TASMANIA | IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

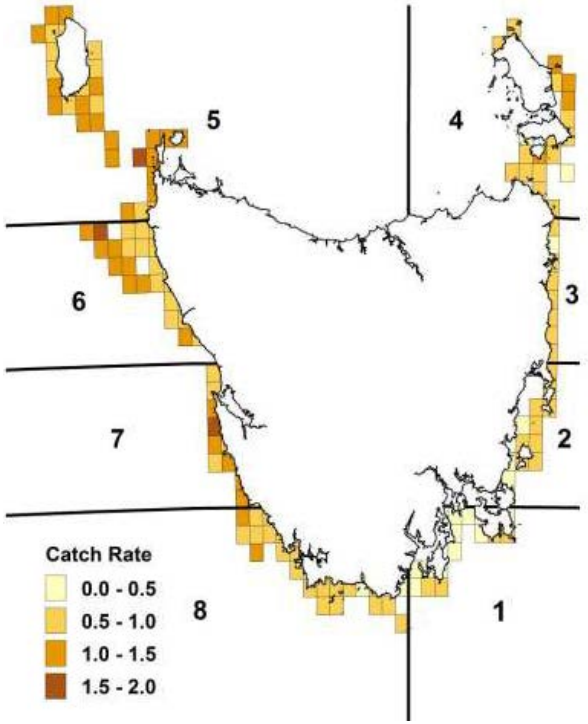
QMS QUANTITATIVE MARINE SCIENCE

INTRODUCTION

ITQ SYSTEMS may increase efficiency and reduce rent dissipation, but don't completely eliminate it.



Stocks commonly have **patchy distributions** and are **heterogeneous** in terms of quality of products, productivity, and accessibility, which ultimately manifest as **economic heterogeneity**.



There may be

- **Fishing effort concentration** in the most profitable patches.
- Congestion externalities, leading to **competition** and **gear interference**.

Rent dissipation

INTRODUCTION

Attempt to address problems derived from stock heterogeneity

Fishing effort coordination

Arrangements evolving

-Pooling of revenues

-Reduction of costs

- Distribution of profit amongst fishers

It is required some kind of fishers association

Caleb Gardner

INTRODUCTION

By using experimental economics this work examined the effectiveness of different managements strategies on fishing effort coordination to reduce rent dissipation in stock enhancement

http://fr.toonpool.com/cartoons/fisherman_41459

http://members.iinet.net.au/~jtisdell/utas_website/about.html

METHODS

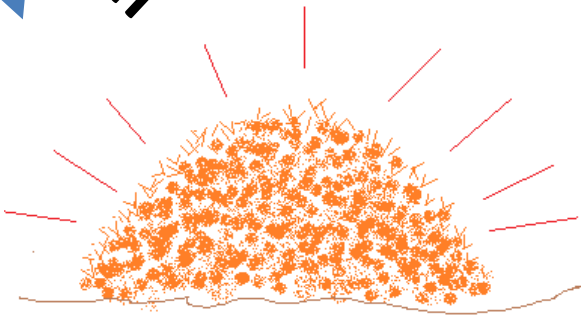
EXPERIMENTAL DESIGN

GENERAL FRAMEWORK:

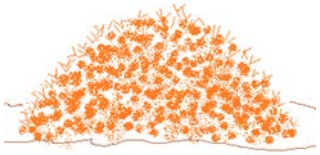
Stock enhancement program (SEP) based on translocation as carried out in the Tasmanian rock lobster fishery.

Southern Rock Lobster
Jasus edwardsii

http://www.sardi.sa.gov.au/fisheries/wild_fisheries/offshore_crustaceans



Enhanced zone (EZ)
Higher profitability



Non-Enhanced zone (N-EZ)
Lower profitability

METHODS

EXPERIMENTAL FACTORS

Payment of the costs of SEP

- **Compulsory**
  Every participant had to pay for the SEP.
- **Voluntary**
  Participants chose to pay or not, regardless whether they fished their quotas in the EZ.
- **By-use**
  Participants had to pay only if they were going to fish in the EZ

Harvesting strategy

- **Individual**
  As in an individual quota (IQ) management system.
- **Collective**
  As in a community-base management system, pooling costs and revenue and profits equally shared amongst only those who paid for the SEP.

