External validity of common pool resources experiments: Lessons from the Chilean seashore

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Structure of the talk

1. A bit of game theory
2. Collective action problems and social norms
3. Experimental game theory (ecological and external validity)
4. The “happy ending” story about *locos* in Chile
5. Common pool resources (CPR) experiments with fishermen
   - Locos (*concholepas concholepas*) framing (with and without external enforcement); *Ecology & Society*, 2013.
   - Locos framing vs hakes (*merluccius*) framing (with and without peer-to-peer monitoring); preliminary results.

Abstract Games

A game is a formal representation of a situation in which a number of individuals interact in a setting of ***strategic interdependence***. To describe this situation we need to know four things:

1. The players: Who is involved in the game?

2. The rules: Who moves when?, what do they know when they move?, what can they do?)

3. The outcome: For each possible set of actions by the players, what is the outcome of the game?)

4. The payoffs: What are the players' preferences (i.e., utility functions) over the possible outcomes?

Prediction (simultaneous games, complete information)

For simultaneous-move games (complete information):

1. Rationality (**Max u**) + **common knowledge** of rationality and of the structure of the game ⇒ Agents play **rationalizable strategies** (survive to iterated deletion of strategies that are never a best-response)

2. Add **mutually correct expectations** about agents' actual play ⇒ Agents play a **Nash equilibrium** (in which each agent plays a best response to the strategies actually played by his rivals).

Prediction (simultaneous games, incomplete information)

For simultaneous-move games (incomplete information):

1. Rationality (**Max E[(u]**) + common knowledge of rationality and of the structure of the game ⇒ Agents play rationalizable strategies (survive to iterated deletion of strategies that are never a best-response in expected utility terms)

2. Add mutually correct expectations about agents' actual play ⇒ Agents play a **Bayes-Nash equilibrium** (in which each agent plays a best response to the strategies actually played by his rivals).

Prediction (dynamic games)

1. **For dynamic games (with perfect information)**, **sequential rationality** ⇒ agents play a **Perfect Nash equilibrium** (rules out Nash equilibria in which non-credible strategies are implemented).

2. **For dynamic games (with imperfect information)**, sequential rationality + **Bayesian updating** ⇒ agents play a **Perfect Bayesian equilibrium** (rules out Perfect Nash equilibria based on unreasonable beliefs).

Games as a model of real-life social interaction

In order to represent a real-life form of strategic interdependence, game theorists *de facto* proceed as follow:

1. Characterize the outcome of the game by **observable net changes in material payoffs** (market direct or indirect value is used to standardize alternative metrics).

2. Assume an **homogeneous utility function of the form $u_i(c_i) = c_i$** and compute the corresponding equilibrium concept (NE, PNE, BNE, PBE, etc.).

3. If an **"anomaly"** is observed, behavioral economists come to the rescue and posit a modified **utility function**, e.g., $u_i(c_i,c_j) = c_i$, that captures the anomaly, but we do not say that they were playing another game.

Games as a model of real-life social interaction

Features that are in general not considered as relevant:

1. Context-specific norms (e.g., the military world vs the civilian world)

2. Role-specific norms (e.g., teachers)

3. The nature of the relationship between players (e.g., strangers, acquaintances, friends, siblings).

	Strangers (one-shot)	**Non-strangers (repeated)**	**Examples**
Coordination Games generic strategies: (Tech A, Tech B)	Nash 1 is Pareto efficiente Nash 2 is Pareto inefficient	Most dynamics lead to Pareto efficiency	Tech with network externalities
Cooperative Dilemmas generic strategies: (Coop, ¬ Coop)	Unique rationalizable equlibrium is Pareto inefficient Unique Perfect Nash in sequential games is Pareto inefficient	Perfect Nash = Nash Perfect Bayesian: Some dynamics lead to Pareto efficiency	Symmetric: Common Pool Resource Public Good Asymmetric: Trust
Distributive Games generic strategies: (Share, ¬ Share)	Multiple Nash with unequal payoffs Unique Perfect Nash in sequential games	Perfect Bayesian: Some dynamics might reduce inequality	Symmetric: Hawk/Dove Asymmetric: Ultimatum Dictator

Some Stylized facts about CAPs

In typical experiments, the CAP is repeated a finite and known number of times.

1. The predicted **Perfect NE** is that no one will cooperate in any of the rounds (Hardin, 1971's **Tragedy of The commons** for CPR games).

2. However, actual people cooperate significant amounts during the early rounds of the experiment. As the game is repeated, **cooperation unravels** but still higher than Perfect NE predicts (see, for example, Ledyard, 1995 for PG games and Walker & Ostrom,1992 for PG games).

3. **Peer to peer sanctions prevent unravelling** (Fehr and Gachter, AER 2002). Explanation: conditional cooperation (Fischbacher et al. 2001)

4. **External sanctions, even if not deterrent, also do the work** (Rodriguez-Sickert, Guzmán and Cárdenas, JEBO 2008). Explanation: shift from conditional to unconditional cooperation.

5. Similar stylized facts between PG games and CPR games, but higher levels of cooperation in CPR games (see Sonnemans, Schram and Offerman, JEBO1998)

Is experimental GT an useful tech to understand real-life social interaction?

Yes, it should be:

1. Laboratory economic experiments **[controlled variation]** can help to identify the determinants of cooperation in the field (Ostrom 2006).

2. **Alternative institutional regimes** can be tested in the lab before implemented in the real world (Levitt and List, 2007).

3. Behavior in social dilemma games can be used to **measure the social capital** of specific communities (Karlan, 2005)

But…

Is experimental GT an useful tech to understand real-life social interaction?

There is the common view the lab produces “unrealistic” data, which lacks relevance for understanding the “real world” **[no external validity]** (Falk and Heckman, 2009):

What is the main basis of this view?

1. **Stakes** are too low (but Fehr et al, 2009).
2. The **sample** is not representative of the diversity of human nature: WEIRD experimental subjects (but Henrich et al. 2011).

We believe that experimental subjects do matter, but **ecological validity** is even more important!

Social Norms

1. "**Social norms** are rules and standards that are understood by members of a group, and that guide and/or constrain social behavior without the force of laws." (Cialdini and Trost, 1998)

2. Social norms "can" serve the function of **restricting egoistic impulses in favor of collective outcomes** (Coleman 1990. Biel, Eek, & Gärling, 1999), e.g., over extracting in a common pool resource game.

