Article

Human–Wild Boar Coexistence: A Role-Playing Game for Collective Learning and Conflict Mitigation

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Abstract: Wild boars have become a common yet controversial species in France, where the main response to the species' development and the problems it may cause is an increased hunting effort. However, wild boars are an extremely adaptive species, and their response to human activities (including hunting) is not fully understood. Moreover, hunting may be a source of conflict with other stakeholders and a topic for public debate, which questions its sustainability. To discuss wild boar behaviour, as well as (other) means to coexist with these animals, we developed a role-playing board game framed around wild boars and hunting. In this paper, we outline the design of the WILD BOAR(D) GAME and reflect on the first three game sessions, which we conducted in our research areas (Gorges du Gardon and Camargue Biosphere Reserves, France). We show that a continuous back and forth between the game and reality allows the participants to elicit their knowledge as well as learn from the other participants, which contributes to filling in the knowledge gaps identified previously in the game design as well as mitigating conflicts regarding wild boars. Finally, we discuss the interest of including wild boars as a role in itself to reflect on their agency.

Keywords: human–wildlife conflicts; wild boars; hunting; role-playing game (RPG); social and ecological interactions; non-human agency

1. Introduction

Wild boar numbers have increased in France over the past few decades, especially since the 1980s in Europe in general [1], or so it seems, based on hunting bags or harvest data and the increasing number of wild boars killed. This situation can be explained by many different factors, one of them being the species' biology and ecology. The wild boar (*Sus scrofa*) is an ungulate with a high growth rate and few predators in France [2]. It seems to benefit at a wide scale from global warming [1,2] and locally from social–ecological evolutions that characterise French landscapes, such as rural decline and wooded encroachment on abandoned land, which enables wild boars to find more places to rest [3]. Being omnivorous, they easily find food resources, even more so as agricultural practices and landscapes have evolved, leading to wider plots and the development of specific crops, such as maize, which provide them with easily accessible and rich food sources [4].

This population increase, along with evolutions in terms of human activities, is often associated with problems [5]: damage to crops, road collisions, diseases such as African swine fever, or negative impacts on plants or ground-nesting birds [6]. In France, for example, the compensation paid by hunters for damage to crops is often an excess of EUR 25 to 30 million a year [7], c. 30,000 road collisions cost above EUR 100 million to insurance companies, and several million are also paid for proactive livestock health measures against swine fever, brucellosis and other diseases [8].

In view of these problems, it is often considered necessary to manage wild boar populations [9]. In France, this management is mostly the responsibility of hunters through wild boar hunting on the one hand and compensations paid by departmental (district level) hunting organisations (FDC) to farmers on the other. Although this management has been

going on for decades, it is still at the heart of controversies or conflicts [8]. On the one hand, hunters are sometimes accused of acting to preserve what has become one of their favourite game species rather than to prevent damage to crops. On the other hand, hunters themselves are critical of the current compensation system, which puts their financial resources—and therefore their activity—at risk at a time when they are already facing demographic and social pressures. They believe that other factors and other stakeholders are responsible for the current problems and should contribute to the compensation scheme and may, therefore, accuse managers in areas with little to no hunting, such as protected areas, of providing refuges for wild boars and hindering hunters' efforts to reduce wild boar numbers.

2. Case Studies, Theoretical Framework and Methods

In this section, we first highlight the circumstances which led us to choose the role-playing game as a tool to achieve the study's objectives. We then detail the game design, which was finalised after numerous tests with researchers, students and hunters.

2.1. Case Studies

An example of these tensions between hunters and protected area managers can be found in southern France, in the Gard department and in the Biosphere Reserve of the Gorges du Gardon (Figure 1). In 2016–2017, the Gard hunting organisation (FDC30) was facing a particularly difficult situation with c. EUR 854 thousand to be paid to the local farmers in compensation for damage to crops by wild boars, which is twice as much as the previous hunting season. To cope with this increase, changes were made to the way the compensation fund was financed by increasing the following: 1/ (1) the price of the license to kill wild boars, (2) the financial contribution of local hunting organisations to the FDC30 on the basis of their hunting effort and the amount of damage on their hunting grounds, and (3) the hunting effort itself, in the whole department, both in time and space. With this in mind, the FDC30 started targeting areas considered to be insufficiently hunted, such as the areas aimed at protecting breeding Bonelli's eagles (APPB), to which access is denied between 15 January and 30 June. No hunting is, therefore, permitted in these areas at the end of the hunting season (between 15 January and 31st March), which is considered difficult to comply with in practice (an incident once occurred as hound dogs ran into one of the APPBs and were followed by the hunter trying to bring them back, which led to an open conflict with the APPB's managers) and detrimental to wild boar regulations.

