Kuwinda Nyama

A multi-player hunting game for social learning and sustainable use

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License

Cover page image: Hunters in a logging concession, Northern Congo © John Sidle

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Why use games?

Games can help people learn about complex issues, make choices and adapt their actions as they observe the consequences of their choices. Games allow adults and children to explore, safely, different scenarios that can generate a variety of outcomes depending on the choices they make as they play the game. Games allow people, quickly and at no risk, to experiment with implementing different courses of action and determining which best achieve their goals.

Playing games is a tried and tested way to promote learning and insights. Unfortunately, many modern games have been developed as university level teaching tools, and typically require either a laptop computer or internet connection, or both. This game is simple and relatively quick to play, requires only locally available and low-cost materials, and is even appropriate for players with low levels of literacy and numeracy, with little or no experience with multiplayer and role-playing games.

Experience from developing and playing these games with many communities confirms our belief that games that are fun to play, have few rules, rely on learning by doing, and enable failure, provoke discussion and collaborative problem solving are essential for adaptive social learning.

Social learning is essential for effective community-led conservation and development as it enables people to prioritize both individual and collective strategies and, most importantly, develops the social cohesion they need to work together, to solve their common problems.

Kuwinda Nyama Congo © F. Sandrin/WCS

Why a hunting game?

Indigenous Peoples have been hunting wildlife, for food and to trade, for millennia. Using traditional, relatively inefficient, weapons such as blowguns (e.g., Dayaks of Indonesia, and Yanomami of Venezuela) or stone tipped arrows (e.g., Efe of DR Congo and the Aka of Cameroon) indigenous hunters rarely had an adverse impact on the population size of the animals they hunted. It is not surprising, therefore, that most traditional hunters believe

that wildlife are an inexhaustible resource. Recent adoption of firearms and metallic and nylon snares by many traditional hunters has dramatically increased the number of animals they can kill in a day. As a result, wildlife populations in many places are declining. The challenge is that traditional hunters often still believe that wildlife can never be depleted by their hunting. In fact, they often find novel ways to explain wildlife scarcity where they have hunted for generations. For example, the Sarayaku of Ecuador, say that the white-lipped peccaries that once were abundant within their forest are now scarce because they are being hidden by shaman of the Jivaro people who live to the south. We wondered how best to promote discussion amongst groups of hunters about the likely impact of hunting on the wildlife they depend on for food and income.

We knew that Dennis Meadows of the MIT Sloan School of Management had developed a board game, called “Fishbanks” to enable his students to better understand the challenges of preventing or avoiding overfishing on the high seas. When he lectured on the topic, all his students would nod their heads agreeing that fishermen would have to be crazy to wipe out a fish stock that their livelihoods depended on, but that is exactly what the students typically did when playing the game. This provoked lively discussions and better understanding into how it was possible to know that overfishing was not a sensible long-term strategy, but cause that outcome to happen almost every time they played the game.

Teams in the Democratic Republic of Congo (DRC), and the Republic of Congo (ROC) decided that simple role-playing games might allow hunters to see how their individual decisions about how many animals to kill each time they go hunting might sustain or deplete the wildlife they target. The teams thought that by playing these games hunters would observe that depending on the choices they make wildlife population numbers might remain stable or decline to local extinction.

Kuwinda Nyama DRC © F. Sandrin/WCS

Playing the game in a public space with others from the community looking on extends the number of people who can learn about the consequences of player decisions on where, how often and how much to hunt. The ongoing conversation during the game encouraged players and observers to talk out loud about which decisions resulted

in desired outcomes and which caused wildlife numbers to decline, jeopardizing the nutritional and income security of wildlife dependent families.

What is the game trying to achieve?

This hunting game is actually played in three versions. Each includes two scenarios. The games are played in sequence, with days, weeks or even months between game playing sessions. Each progressive version of the game adds complexity and realism. Preferably each of the three games is played with the same group of hunters (players). By playing all three versions of the game, hunters will have had multiple opportunities to talk amongst themselves and with others watching the games about hunting for food and income. Each version of the game provokes different conversations and leads to an increase in community understanding of how hunting decisions can generate desired benefits but can also result in depletion of the very natural resources that are central to hunting communities food and income security and cultural sense of self. Playing the games typically brings community members closer together in terms of their shared understanding of the challenges and the culturally preferred actions they can take together to ensure that their hunting practices are sustainable and guarantee that wildlife populations will remain at levels sufficient to meeting both dietary and income needs long into the future.