3. In a social dilemma context, that a **"hurt" frame** (i.e., one that makes salient that defection leads to negative consequences) is more likely than a **"help" frame** (i.e., one that makes salient that cooperation leads to positive consequences) to activate a norm for cooperation (e.g., Kerr & Kaufman-Gilliland, 1997)

4. Social norms are **context-specific,** and are **unconsciously activated by situational cues**. Once activated, they will show some inertia, in the sense that unless a major change in circumstances occurs, people will keep following the norm that has been primed, i.e., **norms can be internalized** (Bicchieri, 2002)

Implications for experimental analysis

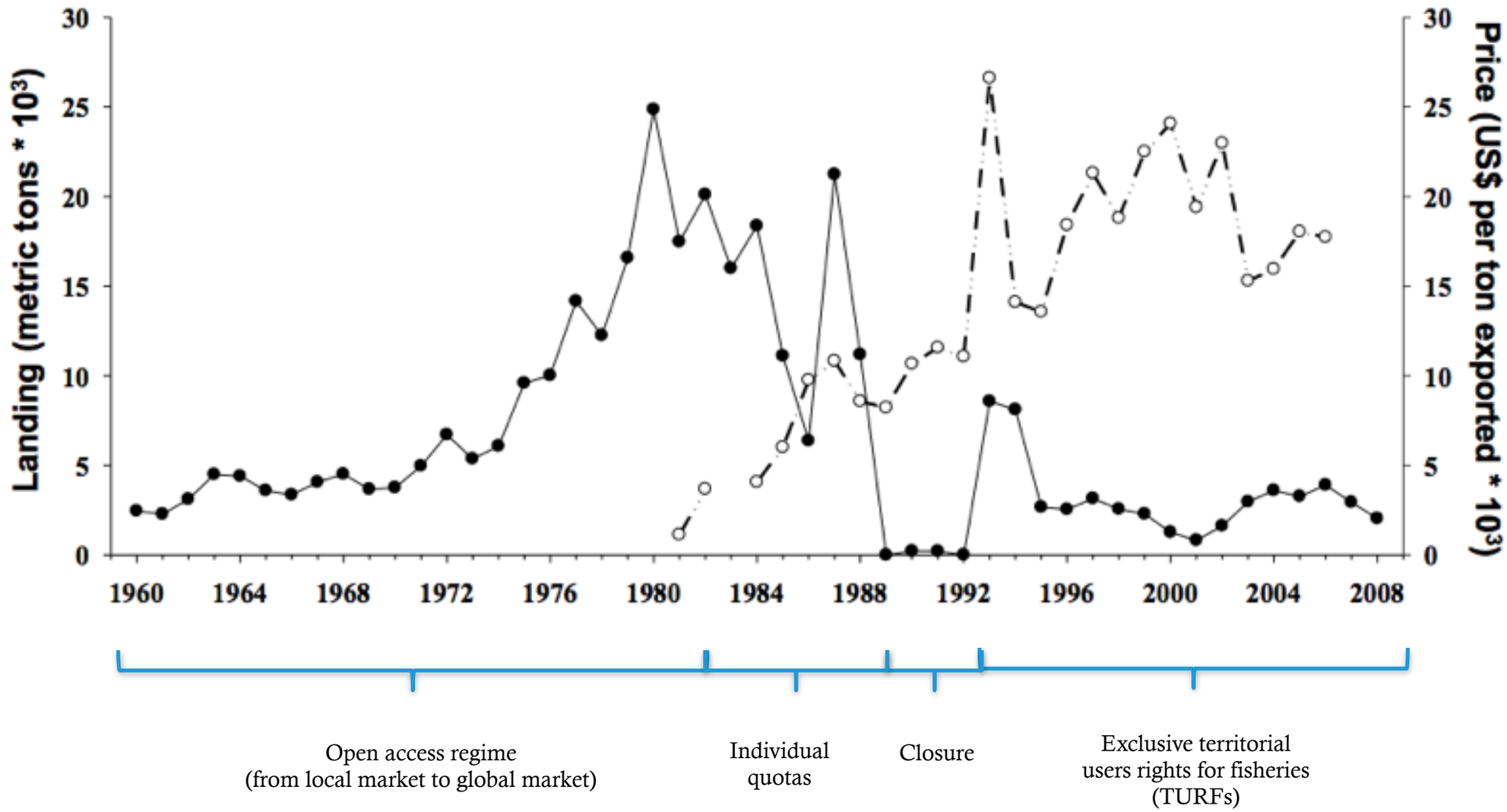
Ecological validity gives situational cues to experimental subjects about the social norm in place when they play the CPR game in the lab ⇒

- Heterogeneity in norm adherence of loco divers between different caletas in the real world will permeate lab behavior
- If the same game is framed as fishing hakes (where there is not a social norm in place), cooperation will decrease even if the game is played among members of the same community.

Previous work - Building Blocks

Rodriguez-Sickert et al (JEBO 2008)	**Gelcich et al (PNAS, 2010)**	**Marín et al (E&S, 2012)**
CPR experiment – Role of Institutions	The Chilean case: MEABRs and the sustainabilty of the "loco"	Social capital and performance of communites
Bringing the Lab to the Field + Micro-based behavioral explanation Results: unconditional and conditional cooperators, free-riders characterize type space The institutional regime affects the composition of types and thus, the dynamics of cooperation.	Institutional change and the dynamics of the socio-ecological system. Stylized story: 1. Open-access: Tragedy of the Commons 2. Individual property rights couldn't prevent the tragedy. 3. Common property rights (MEABRs) worked (qualitfication: heterogeneity).	Explanation of the heterogeneity of performance between different caletas Result: bridging and bonding positively influence the performance of the caleta Requirement: Performance-based classification of caletas.