This case study is not an isolated one. During our research, we encountered similar issues in the Camargue Biosphere Reserve (Rhone delta, southern France), for example, between the managers of the Scamandre Nature Reserve (western Camargue) and the FDC30. Back in 2011, it was the hunting organisation FDC13 (Bouches-du-Rhône, eastern Camargue) which sued protected area managers and owners for not hunting enough and for being responsible for wild boar damage to crops (the FDC13 eventually dropped the charges in 2014). These tensions can, thus, escalate into real conflicts and have serious and controversial consequences, such as hunting and regulation operations in protected areas at times and in ways that may be detrimental to their conservation objectives. Although this refuge effect provided by protected areas has been documented in the literature, the authors have also shown that this phenomenon is highly dependent on the local context and on a wide array of factors [10–12]. Moreover, assertions as to the existence and influence of a reserve effect on wild boar behaviour and damage to surrounding crops are very often informed by social or political postures [5]. It is, therefore, crucial to document locally the behaviour and movements of wild boars [13] in order to clarify these discourses, foster the dialogue between different stakeholders, especially hunters and protected area managers, and discuss means of managing wild boar impacts.
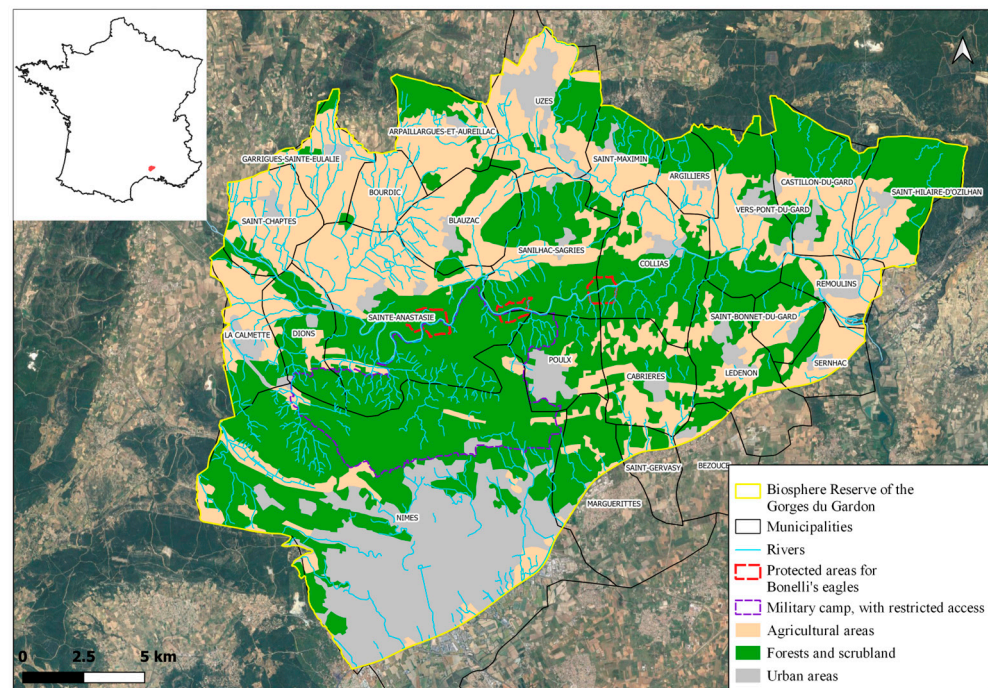
Figure 1. First study area in southern France (Gard), showing the Gorges du Gardon Biosphere Reserve and areas with limited access (protected areas for Bonelli's eagles and military camp), which were at the heart of a conflict between hunters and area managers.

