Coalitions, Competition, and Conservation: Spatial Procurement Auction Design and Performance[1]

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Extended Abstract

Spatial configuration is an important determinant of the cost-effectiveness of bids in conservation auctions, because a parcel's location on the landscape is critical in defining the benefit of conservation actions undertaken on the site. A parcel's location is also important because the benefits of some conservation practices may increase nonlinearly in area, meaning that total benefits procured and overall cost-effectiveness might increase if multiple adjacent bidders were able to offer the same conservation practice in their bids. For this reason, past researchers have explored the impacts of additional payments made for coordinated conservation practices, termed an agglomeration bonus. Researchers have also explored the impacts of joint bidding, in which coalitions of adjacent bidders enter a single offer, on conservation auction performance, and have focused on conservation auctions that explicitly consider spatial coordinated project selection as a goal of the auction

In the current paper, we present a spatial conservation auction and evaluate the performance of the auction and individual behavior using results obtained from controlled laboratory experiments. Our auction incorporates an agglomeration bonus component, whereby bids for the same practices from neighboring producers have a higher chance of being selected in the auction, because coordinated, aggregated adoption of the same conservation practices generates additional benefits.

Past research has indicated the overall complexities associated with the bid-submission process in non-spatial conservation procurement auctions. These complexities are expected to be further magnified in spatial conservation auctions in which bidders must select one of several available conservation practices (e.g., riparian buffer, cover crops, pollinator and other animal foraging patches etc.) in addition to attempting to coordinate their practice choice with

neighboring producers to submit bids that maximize the expected return of auction participation. In keeping with the findings of, we evaluate auction performance and bidder behavior by varying two key auction design features, the format in which environmental quality information is provided and the opportunity for bidder communication, in ways meant to explore the tradeoffs between efforts to achieve desired spatial patterns of conservation practices, while managing bidding complexity and concerns of facilitating additional rent-seeking and collusive bidding. These alternative design features are implemented as between-subject treatments in controlled laboratory experiments.

The design features chosen for adjustment share tradeoffs relating to ease of bid formation, including item selection, with the opportunity for increased rent-seeking when bidders have information that makes them confident in the strength of their bids, behavior that has been observed in laboratory experiments with non-spatial auctions. In spatial auctions, with increased complexity in the bid-formation process, understanding the combination of information access and opportunity for coordination between bidders that provides the most cost-effective bids is critical. In the absence of prior information about whether the positive or negative effects of information provision and communication will dominate, the results of our inquiry should be a meaningful contribution to the conservation auction design literature.

We explore the impacts of variation in our chosen aspects of auction design when coalitions of optimal conservation practices are arranged in different spatial configurations. Specifically, our alternative landscapes involve a single large coalition (Single-Large) or two smaller equal sized coalitions (Several-Small). Creation of specific configurations of land use practices on geographical landscapes has long been a subject matter of conservation biology, reserve design for species conservation and ecosystem services provision research. The SLOSS debate in conservation biology considers the relative merits of aggregating conserved habitat in a Single Large contiguous area, which minimizes edge effects, versus Several Small reserves, which allows for greater resilience of the targeted habitat in relation to climate change, disaster, and disease.

The variation in spatial configuration of land use practices presents the opportunity to systematically evaluate the bidding behavior of participants depending upon whether or not they are part of the coalition of winners that would be selected by the auctioneer in the absence of asymmetric conservation practice cost information. Furthermore, we are able to explore the manner in which bidders' location within the winning coalition on the landscape has bearing on their bidding behavior and the implications of this behavior on auction performance. We believe these aspects to be a seemingly critical aspect of spatial payment for ecosystem services program design that to the best of our knowledge has been relatively neglected in the existing literature.

On the basis of controlled laboratory experiment sessions, we find that the level of environmental quality information that leads to the best auction performance, in terms of cost-effectiveness, depends on landscape type and communication opportunities. Access to absolute benefit value information never improves auction performance in the absence of communication, though with communication this information does improve performance in the Several-Small configurations. The impact of access to ranked benefit information depends entirely on communication: without communication this information enhances auction performance in the Single-Large landscape, while this information improves performance in the Several-Small configuration with communication.

The mechanisms behind our auction performance results can be partially explained by results from our analyses of bidder behavior. We find that access to absolute benefit information increases the likelihood of selecting a bidder's optimal item in both the Single-Large and Several-Small configurations regardless of the communication treatment. Despite these heightened abilities to identify a bidder's optimal item for submission, we do not find that access to any form of item-quality information improves our bidder-level measure of cost-effectiveness. These results are all consistent with the idea that successful bidding in a spatial conservation auction requires substantial coordination between bidders, which, if realized, results in more confidence in the desirability of bids from coalition members. A bidder's ability to translate this confidence into increased rent-seeking behavior depends on the configuration of the landscape, with heightened opportunities to do so in larger bidding coalitions.