"I have a lot of experience of hunting and I can tell you that the animals in the forest have diminished a lot. Today you can walk for miles and miles without seeing a single track."

Game Player Quote

The first version of the game assumes that hunters, typically, all hunt in the same area, have less than complete knowledge of how many animals are present where they hunt, and rarely, if ever, share information about how many animals they hunt with other hunters or groups of hunters. So this game starts with a scenario where the players (hunters) do not know how many animals are available to hunt, nor do they know how many animals each hunter is hunting, nor are they allowed to talk with one another during the game. Then the game is repeated but in this second scenario the hunters can see how many animals are available to hunt and how many animals are hunted by each player. They can also talk with one another during the game. This game is designed to allow players to explore and discuss how access to information about wildlife numbers and offtake (i.e., the number of animals hunted) and open communication and transparency amongst hunters can

influence the level of hunting and its impact on wildlife populations.

Bate's pygmy antelope © D. Wilkie/WCS

The second version of the game builds on the first by allowing all hunters to see how many animals are available to hunt and how many animals each hunter is taking during each round. This time, however, the animals available to hunt are found in three different areas. In the first scenario each hunter, independently, decides which of the three areas to hunt during each round. In the second scenario hunters are asked to talk together about where they will all hunt during the upcoming round. This second scenario effectively leaves some areas un-hunted and thus able to recover from the impacts of hunting. This version of the game allows hunters to see how a common agreement on shifting hunting areas in space and time (i.e., spatio-temporal rotation) influence the impact of hunting on wildlife populations and their ability to recover from the effects of hunting.

The third version of the game starts with hunters being told that all animals available to be hunted are a mixture of three different species of animals, each with a different abundance. What they are not told initially is that each species also has a different reproduction rate. They will witness that at the end of each round, after the Bean Counter has added offspring for each species based on their reproductive rate and the number of individuals of each species left in the hunting areas. In the second scenario, the different reproduction rates are explained to the hunters (i.e., the abundant species is a fast-breeding such as rodents, the somewhat abundant species is a forest antelope which is neither fast nor slow breeding and the scarce species is a slow reproducing species such as a primate. Version three of the game encourages hunters to talk about the response of different species with different reproductive rates to hunting, and what this might mean to their aspirations to take actions to ensure that hunting is sustainable and generates food and income over the long term.

How do you play the game?

The game is played with between 6 and 8 players and can include both men and women. Players do not need to be hunters but they should be engaged in some way in the

wild meat sector (e.g., transporters, retailers and consumers). Players need to be able to sit comfortably around a game table. A second table needs to be set up to store several piles of 10 beans to speed up the process of adding beans that represent annual reproduction at the end of each round of play. The table should be located out of sight of the game table for Game 1-scenario 1. Others in the community are encouraged to stand behind the players and not only watch the game but at the end of the game to talk about what they saw and to comment on decisions made by players.

"If the animals are finished in the forest, it means we've used the wrong hunting techniques, like metal traps."

Game Player Quote

All three games use beans to represent animals that can be hunted. Games 1 and 2 use beans that are the same color and size to represent a single species. Game 3 use beans of three different colors, representing three different species.

The game convenor (most likely a community support partner) needs to have at least: a) a team member designated as the host or Game Manager who provides instructions to the players, answers questions as needed, and moderates the discussion at the end of each game; and b) a team member designated as the Bean Counter who records the number of beans in the game bag after each round, and calculates how many beans (offspring) must be added to the population. It is useful to also have a team member designated as a Note Taker to document conversations and discussion and to take photographs during the game and post-game discussions.

Collared peccary, Honduras © D. Wilkie/WCS

The Game Manager assures that all materials are ready for play and that the players have been identified, have formally consented to play, and have decided whether or not to consent to being photographed or videotaped during the game.

Running Game 1

Materials

- 1 20x30cm opaque cloth bag representing the hunting area in scenario 1
- 8 15x15cm opaque cloth bags representing the hunters bags in scenario 1
- 4 bowls

- 1000 beans of the same color representing the animals to be hunted
- Pen and notepad or smartphone with KoBoCollect app and data entry form. Kobocollect is not essential but makes summarizing the results of the game much easier and faster.