More broadly, numerous knowledge gaps remain regarding the wild boar, which is a highly adaptive and flexible species. Hunting, for instance, is the main response to wild boar population increases and impacts, but also has major influences on wild boar behaviour, movement and population dynamics, as shown by the literature, with contrasting results depending on the social and environmental context [14–16]. Hunting does not consist solely of harvesting wild boars but comes with a set of values and practices [17,18], whether during the hunt or in the overall management of a hunting ground, which may trigger different responses by wild boars. The practice of providing supplementary feeding, for example, remains difficult to document while being highly controversial, and its potential influence on wild boar population growth and feeding behaviour is little studied (for one case study, see [19]). Moreover, the response of wild boars to climate change and its potential consequences (milder winters, more frequent droughts, or the increased mast seeding of oaks) is not yet fully understood. Finally, the sustainability of hunting is questioned [20] as the number of hunters decreases [1] and as conflicts persist with other landscape users (inhabitants, hikers) or animal rights activists, which calls for the need to identify other solutions to wild boar damage.

2.2. Theoretical Framework and Methods

2.2.1. A Role-Playing Game as an Intermediary Object

To fill these knowledge gaps, in our different research projects in the Gorges du Gardon and the Camargue Biosphere Reserves, or the Ecrins National Park, several methods were employed, including semi-structured interviews with local stakeholders and wild boar tracking using GPS collars [8]. However, these methods have their drawbacks. The possibility of equipping wild boars with GPS collars is highly dependent on the characteristics (i.e., weight mostly) of the captured individuals and the overall success of such an experiment varies depending on capture effort, the collars' reliability and is inevitably incomplete (depending on the sample size or time-lapse in-between locations). Finally, it comes with welfare and ethical issues [21]. The semi-structured interviews with around sixty people and the workshops to discuss animal movements on the basis of GPS tracking

enabled us to raise and discuss rather controversial issues (such as supplementary feeding, the refuge effect of protected areas or the impact of fencing). We were looking for a tool that would help share more knowledge and create a more trustful relationship between the various stakeholders. With this in mind, we aimed at developing a device that would enable us to fulfil the following points:

1. Better understand the behaviour and movements of wild boars by giving a voice to local experts and people who have studied or interacted with wild boars;
2. Discuss hunting in particular and its impact on wild boars themselves (in terms of behaviour, movement, population dynamics), humans and landscape sharing;
3. Bring up for discussion issues that have been less studied or that may be controversial and difficult to discuss by other means, such as supplementary feeding.

First developed in the military field [22], then for health, administration, business or education purposes [23,24], role-playing games are now regularly used in companion modelling approaches to discuss the collective management of natural resources [25,26]. They take the form of an interface (computerised or not) and involve players who each have roles and objectives and must abide by a set of rules. The players' interactions with each other and with the interface influence the model represented, the situation played out and the scenarios that gradually emerge [27]. Role-playing games can have different purposes [28]. They can help obtain a better understanding of the system represented in the game and improve its management or be more specifically targeted at improving the dialogue between the different players and stakeholders and at increasing knowledge-building and collective learning [29]. Role-playing games can, thus, serve as intermediary objects [30], meaning intermediary results to be discussed in the research process but also intermediaries in the social arena.

With this and the previously stated objectives in mind, we designed a role-playing game (RPG), hypothesising that the RPG frame would enable us to perform the following:

1. Discuss local situations in different contexts despite being a generic device;
2. Allow us to gather different stakeholders with different areas of expertise, interests and standpoints in the human–wild boar network in a safe and playful atmosphere, thus contributing to (i) a better understanding of wild bar behaviour and movement and (ii) conflict mitigation.

2.2.2. Human and Non-Human Roles

For some years now, researchers from different disciplines have argued for a better acknowledgement of non-human animals as agents [31–33] and a shift to a less human-centred perspective both in research design and in humans' coexistence with other beings [34].

Several research projects on wild boars have started to embrace this call. They have shown how wild boars transgress the limits they are being assigned [35], trigger social and environmental reorganisations [5], and can influence human practices and activities. They challenge categories humans would like them to fit into. They are sometimes considered as the epitome of wild species; they may, on the other hand, be considered a domestic species when they feed on crops or supplementary feeding [8]; an important game species for some, they are considered a pest by others. If wild boars' agency, therefore, seems widely acknowledged, it has, however, been given little attention in research-action projects and management discussions. In role-playing games, although other-than-human animals are often represented, they are mostly displayed as resources [36,37] using simplified models or as biodiversity indicators [38], but they do not play a role in the game itself. By designing a role-playing game whereby wild boars have a role for themselves, we aimed to fill this gap, following other games related to hunting and wild duck management [39].