Real-life Commons in the Chilean Seashore

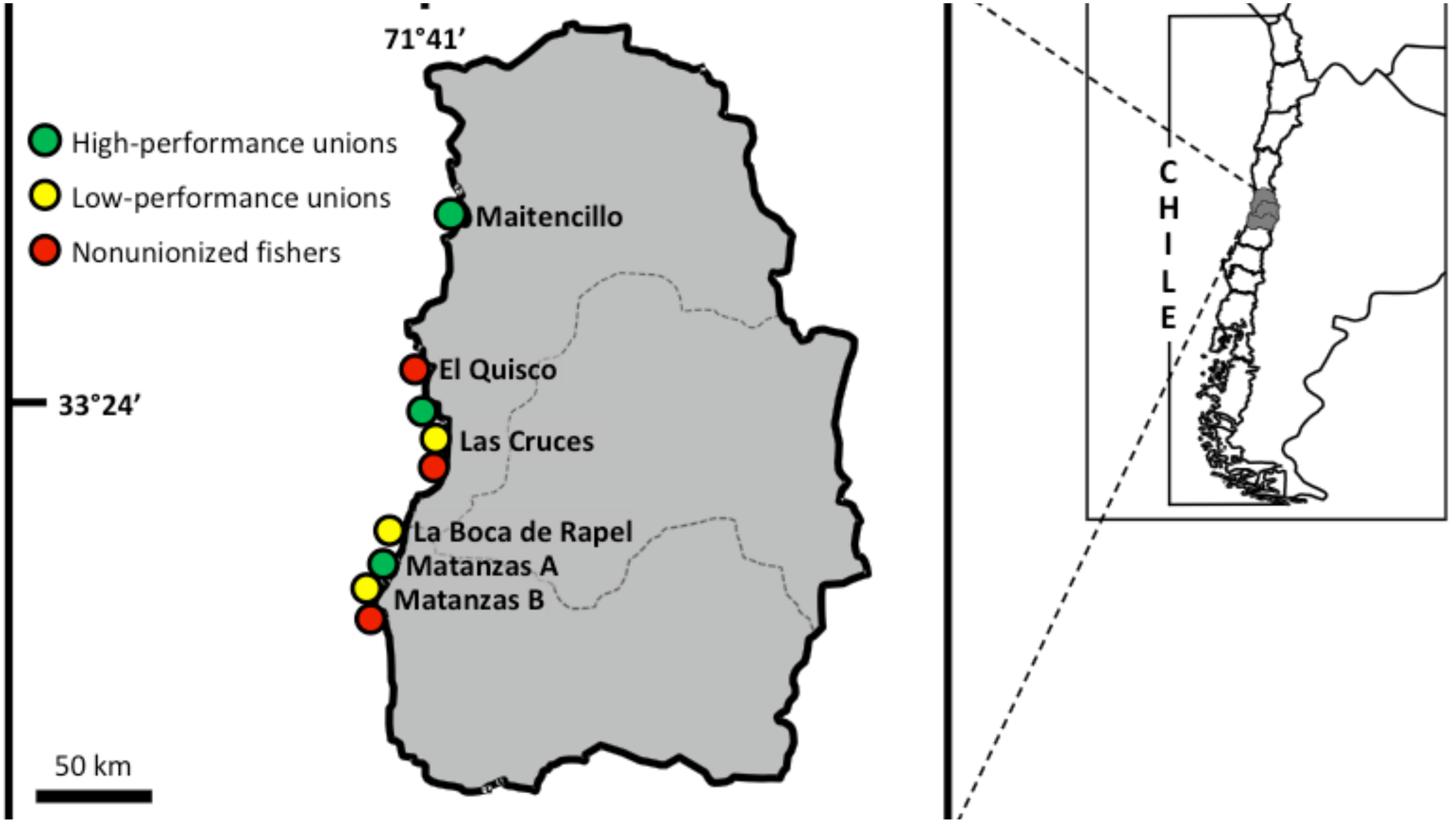


Sample

Table 1: Characteristics of the sampled unions

Union	Performance[1]	Number of subjects
Maitencillo	High	10
El Quisco	High	10
Matanzas A	High	10
Las Cruces	Low	10
La Boca de Rapel	Low	10
Matanzas B	Low	5

This score is based on the unions' performance in several dimensions: organizational robustness, norm complia monitoring and enforcement, trend in total allowable catches, satisfaction with the MEABR, and the equit ibution of benefits (Marin et al 2012).


71°41'
High-performance unions
Low-performance unions
Nonunionized fishers
Maitencillo
El Quisco
33°24'
Las Cruces
La Boca de Rapel
Matanzas A
Matanzas B
50 km
CHILE

Caleta Maitencillo, Región de Valparaíso, Chile.

Some guys from the Maitencillo fishermen union.

The Experiment- Explaining the instructions

The Experiment- Trial rounds

The Experiment- Trial rounds

The Experiment- Trial rounds

CPR protocol (concholepas)

During the first ten rounds N = 5 fishermen play a CPR game:

- Individual quota: 100 units of *locos Price pero loco: U$ 0,02*
- Overharvest range: [0,50]
- Negative externality of overharvesting: ½ per peer

Information between rounds

- average extraction,
- individual loss due to his peers' over harvesting
- net profits

Payoffs are given by:

$$\pi_i = 0.02 \times \left(100 + x_i + \frac{1}{2} \sum_{j \neq i} x_j \right)$$

Unique NE: full over harvest

During the last ten rounds, external enforcement is also incorporated:

- 2 subjects are randomly inspected
- harvest is confiscated if quota exceeded

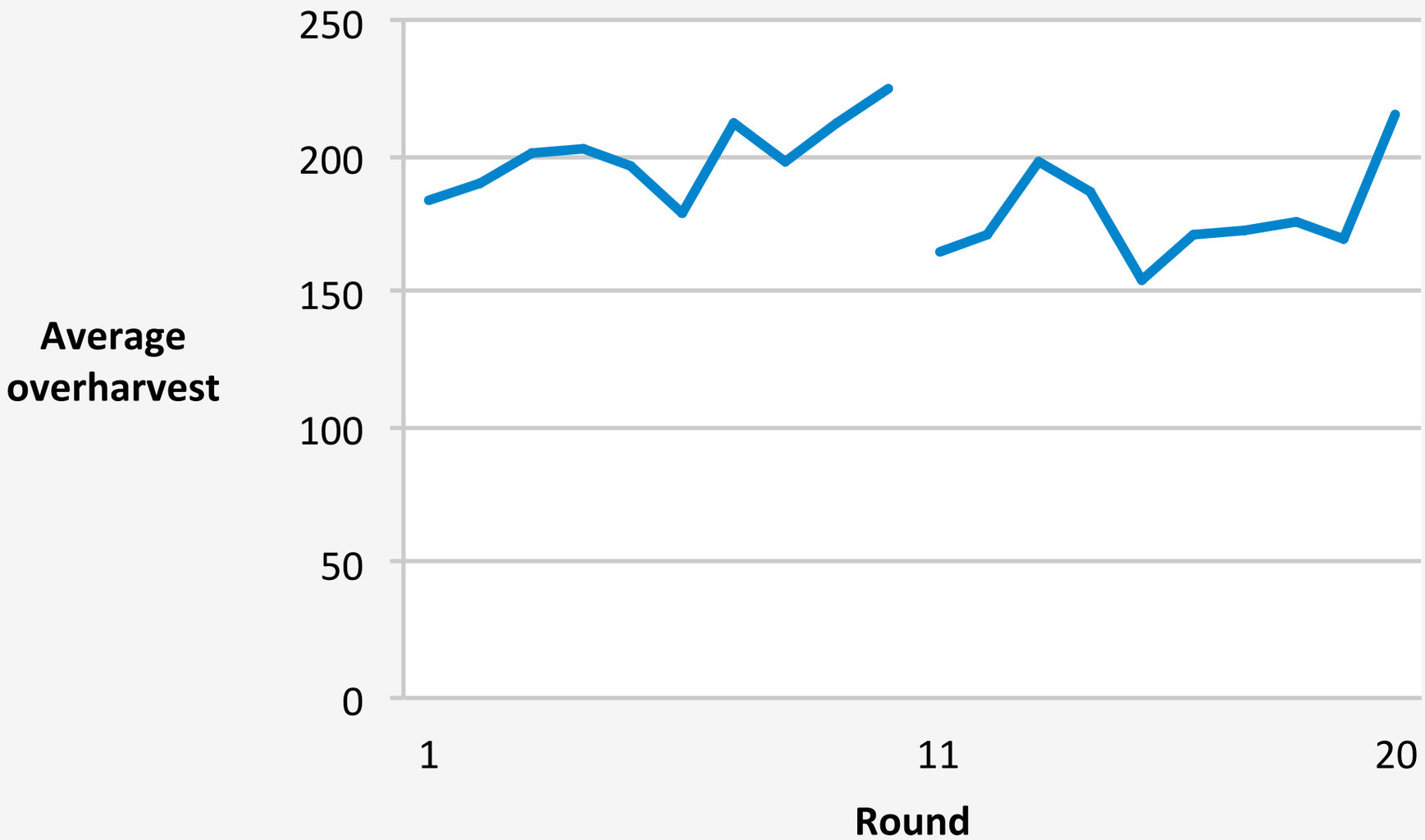
Expected profits are given by:

$$\mathrm{E}\pi_i = 0.02 \times \begin{cases} 100 + x_i - \frac{1}{2} \sum_{j \neq i} x_j \text{ if } x_i = 0 \\ \frac{3}{5} \times \left(100 + x_i - \frac{1}{2} \sum_{j \neq i} x_j \right) \text{ if } x_i > 0 \end{cases}$$