Game bags © F. Sandrin/WCS

Objective

The objective of this version of the game is to see whether knowledge about the size of the wildlife population in the hunting area and the number of animals hunted influences hunting behavior so as to avoid over-hunting and depletion or local extinction of the wildlife population.

Playing scenario 1 of Game 1

Once the players are seated around the game table, the Game Manager provides the following information to both the players and the audience.

- The game bag that I am holding up represents the hunting area (i.e., the forest or woodlands or grasslands where the community typically hunts)
- Inside the game bag are some beans like these in my hand. Each bean represents an animal that can be hunted, like an antelope or deer.
- Each player will be handed the game bag in turn. Each player will dip a hand into the game bag and take as many beans (animals) as they want. Without showing how many beans they have taken from the game bag, they will add these beans to their own hunting bag. [The Game Manager demonstrates how to take beans from the game bag and add them, without others seeing, into his hunting bag]
- Players should not talk to other players during the game.
- After each player has taken beans from the game bag, this round of the game is over.
- Each round of the game represents a year of hunting, and the game will continue for several rounds (years) of hunting.

"If reality is like the game, tomorrow we won't have anything left to eat in the village!"

Game Player Quote

Important Note

The Game Manager and the team must ensure that they:

- DO NOT Tell the players exactly how many rounds of play (5) there will be in the game as this may influence their behavior during the game. Remember that the goal is not to manage hunting for just 5 years it is to manage wildlife hunting over the long-term.
- DO NOT Tell the players how many beans (animals) are in the game bag at the start of the game.
- Ensure that the players understand the rules, and test this understanding by asking questions like:

  When I hand the game bag to you, what do you do?

  As a player can I talk with other players about what I am doing during the game?

At the end of each round the Game Manager tells the players that the Bean Counter will take the game bag to the other table where some additional animals will be added to the bag because animals reproduce.

Kuwinda Nyama Congo © F. Sandrin/WCS

Out of sight, the Bean Counter counts all the beans in the game bag. Half of the beans represent females and half males. The Bean Counter adds one additional bean to the game bag for every female counted. This represents a reproduction rate of one offspring per female per year. The game counter then puts all the counted beans back into to the game bag and returns it to the Game Manager to start the second round of play.

In scenario 1 we expect, from experience, that hunting will be unsustainable and all animals will have been taken from the game bag before the end of round 5. In fact, this is the underlying social learning purpose of this scenario, for the players to hunt unsustainably and then discuss the outcome.

"You have to hunt like our parents, they hunted with the concern of not finishing everything."

Game Player Quote

If, however, fewer beans (animals) are being removed from the game bag in rounds 1 and 2 than expected, the Game Manager might subtly encourage the players to hunt more animals in upcoming rounds by asking the players whether they feel that the animals they have taken so far are sufficient to feed their family and to sell.

When the scenario 1 game ends, either because all animals have been hunted from the game bag, or round 5 of the game has been completed, the Bean Counter counts and records the beans remaining in the game. She then pours the game bag beans into a large bowl and the players beans into another bowl. The Game Manager places the **game bowl** with no beans or a few beans and the **hunters' bowl** on the game table where everyone can see, and starts a discussion of what players and the audience observed and what they thought about as the game was being played.

The Game Manager should encourage players and the audience to reflect on what happened during the game, and what the real-life consequence might be, based on the outcome of the game, on their livelihoods and food security. If the game bag was depleted at round 5 or completely emptied before then, the Game Manager can ask "why do you think this happened? Is what happened a bad thing, what would it mean in real life? And if so why? Has this happened in any of the places where you hunt?"

When the discussions finish, the Bean Counter takes away the game bowl and hunters' bowl and places them on the second table so that they can be used at the end of

Kuwinda Nyama DRC © F. Sandrin/WCS

the next game (scenario 2) to allow players and the audience to see and compare the results of playing scenario 1 and scenario 2.

Playing scenario 2 of Game 1

After the scenario 1 discussion the Game Manager should announce that the players will now replay the game but with a few small differences.