Access to the EZ

- ***Access restriction***
  Participants who didn't pay for the SEP can't go fishing in the EZ.
- ***No access restriction***
  Participants allowed to go fishing in the EZ no matter if they pay or not.

IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

METHODS

TREATMENTS: Combination of experimental factors, representing different co-managements strategies

Compulsory

EZ — All pay, Individual harvesting, No access restriction — **N-EZ**

Voluntary

EZ — Voluntary payment, Individual harvesting, No access restriction — **N-EZ**

By-use A

EZ	Access restriction	N-EZ
-Individual harvesting -Voluntary payment		-Individual harvesting -No payment required

By-use B

EZ	Access restriction	N-EZ
-Collective harvesting -Voluntary payment		-Individual harvesting -No payment required

IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

METHODS

REPLICATES & EXPERIMENTAL PARTICIPANTS

www.utas.com.au

- 4 Sessions per treatment
  - 8 different participants per session
    - 3 quotas allocated to each participant
  - 20 rounds per session

Experimental participants

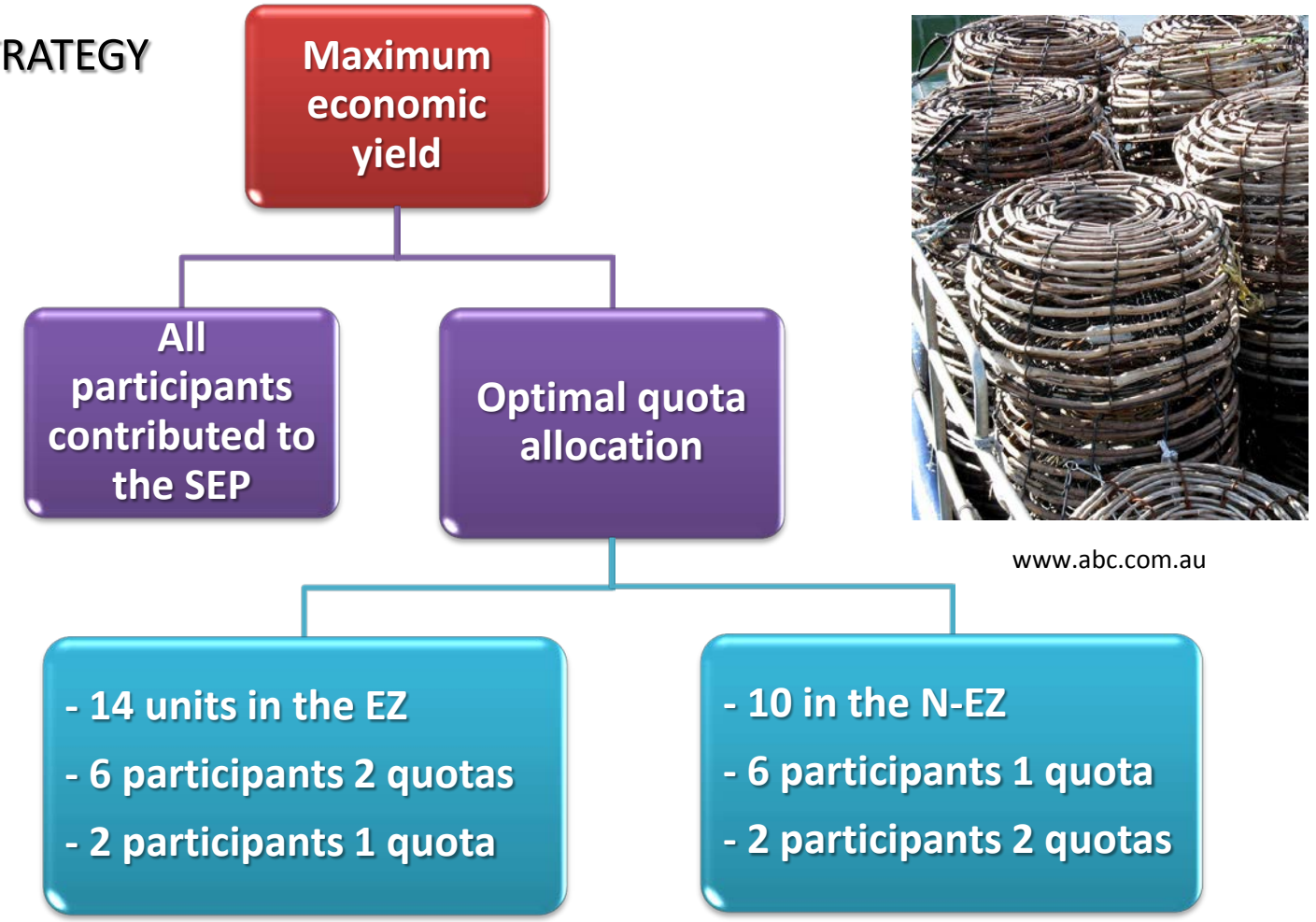
University of Tasmania students were invited to be part of a pool of experimental subjects.