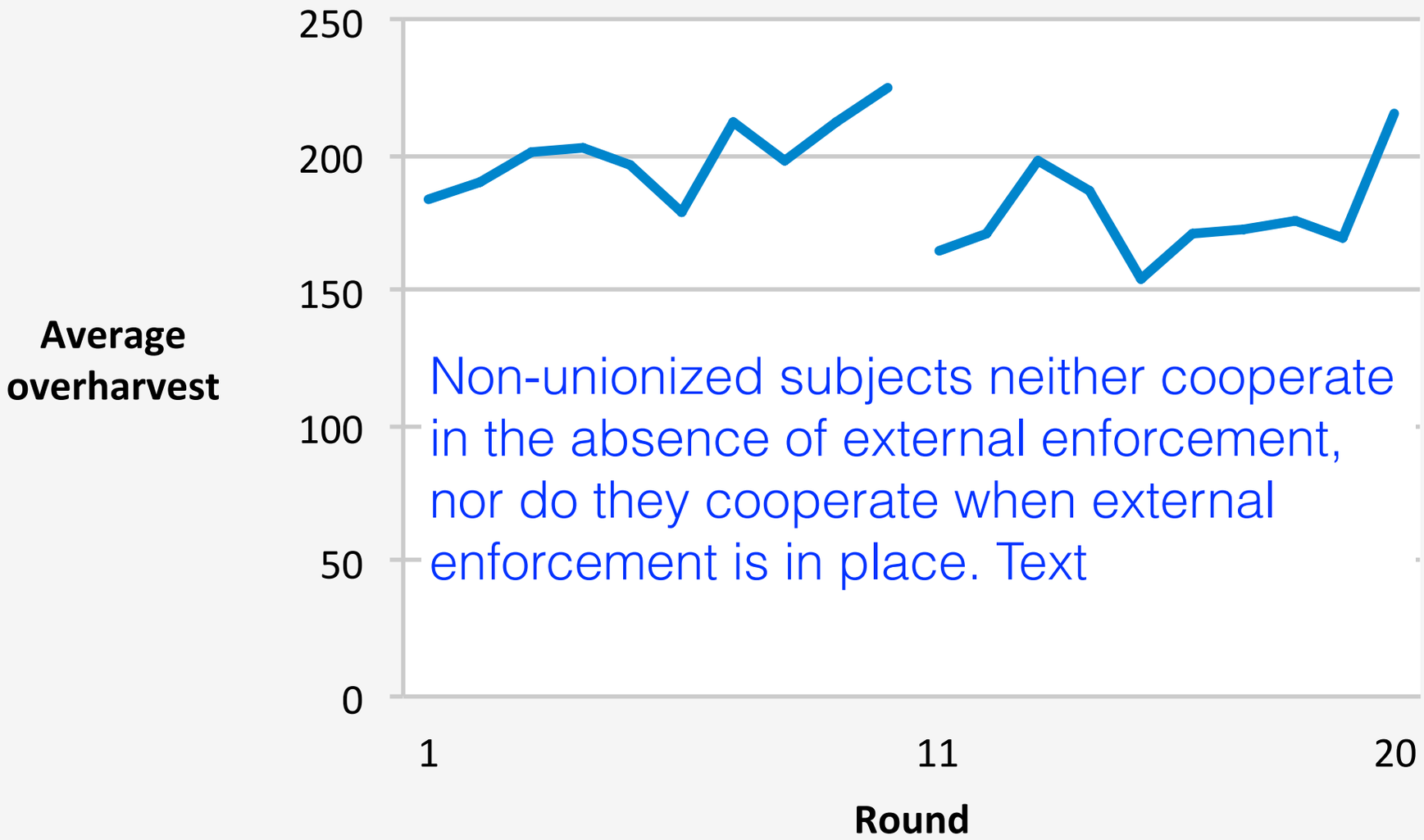
Two BNE:

- full over harvest,
- zero over harvest

Experimental Results - Poachers

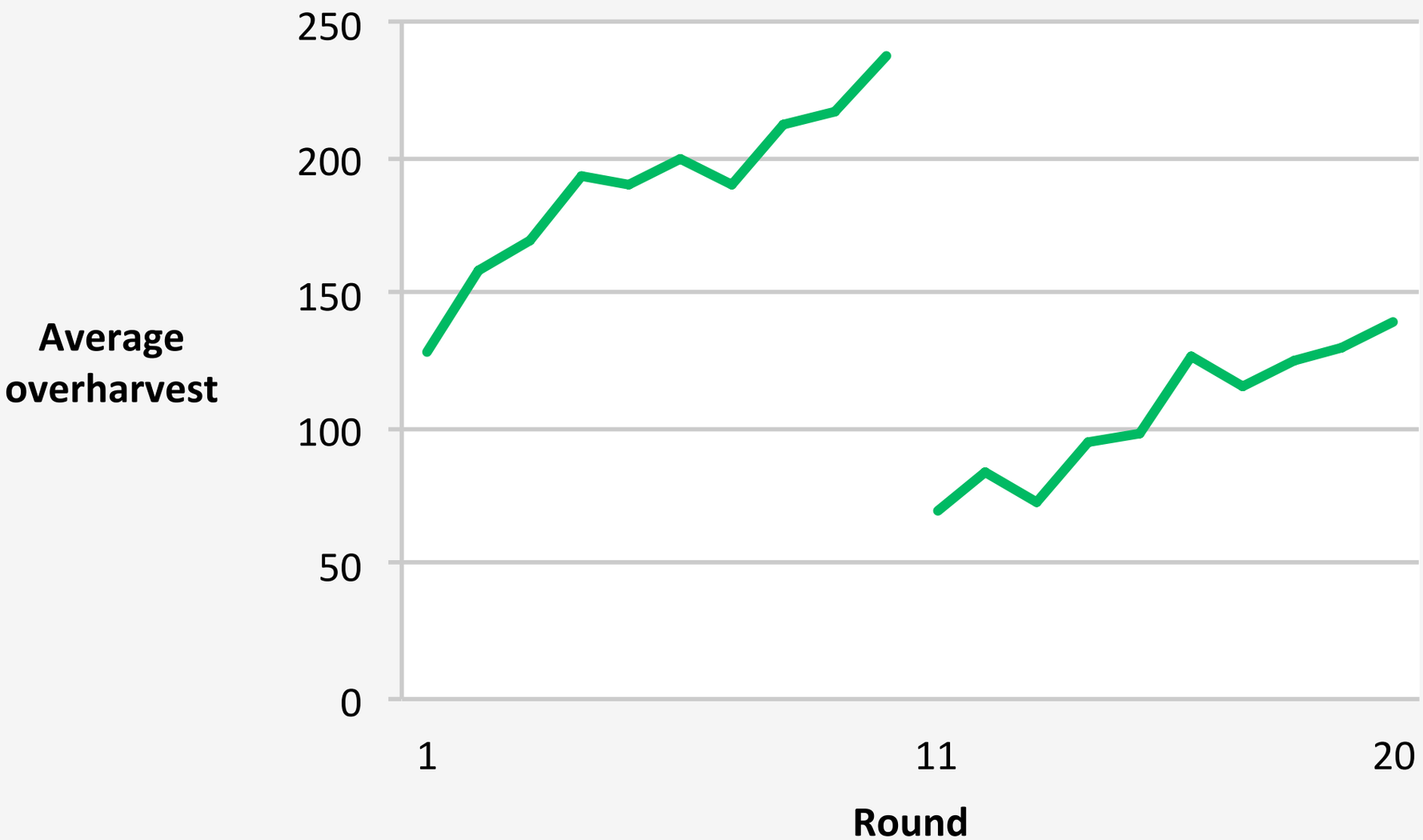


Experimental Results - Poachers

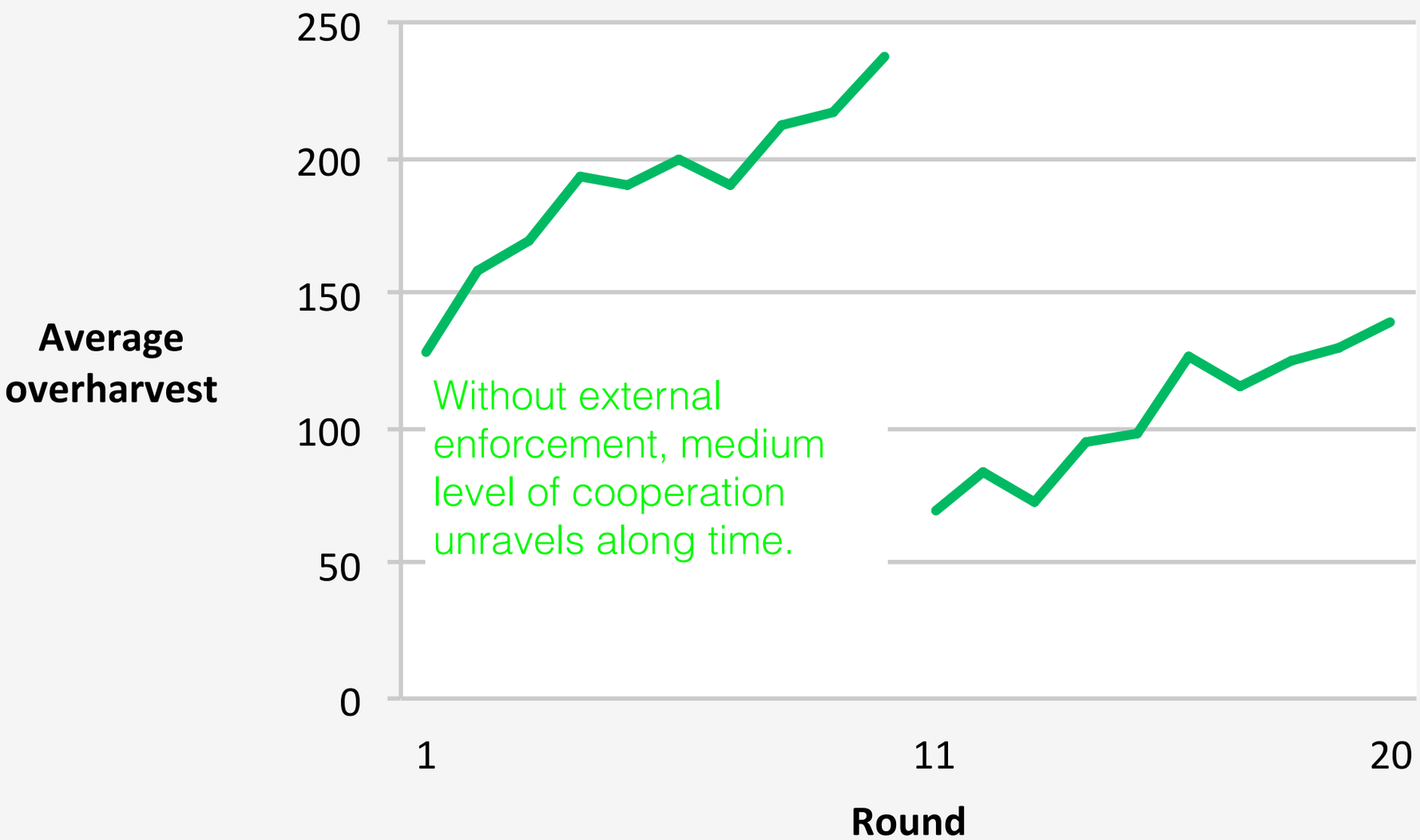


Non-unionized subjects neither cooperate in the absence of external enforcement, nor do they cooperate when external enforcement is in place. Text

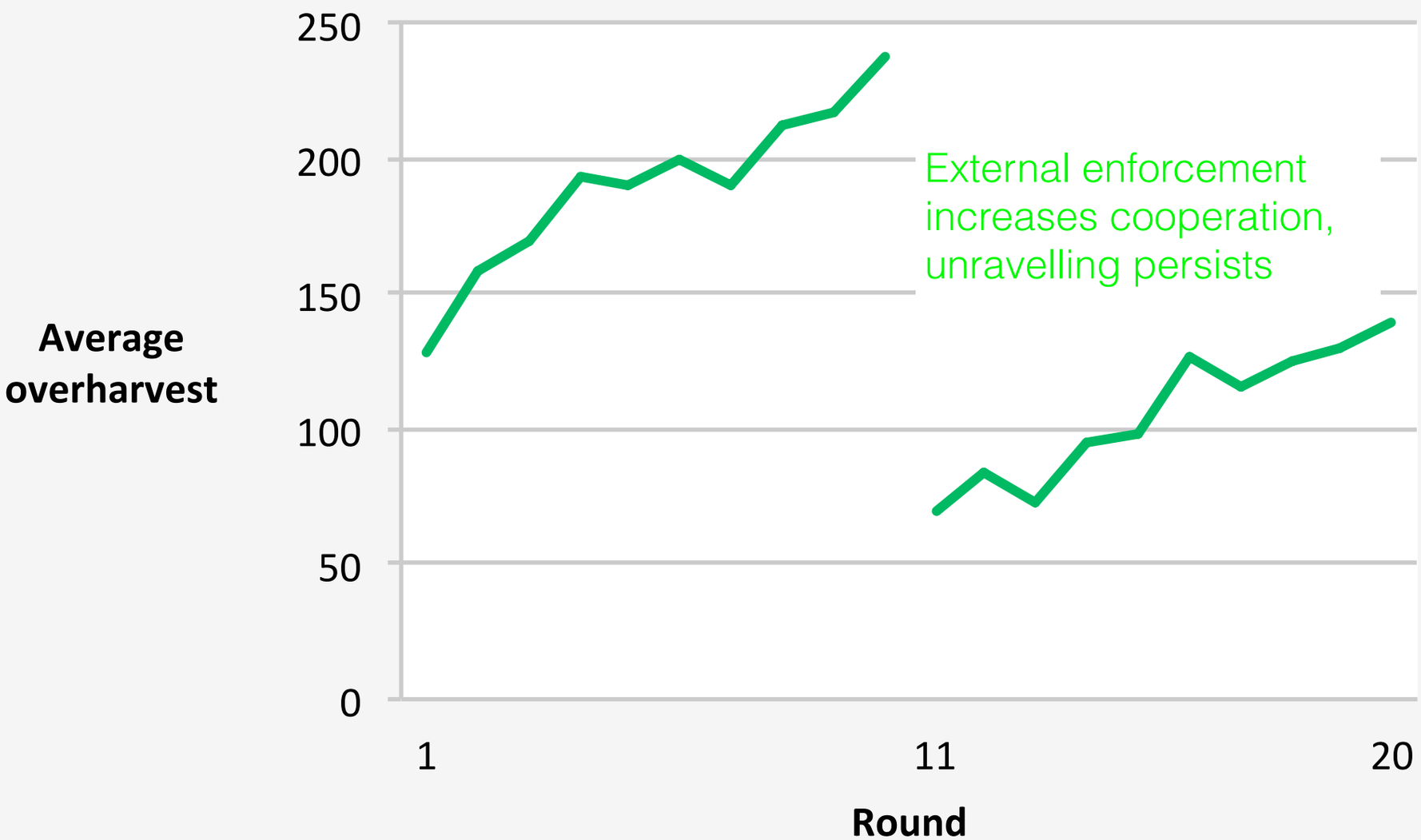
Experimental Results - Unsuccessful Unions