Scenario 2 is exactly the same as scenario 1, but this time the game bag is replaced by a plastic **game bowl** large enough to hold 200 beans, and the players' bags are replaced with another plastic **hunters' bowl** (the same size as the game bowl). Both bowls are placed in the center of the game table. This time all players can see clearly how many beans (animals) are in the hunting area each round, and can also see how many animals all the hunters combined have taken in every round. In addition, players are now encouraged to talk to each other and the

Bean Counter can manage annual reproduction at the end of each round in plain sight of the players and audience.

The purpose of this scenario is to simulate a wildlife and hunting monitoring system, to see if hunters change their hunting decisions when they can now see how many animals are in the hunting area and how many animals the group of hunters take each round.

Many Indigenous People share what they hunt with all families in the community. So for them placing their beans into a communal hunting bowl will seem normal. For other hunters sharing may not be part of their culture. In this case the Game Manager needs to let them know that placing the animals they hunt in each round into a common bowl is because what we want players to know how much they hunt as a community. Placing all animals hunted into the **hunters' bowl** does not meant that hunters are sharing the animals they hunt with other families.

"I like asking what does it mean to win the game, because many times, some players quickly answer that they personally won because they had a lot of beans/animals for themselves. But then, others immediately say that winning means to choose how much to hunt so that there always animals in the hunting area so we can keep hunting to feed our families."

Game Manager Quote

Before the game starts the Game Manager tells the players

- In this game the hunting area is no longer represented by a bag but by this bowl on the table. All of you can see how many animals there are in the bowl, there are as many animals in the bowl as there was in the game bag in the previous scenario.
- In every round of the game, each player will put one hand in the bowl and take as many beans as you want. You then must place the beans in the other bowl (the hunters' bowl) on the table for all to see.
- Unlike in scenario 1 where we asked you not to talk with one another during the game, this time if any player/ hunter would like to say something or ask the other hunters a question during the game then you may do so.

NOTE do not tell the hunters to take fewer animals. Because players need to decide to change their own hunting strategies for this to result in social learning.

The premise underlying this scenario is that if hunters know how many animals are available to hunt and also how many animals each hunter is actually taking, then they may either a) not care because they are hunting for

themselves and don't believe other hunters will change their behavior, or b) change their hunting, hoping that others will do so also, thus preventing unsustainable hunting and depletion of hunted wildlife.

If for some reason the outcome of scenario 2 is even less sustainable than for scenario 1, it is appropriate to replay scenario 2 after guiding players to think about the consequences of a forest empty of animals and see if that alters players behavior.

Tips for discussion

At the end of scenario 2, the Game Manager must again encourage players to talk about what they observed. If hunting was more sustainable (i.e., there were more rounds played or more animals remaining in the game bowl at the end of play), why? What are the implications of this result to your family's food and income security. If both scenarios resulted in depletion of wildlife in the hunting area, what could you do differently? If hunting was more sustainable in scenario 2, would they like to replicate the wildlife and hunting monitoring systems in the real world, and how could they do this? And if not, why not?

The Game Manager might also pose these additional questions:

- Did anyone notice any differences in the outcomes between the two scenarios?
- If so, what do you think was the reason for this?
- Did any player change your hunting behavior between the two scenarios?
- What does it mean to you to win this game? What does success look like in this game?
- Do you think that knowing how many animals there were at the start of each round and how many animals were taken during each round influenced your decision about how many animals you or the other players should take?
- If scenario 2 was perceived as better, ask "Could your community do something like scenario 2, and how might that work in reality?"

Guenon for sale © D. Wilkie/WCS

Running Game 2

Materials

- 8 bowls
- 1000 beans of the same color representing the animals to be hunted
- Pen and notepad or smartphone with KoBoCollect app and data entry form

This Game builds on and largely replicates Game 1, scenario 2. What is different in Game 2 is that there are now three hunting areas (i.e., the animals are in three different bowls) and each hunting area (bowl) contains a different number of animals (44 in bowl 1, 66 in bowl 2, and 90 in bowl 3). The total number of animals (200) is the same as in scenario 1, as is the fact that all beans represent one animal species such as an antelope, or deer.

Objective

The objective of this version of the game is to see if: a) spatial rotation of hunting (i.e., hunter's have the choice to move to a different hunting area if they want) or b) spatial closures (i.e., only one of several hunting areas are open to hunting at a time, the rest are left for populations to recover from hunting) influences the sustainability of hunting.

