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A glance into the willingness to reduce overfishing: Field evidence from a fishnet exchange program

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Abstract:

This paper investigates the actual willingness to reduce overfishing in a fishnet exchange program implemented in Brazilian fishing villages. Fishermen who use fishnets with small mesh sizes were invited to an auction where they could bid negative or positive amounts to exchange their fishnet for a fishnet with a bigger mesh size. We observe that the majority of fishermen are willing to exchange their fishnets without further compensation. In addition, we observe that environmental perceptions and experiences with fishnets help explaining the heterogeneity in bids. Fishermen who are more optimistic that local overfishing can be stopped and who have already used fishnets with larger mesh sizes place significantly higher bids. These findings may provide useful information about the limitations and possibilities of changing the behavior of individuals who strongly exploit resources.

Keywords: auction, common pool resources, fishing, resource exploitation, willingness to change.

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1. Introduction

The prevalent overexploitation of natural resources such as fish stocks challenges policy makers to find mechanisms that limit resource exploitation. While standard economic theory predicts that we often cannot prevent the "tragedy of the commons" (Hardin, 1968) and examples of resource overexploitation are omnipresent, there are also cases of sustainable resource use and ideas about successful mechanisms (Ostrom, 1990, 2009; Baland and Platteau, 1996; Berkes and Folke, 1998; National research council, 2002). However, despite our improved knowledge about likely determinants of resource exploitation, we probably still do know not enough about factors related to the willingness of resource users to reduce their level of overexploitation.

In this study, we investigate individual bidding in a fishnet auction to estimate the willingness to reduce resource exploitation from fishermen whose livelihoods depends directly and crucially on fish stocks. More precisely, we invited fishermen in several traditional fishing communities to take part in a fishnet exchange program. Fishermen in these communities catch at a lake in which overfishing is a severe concern and partly caused by the use of fishnets with small mesh sizes in which large amounts of small and immature fish are caught. The program was targeted at the fishermen who use fishnets with small mesh sizes, and they were offered to place negative, zero, or positive bids for a fishnet with a bigger mesh size in exchange for their fishnet with a smaller mesh size. Besides observing the take-up rate of this auction and the actual bidding, we also relate the participants' choices to their individual characteristics such as risk preferences, environmental perceptions, and fishnet experiences. Moreover, because we have older data from the same fishermen on their hypothetical willingness to take part in a fishnet exchange we are also able to compare their hypothetical to their actual willingness.

We observe in the fishnet auction that almost 60% of the participants place zero bids; i.e., the majority is willing to exchange fishnets without further compensation. Almost 20% of

the participants do not want to take part in the auction although they can place substantially negative bids whereas more than 10% even place positive bids. Environmental perceptions about overfishing and experience with fishnets with larger mesh sizes are important determinants for auction behavior: fishermen who are more optimistic that local overfishing can be stopped and who have already used fishnets with larger mesh sizes place significantly higher bids. In addition, we observe that more risk-averse fishermen place higher bids and that the hypothetical willingness to exchange fishnets is quite accurately predicting the actual willingness.

While these findings are difficult to reconcile with standard economic theory, they are consistent with findings in behavioral economics. For example, there is considerable evidence that many resource users are cooperative and willing to refrain from overexploitation (Fehr and Gächter, 2000; Camerer, 2003; Anderies et al, 2011; Fehr and Leibbrandt, 2011); in particular, if other resource users are cooperative as well (Fischbacher et al., 2001, Keser and van Winden, 2002; Frey and Meier, 2004; Rustagi et al, 2011). These non-selfish motivations may account for the finding that a large fraction of fishermen is willing to exchange fishnets without compensation and that this willingness depends on perceptions about overfishing. Moreover, the finding that many fishermen are not willing to bid their fishnets despite considerable monetary incentives is consistent with the "endowment effect" (Kahneman and Tversky, 1979; Thaler, 1980; Kahneman et al 1990): fishermen appear to place a higher value on goods (here fishnets) if they are part of their endowment.

We view our study as a first attempt to investigate the actual willingness to reduce natural resource exploitation using individuals whose livelihoods critically depend on this very resource. While there is a large literature on contingent valuation of environmental resources (Rowe et al, 1980; Brookshire and Coursey, 1987; Urama and Hodge, 2006; for a review see Horowitz and McConell, 2002) we explore the actual willingness to reduce overfishing and use a good for which there is a well-defined market price (fishnets). Our

approach also contrasts with the existing literature on the actual willingness to change exploitation as this literature usually studies goods of low values that are typically below an hourly wage (Shogren et al, 1994; Lusk et al, 2001).