8 individuals were randomly drawn from this pool to participate in each session

IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

METHODS

OPTIMAL STRATEGY



www.abc.com.au

-Unequal payoffs unless participants took turns through rounds.
-Participants could communicate and coordinate before each round.

METHODS

DECISION TABLE:

- Payoff increases when number of participants paying for the SEP also increases.
- There is a threshold of number of quotas allocated in each zone, over which the payoff decreases.

DATA ANALYSIS:

- Analysis were conducted with Generalised Estimating Equation (GEE) modelling

www.abc.com.au

	Payoff per quota according to the total number of quotas allocated by all participants in each zone								
	Enhanced zone (EZ)								
	N° participants in the enhance program								*Non-EZ*
Quotas	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	
0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
1	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
2	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
3	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
4	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
5	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
6	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
7	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
8	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$15.00
9	$20.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$12.00
10	$10.00	$25.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$12.00
11	$10.00	$15.00	$28.00	$31.00	$33.00	$34.00	$35.00	$36.00	$12.00
12	$10.00	$15.00	$18.00	$31.00	$33.00	$34.00	$35.00	$36.00	$8.00
13	$0.00	$15.00	$18.00	$23.00	$33.00	$34.00	$35.00	$36.00	$8.00
14	$0.00	$5.00	$18.00	$23.00	$30.00	$34.00	$35.00	$36.00	$5.00
15	$0.00	$5.00	$8.00	$23.00	$30.00	$28.00	$31.00	$36.00	$5.00
16	$0.00	$0.00	$8.00	$15.00	$30.00	$28.00	$31.00	$32.00	$2.00
17	$0.00	$0.00	$0.00	$15.00	$22.00	$28.00	$31.00	$32.00	$0.00
18	$0.00	$0.00	$0.00	$7.00	$22.00	$22.00	$31.00	$32.00	$0.00
19	$0.00	$0.00	$0.00	$7.00	$22.00	$22.00	$27.00	$32.00	$0.00
20	$0.00	$0.00	$0.00	$0.00	$16.00	$16.00	$27.00	$27.00	$0.00
21	$0.00	$0.00	$0.00	$0.00	$16.00	$16.00	$21.00	$27.00	$0.00
22	$0.00	$0.00	$0.00	$0.00	$8.00	$10.00	$21.00	$21.00	$0.00
23	$0.00	$0.00	$0.00	$0.00	$8.00	$10.00	$15.00	$21.00	$0.00
24	$0.00	$0.00	$0.00	$0.00	$0.00	$4.00	$9.00	$15.00	$0.00