For scenario 1 of Game 2

The instructions given by the Game Manager to the same players are a little different from Game 1.

- This time there are three places that you can hunt. Each bowl on the table represents a different hunting area and each hunting area (bowl) as you can see has different numbers of animals (beans).
- In every round of the game, each player must choose which bowl they will hunt in. But they must not tell the other players which hunting area (bowl) they have decided to hunt in this round of play. Each player can only hunt in one bowl during each round. But each player can change which area (bowl) they will hunt in at the start of each new round.

"Hunter 1: Don't hunt too much, think of our children!

Hunter 2: Yes, we have to leave animals for everyone.

Hunter 3: Yes, but I go hunting a lot because I'm looking for money to buy clothes for my wife and children."

Game Player Quotes

Kuwinda Nyama Congo © F. Sandrin/WCS

- Like in Game 1, scenario 2, in every round of the game, each player will put one hand in one of the three bowls (i.e., the one they chose but did not tell anyone) and take as many beans as you want. You then must place the beans in the hunters' bowl on the table for all to see.
- After each round the Bean Counter will count the remaining number of animals in each bowl and add the offspring to each game bowl, in plain sight, as in Game 1. For example, if there are 10 beans in hunting area (bowl) 1, that means 5 females remain, and 5 offspring are added to that hunting area (bowl).
- Players should not talk to other players during the game

The Game Manager continues playing additional rounds of the game until all bowls are empty, or round 5 has been completed. The Game Manager then facilitates a brief discussion of the results of this scenario before starting scenario 2. Before the start of scenario 2, the Bean Counter moves the four bowls (the three hunting area and the hunters' bowl) from scenario 1 to the second table.

"For the first scenario, we didn't cooperate, which is why all the game disappeared. For the second scenario, we defined hunting rules, which enabled us to keep animals in the forest."

Game Player Quote

For scenario 2 of Game 2

This time the Game Manager instructs the players as follows:

- This game is exactly the same as the one you all just played
- Except this time, before each round starts you all need to decide together where all players will hunt during the round. This means that only one area will be hunted during each round
- Like before all players can take as many animals they want from the hunting area and must place the animals they hunted into the hunters' bowl on the table for all to see.
- This time players can talk with other players during the game to decide together which area will be hunted during the following round

Tips for discussion

At the end of scenario 2 the Game Manager must again encourage players to talk about what they observed. If hunting was more sustainable (i.e., there were more

rounds played or more animals remaining in the game bowl at the end of play) why? What are the implications of this result to your family's food and income security? If both scenarios resulted in depletion of wildlife in the hunting area, what could you do differently? If hunting was more sustainable in scenario 2, would they like to implement a spatial rotation system in the real world, and how? And if not, why not?

The manager might also pose these additional questions:

- Did anyone notice any differences in the outcomes between the two scenarios?
- If so, what do you think was the reason for this?
- Which scenario did you prefer?
- Did any player change his hunting behavior between the two scenarios?
- If scenario 2 was perceived as better, could your community do something like scenario 2, and how might that work in reality?

Hunter Congo © Brent Stirton

Running Game 3

Materials

- 6 bowls (scenario 1 uses 2, scenario 2 uses 4)
- 500 beans color 1, 1000 beans color 2, 2000 beans color 3
- Pen and notepad or smartphone with KoBoCollect app and data entry form

This Game builds on and replicates much of scenario 2 in Game 1. Game 3 only has one game bowl (not three as in Game 2) but this time it contains three different types of animals representing slow- medium- and fast-reproducing species. The slow reproducing species are the least common (abundant) and the fast-reproducing species the most common (abundant) in the hunting area.

Objective

"I was in the forest with the Mbuti [Indigenous Peoples], we spent a lot of time hunting and found nothing for a long time."

Game Player Quote

The objective of this version of the game is to see if hunters change their hunting decisions when they know that there are different species with different body-size and have different population densities and reproduce at different rates.

For scenario 1 of Game 3

Before the game starts the Game Manager tells the players that this game is exactly the same as Game 1, scenario 2 (assuming that the players have already played this version of the game). He describes the game details from Game 1, scenario 1 except that this time he notes that the animals in the hunting area are a mixture of three different species, (using the names of local species), one small, fast breeding, abundant species, one midsize, neither fast or slow breeding, somewhat abundant species, and one large bodied, slow breeding, relatively scarce species. However, the Game Manager does not mention that each species has a different reproduction rate.