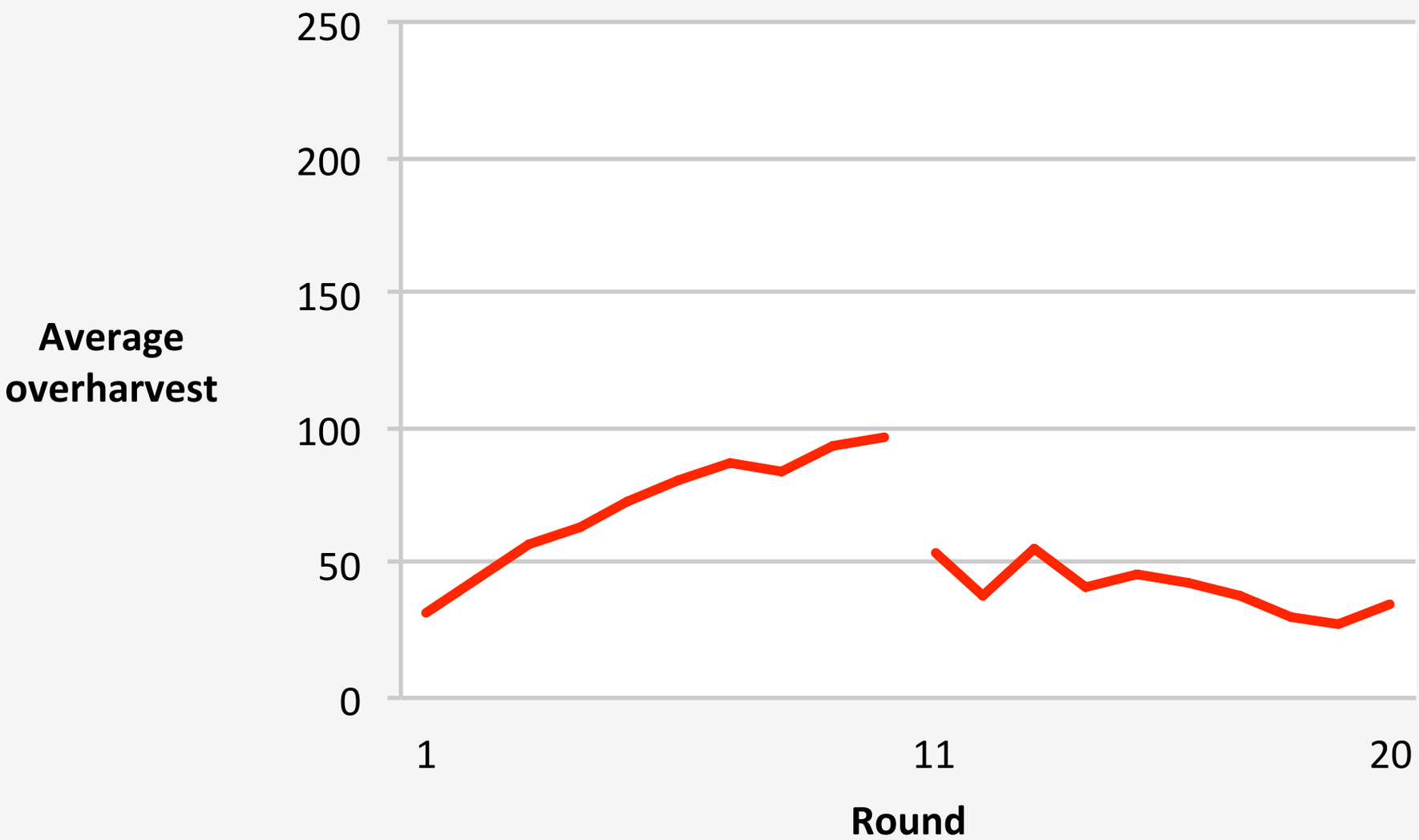
Experimental Results - Unsuccessful Unions



Experimental Results - Unsuccessful Unions



Experimental Results - Successful Unions



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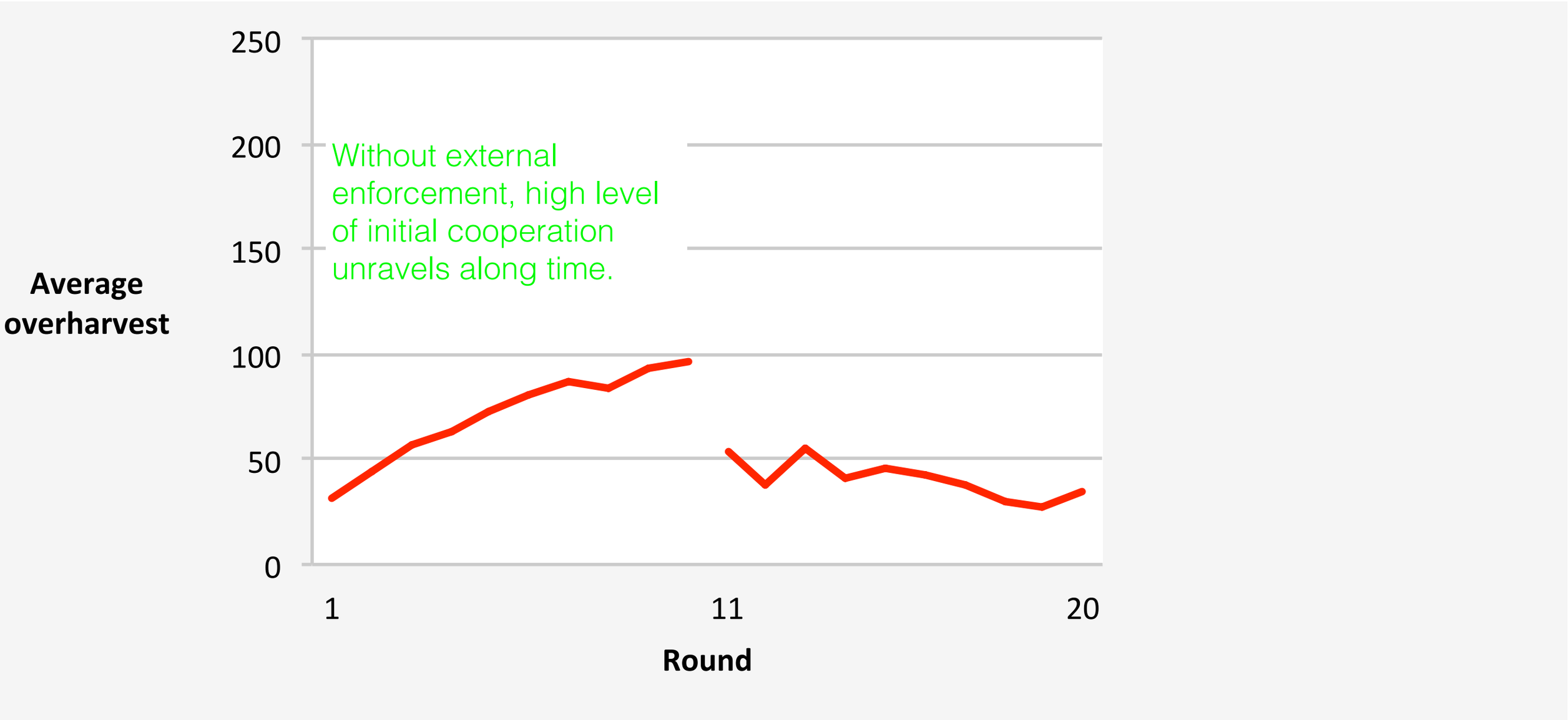