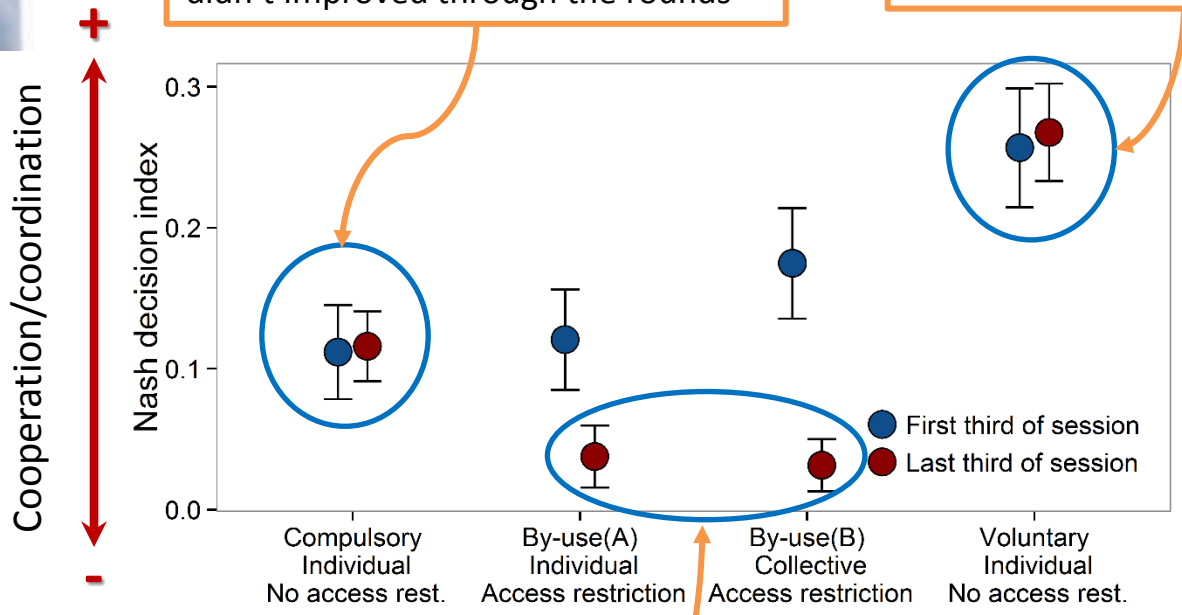
Based on Cardenas (2000)

RESULTS

Rent dissipation

Initial low rent dissipation, but it didn't improved through the rounds

Higher rent dissipation
It didn't change through the rounds



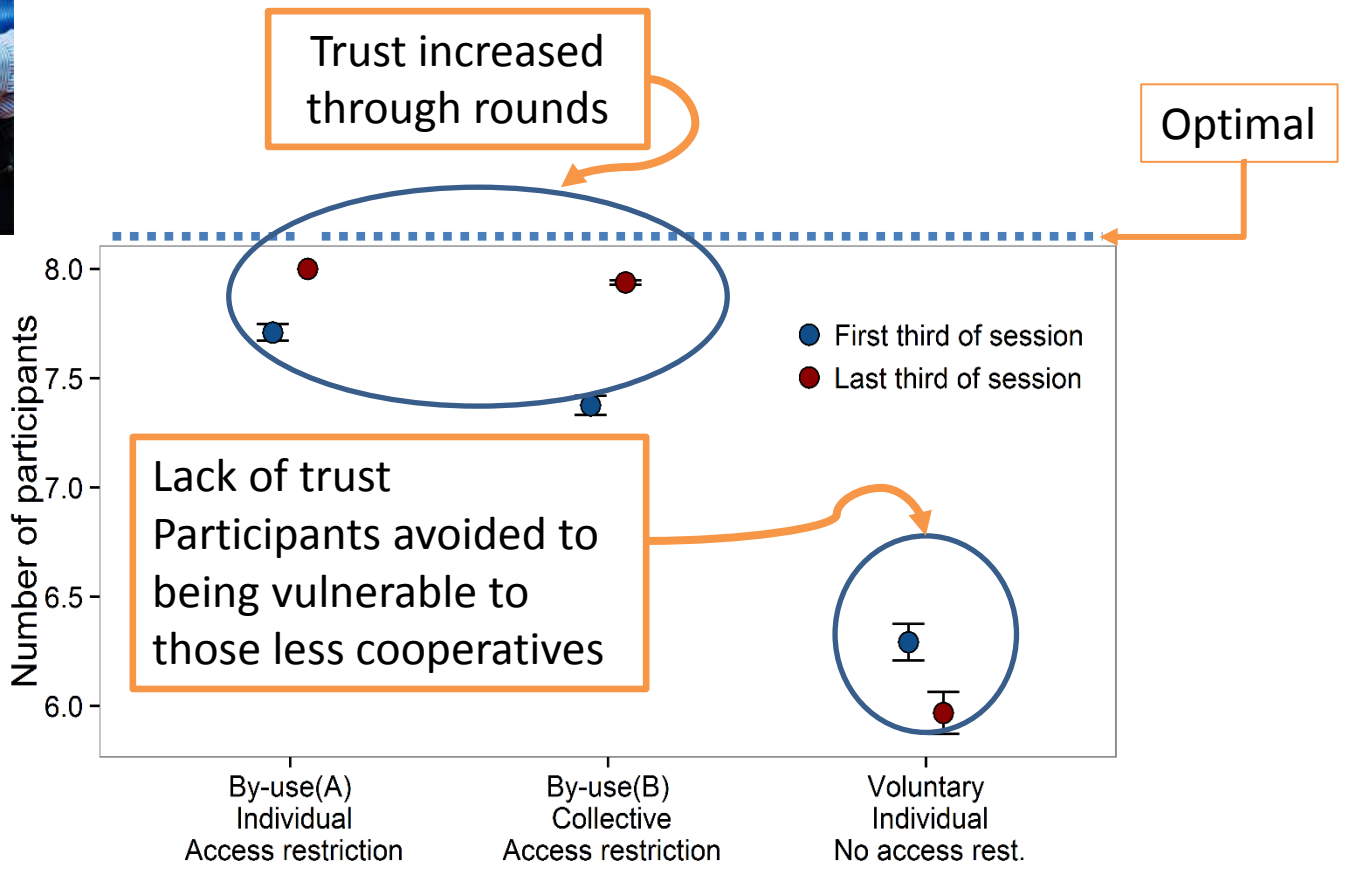
User-pay system for access to EZ had significant lower rent dissipation