Appendix: Experimental Instructions

General Information:

Welcome! This is an experiment in economic decision making and it has **two stages**. You will be paid in cash on the basis of your choices in this experiment. If you follow the instructions carefully, you will be well-prepared to succeed today.

Your total earnings in Stage 1 will be recorded in real US$ and earnings from Stage 2 will be recorded in experimental currency units (ECU). At the end of the experiment, ECU will be converted to U.S. dollars at the rate of 1 U.S. dollar for every 27 ECU and will be added to your earnings from Stage 1. In addition to the earnings from Stages 1 and 2, you will also be paid a show-up fee of $9.

If you have any questions during the experiment, please raise your hand and wait for the experimenter to come to you. **Please do not talk, exclaim, or look at the computer screens of other participants during the experiment**. Cell phones must be switched off or placed into airplane mode. Participants intentionally violating the rules will be asked to leave the experiment and will not be paid.

Please raise your hand if you have any questions or click "Continue" to proceed to Stage 1.

New Screen: Stage 1 Instructions

In Stage 1, you will be given 10 different **scenarios** in which you must choose between **alternatives LEFT** and **RIGHT**. In each **scenario**, the **alternative LEFT** gives a certain payment. If you choose **alternative RIGHT**, your payment depends on chance. Let us consider an example **scenario**.

Example: Here you must decide whether you prefer **alternative LEFT** in which you receive **$1.75 for certain** or **alternative RIGHT** in which there is a **50% chance that you receive $2.50 and a 50% chance that you receive $0.**

LEFT	Please indicate your choice	**RIGHT**
$1.75 for certain	**LEFT○ ○RIGHT**	50% chance of $2.50 and 50% chance of $0.

<u>**Earnings in Stage 1**</u>

Earnings for Stage 1 will be calculated at the end of the experiment. Only one of the 10 scenarios **will be used for computing your earnings in Stage 1.**

Please raise your hand if you have any questions. Otherwise, click "Continue to Stage 1 Task" to proceed.

<u>**Earnings in Stage 1**</u>

We will now determine the earnings from Stage 1. Remember that only one of the 10 decisions you made will be used for computing your earnings in Stage 1. The **scenario** will be selected at random - the experimenter will publicly draw a card from a shuffled deck of cards numbered 1 through 10 (corresponding to the 10 **scenarios**). Each **scenario** has the same probability of being picked. The **scenario** picked will be the same for *everyone* in the room.

Once the **scenario** has been picked, another card will be randomly picked from a deck of two cards that contains one face card (a Jack) and one non-face card (#2). **The card drawn will determine the earnings of everyone that picked** alternative **RIGHT for the** scenario **chosen in the first card draw:**

- If the Jack is picked, those that picked RIGHT will receive the high payoff ($2.50).
- If the #2 card is picked, those that picked RIGHT will receive $0.

Everyone that picked LEFT will receive the certain payoff for the **scenario**.

Please raise your hand if you have any questions. Otherwise, click "Continue"

Description of Stage 2 Setting

In this stage, everyone is in a 12-person group and has a randomly assigned unique Subject ID visible on your screen. <u>Please only use this ID to identify yourself in the experiment.</u> The **12** people are arranged around a circle. The numbers on the circle represent every person in your group. On this circle, everyone has two neighbors - **a right or anti-clockwise** neighbor and **a left or clockwise** neighbor. <u>**Your neighbors will be the same all throughout Stage 2.**</u>

Please note: ID assignments have been randomly determined for all participants and does not reflect anyone's computer terminal or seating location.

Description of Auction

- In Stage 2, you will participate in multiple auctions with many rounds. Each round has many steps
- In each auction, you have three types of items – **Red, Green,** & **Blue**.
- Each item has a **Cost** and **Quality.** These values will change from auction to auction.
- These values will be shown on your computer screen.
- Your items' values are not known to others and vice-versa.
- In the auction, you will select one of your items and submit a Bid at which you are willing to sell this item. This Bid is the price you will receive for that item if it is selected in the auction.

Communication between Rounds of an Auction:

During an auction round, you can discuss all aspects about the auction with your neighbors through on-screen chat windows. But please (1) **only use your ID to identify yourself** and (2) **be civil to one another and do not use profanities**.