Studying the actual instead of the hypothetical willingness can be a significant advantage as there is evidence that the hypothetical willingness may be often severely biased (Bohm, 1972; Bishop and Heberlein, 1979; Shogren, 1990; Seip and Strand, 1992; Neill et al., 1994; Carson et al., 1996; List and Shogren, 1998; List and Gallet, 2001). In addition, studying the willingness to reduce overexploitation in the field as opposed to in the laboratory with artificial resources has the advantage of observing choices in the natural decision environment of the resource users. A further interesting feature of our study is that we investigate the willingness to reduce overfishing from resource users who particularly exploit fish stocks.

More generally, our study is related to the recent experimental literature on the role of individual variables such as preferences and beliefs for the sustainability of natural resources (Walker et al, 1990; Ostrom et al, 1992; Cardenas, 2000; Ostrom and Nagendra, 2006; Bouma et al, 2008; Anderies et al, 2011; Fehr and Leibbrandt, 2011; Cavalcanti and Leibbrandt, 2012; Cavalcanti et al, 2013). For example, Fehr and Leibbrandt (2011) show that the mesh size of the fishnet can be predicted by the fishermen's level of prosociality and impatience. Rustagi et al (2010) observe that the extent of conditional cooperativeness in forest user groups is related to forest commons outcomes. Bouma et al (2008) investigate correlates of community resource management and find that measures of social capital are related to household contributions to soil and water conservation maintenance. Cavalcanti et al. (2013) find that social networks play an important role for community participation. One crucial difference to these studies is that we investigate individual factors related to the willingness to *change* real environmental resource exploitation when resource users are offered an environmentally friendly technology instead of studying factors related to ongoing

exploitation. Thus, we can get a better glance into the role of individual variables that are related to the success of environmental programs/policies that aim at changing resource user exploitation behavior.

2. Field setting

The fishnet auction took place with professional fishermen from eight traditional fishing communities situated around a lake in the northeast of Brazil. Catching fish and shrimp is the main income source in these communities. Fishermen sell their catch at fish markets and thus provide their family with income and nutrition. Fishermen who catch fish use fishnets as fishing gear and these nets while identical on most dimensions differ according to their mesh size. Fishnets with smaller mesh sizes pose a considerable threat to sustainable fishing because smaller and immature fish are caught. As a rough reference point, note that small fish that are below the legal minimum size are frequently caught in fishnets with mesh sizes that are smaller than five centimeters.

The use of smaller mesh sizes is very common in the field setting (approximately two-thirds of the fishermen from this field setting report to use a mesh size that is smaller than five centimeters). In fact, note that while fishnets with smaller mesh sizes can be easily bought at local markets, fishnets with larger mesh size are not even readily available at the local markets. We had to commission the manufacturing of fishnets with a larger mesh size. Fishing with smaller mesh sizes leads to substantially higher individual incomes. Data from nine fishermen who frequently use two different fishnets – one with a smaller mesh size, and one with a larger mesh size corresponding to the one we auctioned – report to catch on average 16% more kilograms of fish per hour with the small mesh size. This suggests an income increase of approximately 8% when using the fishnet with the smaller mesh size assuming that the additional fish caught with the small mesh size are small fish, which are sold at a 50% lower price than the typical fish caught in a larger (and smaller) mesh size

(which is a realistic assumption based on information provided by the fishermen and own observations).

There is open access to the fishing grounds and there are no legal constraints concerning the mesh size of the fishnet. There is only one legal regulation concerning the catching of fish which is the prohibition of catching small fish (below 20–30 centimeters, depending on fish type). This regulation is, however, rarely enforced. Most fishermen do not fear controls and small fish are frequently offered at markets and in restaurants. In recent years, many fishermen have complained about decreasing catch rates and report finding fewer big fish, which they often blame on the catching of large amounts of small and immature fish (Cavalcanti et al, 2010; Cavalcanti et al., 2013). Governmental and local university institutions have taken note of the severity of the situation and first steps were initiated to fight overexploitation of the fishing grounds. The fishnet auction in this study may also be viewed as an attempt in this regard.