$$NDI = \frac{Actual\ total\ profit}{Optimal\ total\ profit}$$

IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

RESULTS

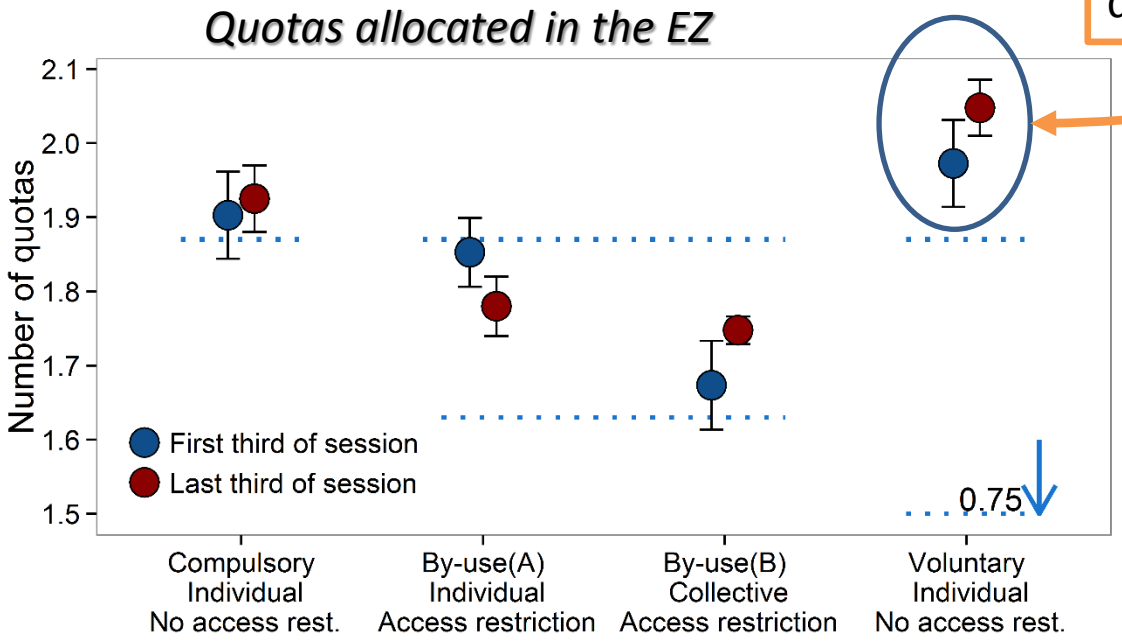
Willingness to pay:



RESULTS

Trust and reciprocity:

Lack of trust & reciprocity
Participants allocated a significantly higher number of quota units than the optimal.