In preparation for the first round, the Bean Counter puts, in the game bowl, 90 beans of color 1 to represent the small, fast breeding species, 66 beans of color 2 to represent the midsize species, and 44 beans of color 3 to represent the large, slow breeding species.

The game is then played exactly as described for scenario 2 Game 1. Each round, each hunter can dip one hand into the bowl and remove as many or as few beans as they want, and then drop the beans into the communal hunters' bowl.

"Papa [name] has caught all the animals in his traps! There's nothing left in the forest."

Game Player Quote

After each round the Bean Counter adds 2 offspring for each small-bodied female left in the hunting area; 1 offspring for each mid-sized female and 0.5 offspring (rounded up) for each large-bodied female. So if there are 5 large-bodied females left in the hunting area (bowl), the Bean Counter adds 3 (i.e., 2.5 rounded up to 3) beans (offspring) back into the hunting area.

At the end of the game (i.e., when all beans have been removed or after round 5 is completed) the Game Manager facilitates a discussion with questions similar to Game 1 scenario 2 with the addition of these questions:

- What species seem to be more abundant or more scarce at the end of the game? Why might that be?
- When you hunt, what type of species are you hoping to catch, and why?
- Did you try to select a specific species when you reached to the bowl to hunt?

For scenario 2 of Game 3

Before the game starts the Game Manager tells the players that this game is exactly the same as Game 3 scenario 1 except this time the hunters can choose which animals they want to hunt because each species will be placed in their own bowl. The Game Manager will tell the players that they are all hunting in the same area but this time they can decide which species to hunt and how many animals they hunt each round. Each round of play a hunter can take as many animals as they want from any or all game bowls they want. They must then drop the animals they hunted in the hunters' bowl.

At the end of each round the Bean Counter adds the appropriate number of offspring to each game bowl applying the different reproduction rates.

Kuwinda Nyama Congo © F. Sandrin/WCS

At the end of the game, when all beans are removed from all three bowls or at the end of round 5 the Game Manager facilitates discussions similar to scenario 1 of Game 3 with a couple of additional options.

- Did you select a specific species to hunt or did you hunt whatever you could pick up?
- What species breeds a lot? And what happened to them by the end of the game?
- Which ones reproduce slowly? And what happened to them by the end of the game?
- Where you go hunting, which species should be hunted more and which should be hunted less? Why?

Other points to consider

If you have a smartphone you can enter the results of each round using the KoBoCollect forms available URL here to quickly calculate results from both scenarios in each game and be able to compare them. At the end of each game, the Kobo App will show for each scenario the number of rounds played, the total number of animals hunted, the number of offspring added to the population, and the number of animals remaining in the hunting area. It also helps saving the results and other information about this game session such as the number of players, the place, the date, etc. Also use the game bowls and hunter bowls to let the players and the audience see how the results of each scenario differ and provoke discussion of why.

It is possible that participants criticize certain aspects of the game, such as the fact that there is only one species of animal and they only produce 1 offspring each year.

Green Iguanas Honduras © D. Wilkie/WCS

This is a hard question to respond to, because we know that all models are simplifications of realty, but the players are real hunters, hunting in real places, where there are lots of animals of difference body sizes and different reproductive rates. Rather than trying to answer the questions the Game Manager should try and reply with another question that relates to the question the participant asked. So if the participant says “But our forest has many different wild animals, we don’t just hunt, eat and sell one type of animal. What we hunt depends on what we encounter in the forest.” The Game Manager might answer “that is a very good point. What animals do you encounter and hunt most often.” The participant answers “small antelope.” The manager then asks “so if the animals in the game where small antelope, would that make the game more realistic?”

It is also possible that participants give other reasons for the unsustainability of hunting in their land, such as the intrusion of external hunters, the lack of food and economic alternatives to hunting, the multiplication of access roads, etc. If the concern is about external factors and not a result of community hunting, the Game Manager should say something like “well that is really interesting. Is that something that the community can take action to prevent? And if not what support might the community need to help reduce or halt these external pressures?”