3. Fishnet exchange program: the fishnet auction

The fishnet auction took place in 2008. Before, in 2006, we conducted a longer survey with fishermen from this field setting in which we also asked participants whether they would be willing to exchange their fishnet with a small mesh size (< five centimeters) to a fishnet with a mesh size of five centimeters. In this survey, the majority stated their willingness to exchange and this provided the basis for the fishnet exchange program.

The fishnet exchange program conducted in 2008 used a sealed bid first-price auction for mainly two reasons. First, the first-price auction mechanism is useful to identify the true willingness assuming the number of bidders is sufficiently large, which was arguably the case in our auction[1]. Second, we believe that the first-price auction was easier to understand for the participants in our study than alternatives such as the Vickrey auction or the Becker-DeGroot-Marschak method. Consequently, we asked fishermen who possessed a fishnet with a mesh

size smaller than five centimeters to place bids for a new fishnet with a mesh size of five centimeters in exchange for their fishnet.

We informed the participants that we auction in total ten fishnets that are given to the ten highest bids from all participating fishermen. Fishermen were aware that the number of bidders is significantly larger than ten but they did not know the exact number of bidders. To the best of our knowledge participants understood the auction. We made it very clear to the participants that their bids in this auction are binding and that the exchange will actually take place. Fishermen were informed that they did not have to take part in this auction. They could either drop out of this auction (i.e. decide to not offer their fishnet), place negative (= exchange in combination with compensation), zero (= exchange without compensation or payment), or positive bids (= exchange with additional payment). More precisely, fishermen could either place no bids (not take-up), a negative bid of 50 Reais[2] (= cost of a new fishnet), 25 Reais, 0 Reais, or any positive bid. Note that 50 Reais is a relatively large amount of money for fishermen as it roughly corresponds to the income generated from five working days. Because the cost of a new fishnet is 50 Reais independent of the mesh size in this setting, all participants should enter the auction. For example, a successful negative bid of 50 Reais would provide fishermen with a new fishnet and the money to buy another fishnet.[3] In total, 69 fishermen were invited to participate in the fishnet exchange program.

One has to be cautious to interpret bids as the precise willingness to pay for sustainable fishing, as the exchange of the fishnet will affect income generated from fishing in a nontrivial manner. If we abstract from reduced congestion and search costs due to the use of the auctioned larger mesh sizes (which seems sensible in our setting given the relatively small number of auctioned fishnets), we estimated an expected income loss of approximately 8%. Thus, in our setting bids are probably a conservative estimate of the willingness to pay for reducing overfishing.

4. Survey data

The fishnet auction was implemented at the end of a survey that was conducted individually and in private. Participants were not allowed to talk about the survey and their bids until all participants were interviewed. Before fishermen knew that there was a fishnet auction we asked them whether they have a fishnet with a small mesh size (3–4.5 centimeters[4]), and if yes, how old this fishnet is. Then, and only if fishermen responded to the first question with yes, we announced that there is a fishnet auction and we explained its details. In the survey we collected information on the participants' socio-demographic characteristics, fishing related information, and their perceptions about the local fishing situation.

88.4% of the participants are male (n=69). The mean age is 38.75 years and the mean participant attended school for 3.11 years (variable: *education*). 62.3% already possessed the auctioned fishnet in the past (*experience*). 77% of the fishnets that participants would have to hand over in case of a successful bid were on average used for no more than two years (according to fishermen fishnets have a wear of about 2-3 years). We observe that participants differed in their perception of the likeliness that overfishing is stoppable (*environmental perception*). 42.2% believe that is *very* likely that over-fishing is stoppable, 45.6% believe that it is likely, 5.9% believe it is unlikely, 4.4% very unlikely, and 2.9% do not believe that local overfishing is stoppable. All reported survey responses are summarized in Appendix Table 1.

After the surveys and the fishnet auction the participants took part in an experimental session that included a lottery to measure their risk preferences. Fishermen received ten points and chose how many of these points they wanted to invest in a lottery. The lottery was implemented with the help of a coin flip. If participants guess the right side of the coin in advance, their investment is multiplied by 2.5; however, if they guess the wrong side they lose their complete investment. If a participant is risk-neutral, he should invest all ten points as the

expected payoff is 1.25 × investment. There was a 40 percent probability that the outcome in the lottery became payoff relevant. If the lottery game was payoff relevant, one point equaled one Real. We find large levels of risk-aversion in our participant pool. On average, participants do not invest 6.81 out of the 10 points and 21.7% even invest zero. The mode is to invest five points (24.6%).