Only you and the neighbor you are communicating with will be able to view these messages. You will be able to communicate for 30 seconds in each round before the chat windows disappear automatically. All messages exchanged in previous rounds will be visible to you when you are communicating with your neighbors in the current round.

Item and Bid Selection

During an auction round, you will select and submit a bid for one of your items. The computer is the auctioneer. In every auction, the computer has the same budget that it wants to use up to buy some of the submitted items. The computer will choose items such that the sum of item qualities is maximized for the total money spent. The value of this budget will not be known to you.

For this, the computer calculates the Total Score of all combinations of submitted items and selects the winners, given the budget. The group members that own the selected items are the **temporary winners** of that round. Then the next round begins and the process is repeated. This process continues till the **final round** is reached. The people who are selected as temporary winner in this round become the **final winners**. These individuals' items are purchased by the computer and they receive a profit that contributes to their experimental earnings.

If your item has not been selected in a round, a decrease in your item's bid or selection of a different item may improve your chances of being selected in the next round. **The computer will display an error message if you (i) submit a bid that is less than the cost of your item or (ii) submit a higher bid for an item in a round if it was selected in the previous round.**

How the Computer Determines Winners in A Round

The computer values the quality of an item but also how many of the same colored item are offered by neighbors. To decide which items to purchase, the computer calculates the Total Score for all possible combinations of submitted items that can be bought with the budget and selects the combination with the highest Total Score. The Total Score comprises of two values – Total Quality and Total Bid of the combination. For this the computer executes the following steps.

1. It selects one of the item combinations which can be bought with the budget

2. For Total Quality calculation, the computer sums up the quality of all items in this combination. It then adds a **Premium Value** for each item in this combination that has a neighboring item of the same color. The greater the number of neighboring identical items included, the greater the Premium added to the sum of quality.
    - **In the experiment the Premium Value is 25.**
3. For Total Bid calculation, the computer sums up the bids of all items. Then, for all selected neighboring items of the same color, an additional **Bonus** payment is added to the sum of bids. The greater the number of same colored neighboring items included in the selected combination, the greater is the Bonus, added to the sum of bids.
    - **In the experiment the Bonus is 50 ECU**.
4. It then calculates the Total Score = ratio of the Total Quality and Total Bid

The computer repeats these steps for all combinations and then selects the combination which has the highest Total Score.

Although the computer prefers to purchase blocks of items of the same color, winning combinations may also include items of participants who are not neighbors or are neighbors but submitted different colored items. These items are not assigned Premium Values and Bonuses when calculating the Total Score.

Also, it is possible that the computer will not buy an item from you in any round of the auction. Since item selection in a round depends on everyone's submissions, it is also possible that even if you were a temporary winner in the previous round, you will not be selected in the current round.

Information you will receive after winners are determined

The computer will display the following information at the end of a round.

1. Whether you are a temporary or final winner
2. The color, cost and submitted bid of your item
3. Whether your neighbors have been selected or not
4. The color of your neighbors' submitted items
5. Your profit and bonus earnings for that round. Note that if the current round is the final round, and if you are selected as a temporary winner in this round, you will be the final winner in the auction. The displayed profit will be your profit for this auction.

Description of Auction Earnings

Each auction has multiple rounds and which round is final is not known in advance. Different auctions can have a different number of rounds. The computer will only make a purchase in the **final round**. If you are a temporary winner in a round and this round happens to be the **final round**, you become the **final winner** of the Auction as a whole. Experimental earnings are only affected if your bid is selected in the final round of an auction. If you are a final winner of an auction, your Profit in that auction will be

$$\textbf{Profit} = (\textbf{Bid} - \textbf{Cost}) + \textbf{Bonus x Neighbor}$$

The value of the term Neighbor in the expression is given by the following table

Neighbor Status	**Both Neighbors selected & submitted same colored item as you**	**One Neighbor selected & submitted same colored Item as you**	**Both Neighbors selected but only one neighbor submitted the same colored item as you**	**Both Neighbors selected but submitted different colored Item as you**	**No Neighbor selected**
Neighbor =	2	1	1	0	0
Bonus Added to Profit	100 ECU	50 ECU	50 ECU	0 ECU	0 ECU

Thus greater the number of neighbors who are selected and submitted the same colored item as you, greater is the bonus you receive and greater is your auction profit if you are a final winner.

Important: you pay an item's cost only if you are a final winner. If you are not a final winner and do not sell an item, your earnings for that auction are zero.

Once you review this information, please click **"Proceed to Quiz"**. After the quiz which checks your understanding of Stage 2, there will be a practice auction. This auction will only have 2 rounds so that you can become familiar with the auction. Your choices in the quiz and practice auction will not influence your cash payment in any way.