Potential additional versions of the game

In this manual we have described only the 3 versions of the game that we developed and field tested. But we envisioned additional versions of the game that might be developed in the future.

Armadillo Honduras © D. Wilkie/WCS

Game 4: Adding search costs to hunting

The games described above assume that there is no search cost to hunters. All hunts are effectively instantaneous as all a hunter has to do is dip their hand into a bag (game 1) or a bowl (games 2 and 3) and grab one or more beans.

In reality, hunters have to invest their time searching for animals, and these costs change according to the density of wild animals in the hunting area. We know that hunters

who travel out from their village in search of wildlife hunt more often in areas close to the village. This is simply a question of geometry (i.e., the area of a circle of radius r, or the area of an annulus ring with an inner radius r and outer radius R). For example, the area within 1km of the village is 3.14 km2, the area between 1 and 2 km is 9.42 km2, and the area between 2 and 3km is 15.70 km2. So the hunter would have to invest approximately 5 times the effort (i.e., hours) to visit all areas within 2-3 km to search for animals compared to all areas that lie within 1km of the village. This means that areas further away from a village, assuming that travel costs are equal in all directions, are typically hunted less frequently than those closer to the village. This, in turn, means that wildlife population density within a circular hunting area increases with distance from village. There is strong empirical evidence to show that this assumption is, in fact, true.

We know from published evidence that the search costs for hunters increase as the density of hunted wildlife in an area decline.

We believe that we can simulate changes in search costs by:

- Burying the beans in 20cm of sand within a 60x60x30 cm wooden box or plastic tub
- Telling each hunting that during their turn they will have 15 seconds to hunt in the sand for animals (beans). The Game Manager will count down from 15 to zero at which time the hunter's turn is over.
- The hunter can only use one hand when searching in the sand, and they must close their eyes.
- When they do find an animal they must remove it from the sand and place it in their bowl, only then can they resume hunt in the sand. If they encounter two or more animals together then can only pick up one.

In this version of the game hunters cannot seen the animals in the hunting area, they must comb through the sand to find them. They are also only allowed to hunt for a short time. This also simulates that hunters only have so many hours in the day to go hunting.

In this version of the game the animals do not reproduce at the end of each round. Given this, as the game progresses from round to round the number of animals left in the sand declines and it should take longer for each hunter to find the increasingly few animals left in the sand.

The game could be played where the animals reproduce after each round but this would require asking the hunters to step away from the table after each round and allow the Game Manager to sift the sand to remove all remaining beans, then add more beans based on the number of remaining females, then remixing the beans back into the sand ready for the next round of hunting.

Game 5: Dividing players into part-time hunter farmers or full-time hunters

This game would replicate Game 4 but this time players would be assigned to play the role of either part-time hunters full-time hunters.

The part-time hunters need to spend time tending their fields, so they do not have as much time to hunt as the full -time hunters, who sell some of their catch to buy farm produce to feed their families. To simulate this part-time hunters are only allowed to hunt for 7 seconds each

Congo wildmeat market © Brent Stirton

round, whereas the full-time hunters continue to hunt for 15 seconds.

The number of part-time and full-time hunters can also be modified. The Game Manager can assign players to a role by making a deck of playing cards equal to the number of players with spades representing full-time hunters and diamonds part-time hunters. The Game Manager would shuffle the deck then deal the cards face up to players seated around the table.

An additional modification might be to provide each player with a sheet of paper that assigns to them their role and family size. For example, a player might be given a sheet of paper that assigns them as a full-time hunter with a family size of 5, that requires 10 units of food each round. This means that the hunter must catch at least 10 animals per round or their family does not have enough food. On the back of the page are 10 circles that represent the food the player needs to produce during each round. The player needs to put a bean in each circle during each round to show that their family has enough food. Another hunter profile could assign the player as a part-time hunter and part-time farmer, with a family size that needs 12 units of food. But in this case, as the player is a part-time farmer, 8 out of the 12 circles are already filled with the drawing of a bean (because they produce food from their fields), so he only has to hunt 4 animals each round to feed his family.

Game 6: Adding hunters not from the community

This game would replicate Game 2 scenario 2 but this time players would represent either community hunters who would have to comply with hunting rules, whereas the external hunters would be allowed to break the spatial rotation rules and hunt wherever they want.

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