5. Results

Table 1 reports the behavior in the fishnet auction and Appendix Table 2 reports the behavior in the fishnet auction for each community separately. In Table 1 and in our consecutive analysis and tables we use for practical reasons six categories of bids (no bid, -50, -25, 0, 1-10, 11-35).[5] We observe that 17.4% (12 out of 69) did not place any bid, i.e. they did not want to exchange their fishnets even if they were given 50 Reais in compensation. 5.8% (n=4) and 4.4% (n=3) placed a negative bid of 50 and 25 Reais, respectively. Interestingly, the majority of fishermen (59.5%; 41 out of 69) placed zero bids, and nine participants placed positive bids (1, 1, 5, 10, 10, 15, 16, 20, 35). In consequence, all participants with positive bids won the new fishnet, and one participant who was randomly chosen among those who offered zero bids.[6]

<Insert table 1 here>

Table 2 shows the relationship between bidding and the perception about the extent to which overfishing is stoppable – which we term environmental perception. It seems plausible that fishermen are willing to bid higher values for fishnets that help reducing overfishing if they are more optimistic about the chances that local overfishing is stoppable. Consistent with this conjecture, we observe a strong positive correlation between bids and our measure of environmental perception significant at the 1%-level (Spearman, $r = 0.321$, $p = 0.008$). For example, 24 out of 28 participants who believe that it is very likely that over-fishing can be stopped place non-negative bids, whereas 6 out of 9 participants who believe that it is unlikely

that over-fishing can be stopped place negative bids. Moreover, fishermen who did not bid have more negative perceptions than fishermen who placed bids (Fisher exact, $p = 0.0448$)

<Insert table 2 here>

An additional factor that may play a role is whether fishermen have already used the mesh size of the offered fishnet. It seems plausible that fishermen who have already used this mesh size can better evaluate its profitability and/or are less hesitant to use fishnets with larger mesh sizes and thus place higher bids in the fishnet auction. On the other hand, it could also be that those fishermen place lower bids because they have switched to using a fishnet with a smaller mesh size. Table 3 illustrates the bids for fishermen depending on their experience. Without controlling for other variables there is a positive but yet insignificant relationship between experience and bids (Spearman, $r = 0.127$, $p = 0.298$) suggesting that experience with fishnets with a bigger mesh size is rather associated with an increase than a decrease in the willingness to bid for a fishnet with a bigger mesh size.

<Insert table 3 here>

In Table 4 we present three ordered probit models in which we regress bids on *environmental perception*, *experience* and other potential covariates.[7] Model 1 uses *environmental perception* and *experience* as independent variables simultaneously. Models 2 and 3 control in addition for *fishnet age, income, risk-aversion, age, gender* and *education.* The difference between models 2 and 3 is whether we control for community fixed effects (model 3) or not (model 2). We chose these controls for the following reasons. *Fishnet age* may predict bids as participants with older, i.e. less valuable, fishnets may have an incentive to place higher bids to exchange their fishnet than participants with new fishnets. *Income* may

be positively related to bids. For instance, participants with higher incomes may place higher bids because they are less threatened by potential income loses using a fishnet with a larger mesh size (Kahneman et al, 1991). *Risk-aversion* may be related to bids in several ways. On the one hand, more risk-averse participants may place higher bids to increase the chance of winning the auction. On the other hand, more risk-aversion participants may also place lower bids because they are less inclined to take the risks using a fishnet with a larger mesh size. We included *age* as it seems plausible that older fishermen are less willing to bid higher values as they may have formed a habit about using certain fishnets (Holland and Sutinen, 2000) and we included *gender* as there is some evidence that men are less willing to cooperate in some contexts (Croson and Gneezy, 2009). Finally, we control for *education* as more educated fishermen may have a more accurate perception of the costs and benefits with different mesh sizes.

We find that *environmental perception* is in all three models a highly significant predictor ($p < 0.001$). Fishermen who are more optimistic about the chances of overcoming overfishing place higher bids and thus are more willing to obtain fishnets with larger mesh sizes. *Experience* is also a highly significant variable in all three models ($p < 0.032$). Fishermen who have already experienced the use of a fishnet with a large mesh size are willing to place higher bids and thus are probably more willing to return to the use of fishnets with a large mesh size.[8]

The only other variable significantly predicting bids is *risk-aversion*: more risk-averse fishermen place higher bids ($p < 0.032$). The relationship between risk-aversion and bids can also be seen in Appendix Table 3; the raw correlation is insignificant at $p=0.261$ (Spearman; $r = 0.137$). *Fishnet age, income, age, gender* and *education* are neither in model 2 nor 3 significant at the 10%-level.