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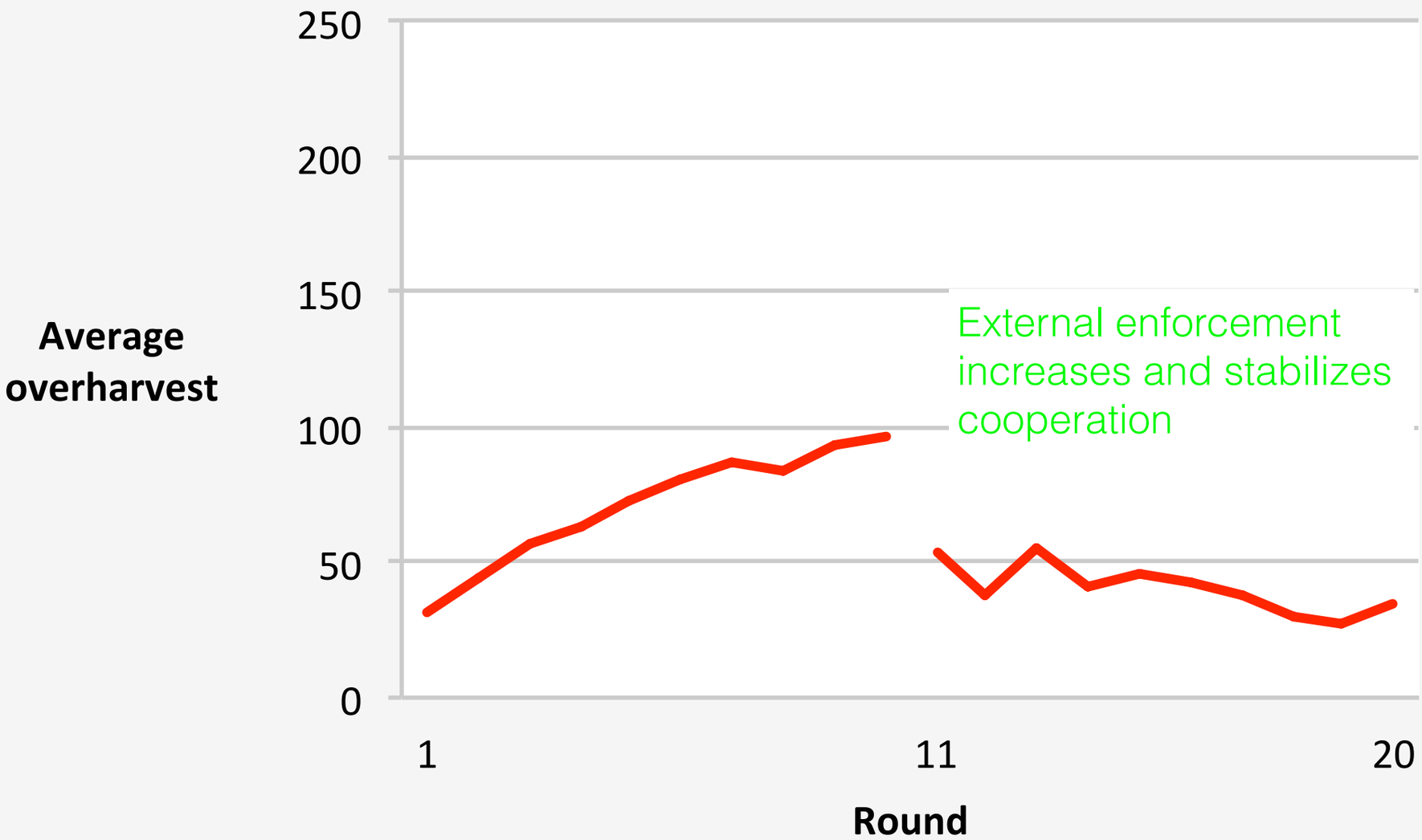
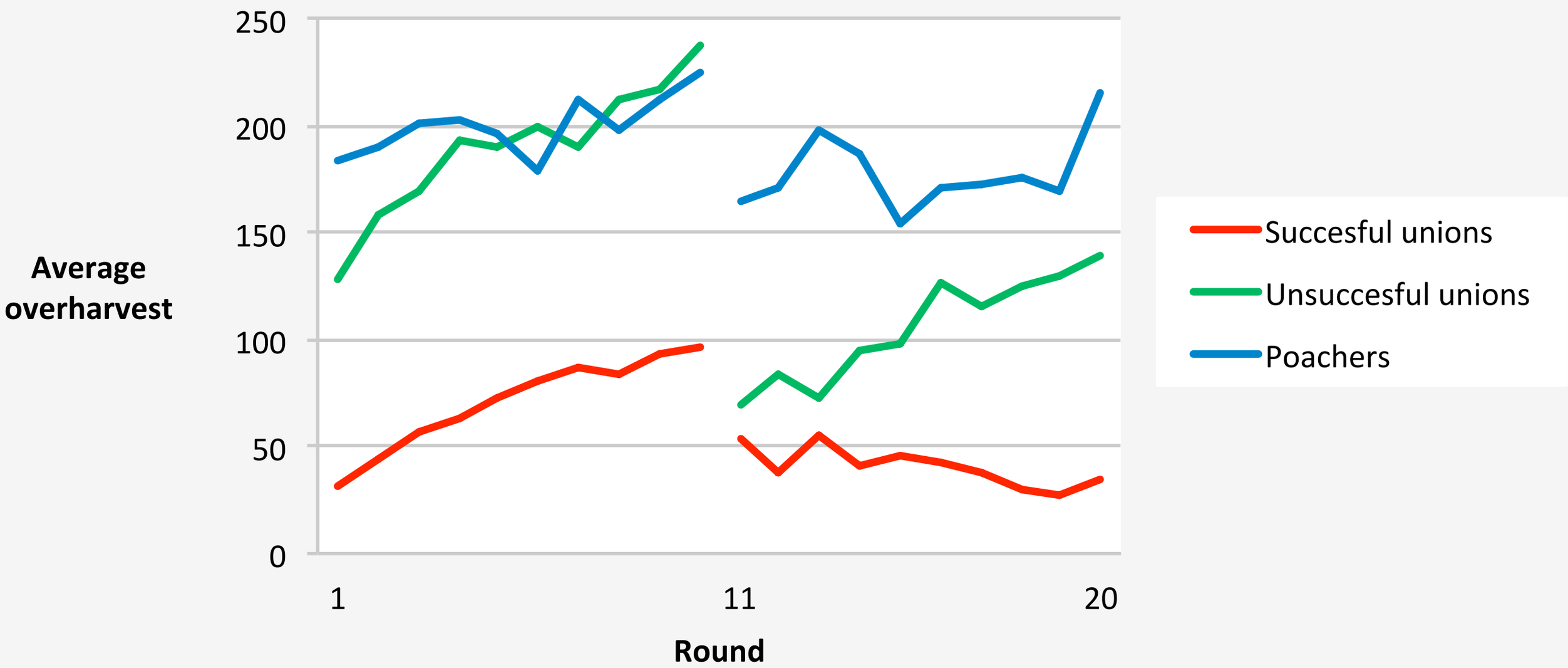