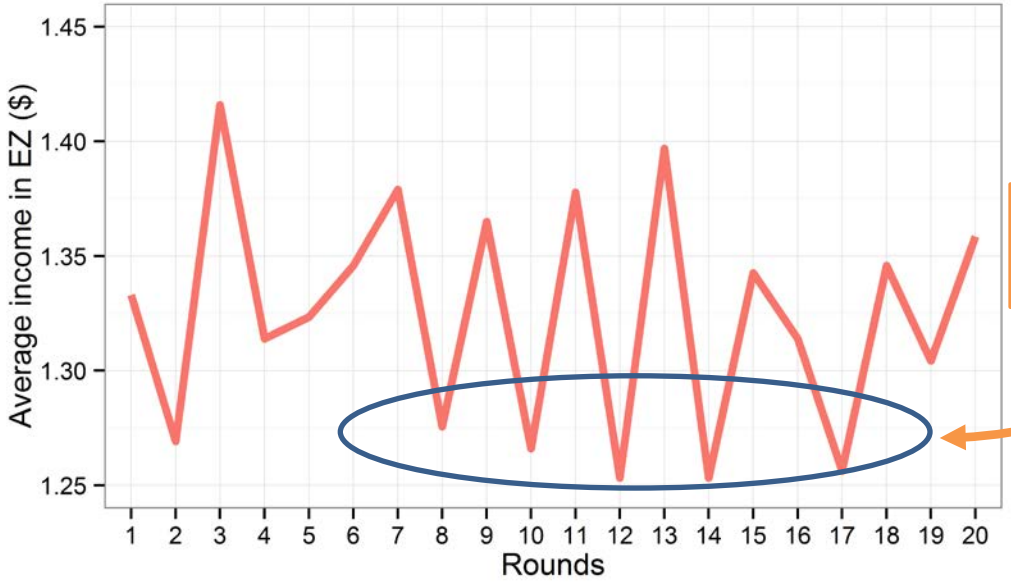


Optimal

DISCUSSION

Compulsory treatment

-Less cooperative participants reacted to the perceived cost-benefit ratio of cheating.
-They occasionally cheated to avoid higher rent dissipation.



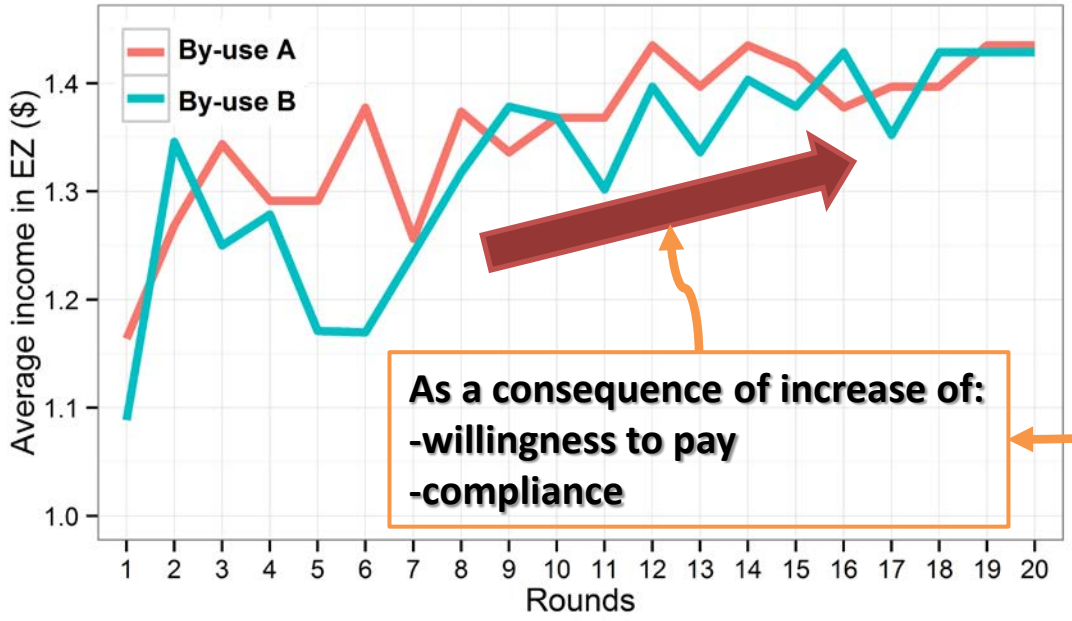
Rent dissipation because of cheating

Compulsory payment has implicit a punishment as any deviation from the optimal cooperation implies cost that could be even higher than the revenues.