<Insert table 4 here>

Our field study also renders it possible to relate the hypothetical to the actual willingness to reduce overfishing. We asked fishermen during a longer survey in 2006 whether they would be willing to exchange their fishnet without compensation. The answer was affirmative for 61.1% (33 out of 54). In the fishnet auction in 2008 we observe a slightly higher willingness to exchange the fishnet without further compensation (72.5%; Fisher Exact test, $p = 0.245$, two-sided). Table 5 reports data from 26 fishermen who took part in the 2006 survey and the fishnet auction in 2008. 17 of these 26 fishermen stated that they are willing to exchange fishnets without compensation and also actually placed non-negative bids in the fishnet auction. Four fishermen stated they are not willing to exchange fishnets without compensation but two years later placed zero bids in the fishnet auction. Only two fishermen stated to be willing to exchange fishnets without compensation but placed no bids. The relationship between the binary survey response and the six categories of bids in the auction is significant at the 2%-level (Spearman, $r = 0.463$). This suggests that in our environment and for this type of auction, the hypothetical willingness to reduce resource overexploitation may be a quite accurate predictor for the corresponding actual willingness (for similar evidence see e.g. List and Shogren, 2002).

<Insert table 5 here>

6. Conclusions

In this paper we investigate the willingness to reduce natural resource exploitation with a fishnet auction where participants had the possibility to place bids to exchange their old fishnet with a small mesh size for a new fishnet with a large mesh size. We observe that the majority is willing to exchange their fishnets without further compensation but also that there is considerable variation in bids. Environmental perceptions about overfishing and experience with larger mesh sizes are two important variables that help to explain the variation in bids.

A shortcoming of this study is the small sample size and the absence of experimental manipulations to cleanly identify the causes behind the willingness to exchange fishnets. For example, it would have been very informative if we could have randomly distributed fishnets (i.e. test material) before the auction and thus had a more exogenous measure of experience with larger mesh sizes. Nevertheless it is our hope that these findings provide useful information for policy makers and managers fighting resource overexploitation.

Our findings suggest that there may be a higher than expected willingness to change and that environmental perception management and test material for resource users could be promising means to increase the willingness to refrain from resource overexploitation. They may be particularly useful in field settings like ours where reputation concerns do not sufficiently deter resource users from overexploitation.

An interesting feature of our fishnet exchange program is that it is targeted at individuals who exploit the fishing resources strongly by using fishnets with small mesh sizes. Understanding the behavior and finding means to change the behavior of the individuals which exploit the resources the most may go a long way as there is evidence that many individuals are conditionally cooperative, i.e. they are willing to cooperate in sustaining resources but only if there are no other free-riding resource users (Fischbacher et al., 2001, Keser and van Winden, 2002; Frey and Meier, 2004).

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Tables

Table 1 – Summary of bids in the fishnet auction

	No bid	-50	-25	0	1-10	>10
N	12	4	3	41	5	4
Percentage	17.4	5.8	4.3	59.5	7.2	5.8

Table 2 – Bids in the fishnet auction and environmental perceptions

Is over-fishing stoppable?	No bid	-50	-25	0	1-10	>10
no	2					
very unlikely	1	1		1		
unlikely	1		1	1	1	
likely	6	2	1	19	1	2
very likely	2	1	1	19	3	2

Notes: Numbers in cells indicate number of bids.

Table 3 – Bids in the fishnet auction and experience

	No bid	-50	-25	0	1-10	>10
No experience (%)	23.1	7.7	3.8	53.9	11.5	
Experienced (%)	14.0	4.6	4.7	62.8	4.6	9.3

Notes: experience = fishermen has used before the auctioned fishnet.