Experimental Results - Summary and Interpretation



Preliminary Results

CPR alternative framing

- In order to rule out self-selection of fishermen as an explanation for both the heterogeneity of behavior in the real world and in the lab, we consider an alternative collective action problem: **hakes**
- Institutional setting similar to **open-access** era of locos). Although there is a quota for hakes, this is not enforced and stocks are in bad shape.
- Enforcement structure in the lab CPR is based on **peer-to-peer monitoring.**

CPR protocol (concholepas + merluccius)

During the first ten rounds N = 5 fishermen play a CPR game:

- Individual quota: 100 units of *locos Price pero loco: U$ 0,02*
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Information between rounds

- average extraction,
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Payoffs are given by:

$$\pi_i = 0.02 \times \left(100 + x_i - \frac{1}{2} \sum_{j \neq i} x_j \right)$$

Unique NE: full over harvest

During the last ten rounds, peer to peer enforcement is also incorporated:

- 2 random pairs are chosen and for each pair, the roles of monitor and monitored are randomly allocated.
- if the monitor observes that the monitored party has exceeded his quota, for U$ 0.5 he can inform this and the monitored party will see his harvest confiscated.

Expected profits are given by:

$$\mathrm{E}\pi_i = 0.02 \times \begin{cases} 100 + x_i - \frac{1}{2} \sum_{j \neq i} x_j \text{ if } x_i = 0 \\ p(x_i) \times \left(100 + x_i - \frac{1}{2} \sum_{j \neq i} x_j \right) \text{ if } x_i > 0 \end{cases}$$

with $p(x_i) \in [0.6, 1]$

Unique Perfect NE: no sanctions, full over harvest

Loco Framing

The game recreates a situation where you go to capture locos and decide individually how many locos you should take.

The game is divided into 20 rounds, which represent diving trips. Each of you has an allocation of 100 locos per round, which was decided by the union (this is part the game, as the union is not involved in this research).

You will also have the option to take up to 50 additional locos for each round.

Getting more locos than the amount allocated to you by the union is beneficial for you from an economic point of view.

But on the other hand, economically detrimental to other members of your group. This is because for every two extra locos that you take out, each one of your bandmates will loose one loco. This is the damage that the over extraction creates on the marine ecosystem, reducing the productivity of all.

Hake framing

The game recreates a situation where you go fishing hake and decide individually how many fish you should take.

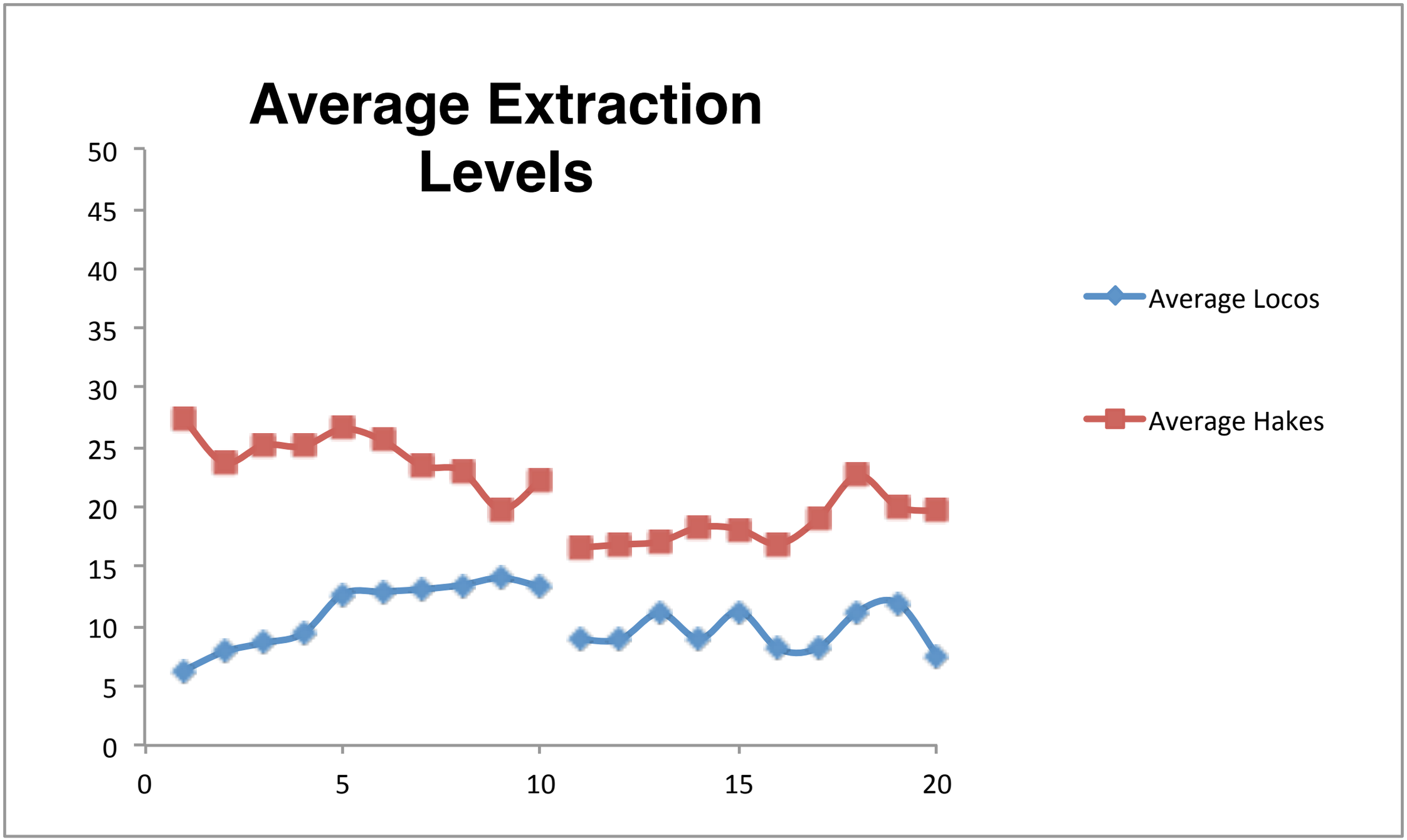
The game is divided into 20 rounds , which represent fishing trips . Each of you has an individual quota of 100 kilos of hake per round , which was assigned by SubPesca (this is part of the game, as SubPesca not involved in this research).

You will also have the option to fish up to 50 additional kilos per round .

Fishing more kilos than the quota stablished by SUBPESCA is beneficial to you from an economic point of view.

But on the other hand, economically detrimental to other members of your group. This is because for every two additional kilos you fish, your bandmates hake lose one kilo each. This is the damage that the over extraction creates on the marine ecosystem, reducing the productivity of all.

Experimental Results - Successful Unions



Experimental Results - Successful Unions