DISCUSSION

By-use A & B treatments

These treatments implied the acceptance of enhancement costs, so participants were more likely to be cooperative when they participated in the SEP.



As a consequence of increase of:
-willingness to pay
-compliance

Those less prone to cooperate were influenced by:
-Cooperative participants
-Low income when not cooperating

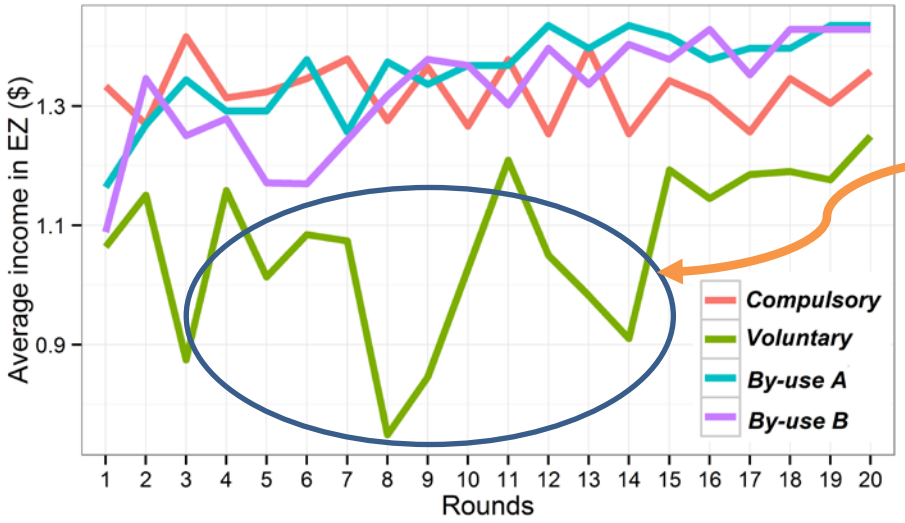
In contrast with *Compulsory* treatment that was based on pure financial incentives, the carrot and the stick, in the *user-pay* systems there may have been non-financial incentives. Eg. Self-determination or altruism (Bowles, 2008; Fehr and Fischbacher, 2003; Fehr et al., 2002).

IMAS
INSTITUTE FOR MARINE AND ANTARCTIC STUDIES

DISCUSSION

Voluntary treatment

-Participants seemed to expect low cooperation from others, because there were no rules to provide any level of security that they would not be the 'fool' exploited by free-riders. There were low expectations of reciprocity.
-Also there was no mechanism to charge participants for cost involved when they cheated on others.



High level of rent dissipation

Lack of rules around location of effort meant that payment for the SEP was too risky and that cheating was not punished, thus self-interested participants dominated the environment leading to rent dissipation.

CONCLUSIONS

- Participants reacted differently according to the signals of different treatments and the behaviour of other participants as sessions were progressing.
- The presence of a compulsory payment provided some security that self-interested participants were going to be controlled, which reduced vulnerability of cooperative participants and increased the expectation of reciprocity.
- However, punishment was insufficient to promote cooperation, and other conditions for self-determination were required.
- Thus, cooperation, trust and reciprocity reached the highest level when individuals had the option of choosing whether to participate in the management measure or not.
- This required a mechanism that spatially blocked the actions of self-interested individuals, as was the case with the By-use treatments.
- Lack of trust and cooperation may increase fisheries management costs as higher level of monitoring and enforcement is required.
- The experimental economic approach provides a tool to assist management by providing information about factors that increase cooperative behaviour.

Thanks

Hobart, Tasmania

Marvin Chew (www.marvinchew.com)

Rafael León

PhD Candidate, CSIRO-UTAS PhD Program in Quantitative Marine Science
Email **Rafael.Leon@utas.edu.au**
Private Bag 49
Hobart, Tasmania 7001
Australia

QMS QUANTITATIVE MARINE SCIENCE

IMAS INSTITUTE FOR MARINE AND ANTARCTIC STUDIES