Table 4 - Predicting bids in fishnet auction (ordered probit)

Model	1	2	3
Environmental perception	0.12436***	0.13424***	0.13552***
	(0.03210)	(0.03656)	(0.03395)
Experience	0.13456**	0.18499***	0.17052**
	(0.06279)	(0.06876)	(0.07146)
Fishnet age		0.00284	0.00662
		(0.00619)	(0.00822)
Income		-0.00009	-0.00001
		(0.00016)	(0.00016)
Risk-aversion		0.02442**	0.02419**
		(0.01137)	(0.01123)
Age		-0.00351	-0.00359
		(0.00216)	(0.00240)
Gender		-0.00539	0.00566
		(0.07450)	(0.08272)
Education		0.00311	0.00200
		(0.01004)	(0.01115)
Community fixed effects?	no	no	yes
Pseudo r2	0.08	0.147	0.159
N	68	63	63

Notes: *** p<.1, ** p<.05, *** p<.01; numbers represent average marginal effects; robust standard errors in parentheses.

Table 5 - Bids in the fishnet auction and hypothetical willingness to exchange fishnets

Hypothetical willingness?	No bid	-50	-25	0	1-10	>10
No	2	1	1	3		
Yes	2			13	3	1

Notes: Numbers in cells indicate number of bids.

APPENDIX

Table 1 - Summary of variables

Variables	Description	Mean	SD	N
Bid	bid in auction; 0 = no bid, 1 = -50, 2 = -25, 3 = 0, 4 = 1-10, 5 >=10	2.51	1.39	69
Hypothetical WTA	whether fishermen reported in 2006 to be willing to exchange fishnet; 0 = no, 1 = yes	0.61	0.49	54
Fishnet age	age of fishnet participants offer in auction	2.19	3.96	66
Experience	did fishermen already use auctioned fishnet?; 0 = no, 1 = yes	0.62	0.49	69
Environmental perception	how likely fishermen believe over-fishing is stoppable; 0 = impossible, 1 = very likely, 2 = unlikely, 3 = likely, 4 = very likely	3.18	0.95	68
Risk-aversion	not invested points in lottery game; 0 (least), -10 (most)	6.81	2.30	69
Age	age of fishermen	38.75	13.02	69
Gender	gender of fishermen; 1 = female, 2 = male	1.88	0.32	69
Education	how long fishermen went to school	3.11	2.48	68
Income	generated income from fishing in Reais	276.98	220.62	68

Notes: SD indicates standard deviation and N the number of observations.

Table 2 - Summary of bids across fishing communities

Community	No bid	-50	-25	0	1-10	>10
1		1		2		
2				2		
3	3		1	4		
4	2		1	10	1	1
5	1		1	8	1	1
6	3			4	1	
7	1	2		6	1	1
8	2	1		5	1	1

Notes: Numbers in cells indicate number of bids.

Table 3 - Summary of bids and level of risk-aversion

Level of risk-aversion	No bid	-50	-25	0	1-10	>10
10	3			9	2	1
9				1		
8	1		1	7	1	1
7	3	1		5	1	
6	3			4	1	
5		1	2	13		1
4		2		1		1
2	2					
0				1		

Notes: Numbers in cells indicate number of bids. Level of risk-aversion = points not Invested in lottery.

[1] If bidders are independent, homogenous, and risk-neutral then the Nash equilibrium in the first-price auction is to bid $b_i = \left(\frac{N-1}{N} \right) \times v_i$, where b_i is the bid of individual i, N the number of bidders in the auction, and v_i the true value of the good for the bidder (Vickrey, 1961).

[2] The Brazilian currency is called Real (singular) or Reais (plural). 1 Real equaled US $ 0.61 in September 2008; mean daily available income is approximately 10 Reais.

[3] Assuming there are no significant transaction costs. This is a realistic assumption in these communities as fishnets with small mesh sizes are frequently sold on the fish market.

[4] There are fishnets with mesh sizes smaller than three centimeters. These fishnets, however, are typically only used to catch bait. This is why we did not offer the possibility to exchange this kind of fishnets.

[5] Our analysis is not sensitive to this categorization. The findings are very similar when using different categorizations.

[6] The costs for the experimenter were 10 × 50 - (1+1+5+10+10+15+16+20+35) = 397, i.e. the auction saved approximately 20% of the costs as compared to if ten fishermen had received new fishnets for free.

[7] We use an ordered probit model because our dependent variable is ordinal and has six categories. Results are very similar if we use OLS regressions.

[8] Interestingly, *experience* and *environmental perception* are marginally negatively correlated ($r = -0.208$, Spearman, $p = 0.088$), i.e. fishermen who have no experience using a fishnet with a larger mesh size tend to be more optimistic that over-fishing is stoppable. This negative relationship helps explaining why *experience* is significantly related to bids after controlling for *environmental perception*.