2.3. Game Design
2.3.1. The Landscape

The landscape is represented on a game board (Figure 2). It consists of more or less open areas and watering points on an overall area of 10,000 ha (10 × 10 km) to simulate

day–night wild boar movements and match (hunting) management units' dimensions in real life. For simplification purposes, the open areas refer to cultivated areas and pastures, while the closed areas refer to either forests or scrublands. In the game's original design, these landscape patterns are not meant to change. The landscape is then split into four management units within the same municipality: two municipal hunting grounds (A and B), one private commercial hunting ground (C) and one area which is initially not hunted but with no specific status (D), which makes a total of three hunted areas and one initially non-hunted area.
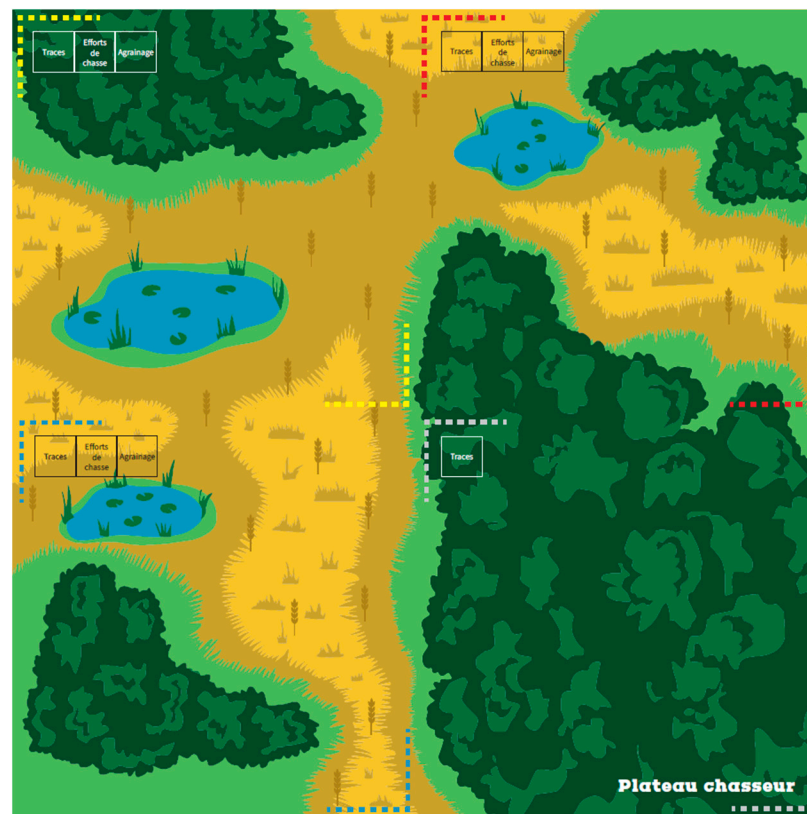

Figure 2. Board representing patches of forest or scrubland, open areas (cultivated areas and pastures) and watering points, divided into the following four units: municipal hunting grounds (in yellow and red, from now on referred to as A and B in the main text), commercial hunting ground (blue, C), and an initially non-hunted area (grey, D).

2.3.2. The Roles

There are four roles in the game: three hunting organisation managers and one wild boar population. Other types of stakeholders were excluded from the game for simplification purposes and to focus on hunting. They are, thus, solely represented through comments or alerts given by the game supervisor. The manager of the hunting ground A (PA) must both satisfy his hunters and avoid damage to crops as much as possible. He is also a mayor and an administrator of the departmental hunting organisation, which should encourage him to talk to the other players and work towards conflict mitigation in general. The manager of the hunting ground B (PB) has a less precise objective: he must manage the wild boar population on his estate well. As for the manager of the hunting ground C (PC), he has a commercial objective: to satisfy the hunters and the shareholders. Each of these players can perform activities on their own hunting ground as follows: they can organise drive hunts and vary the intensity of the hunting effort (1, 2 or 3 guns, for a low, medium or high effort); they can use supplementary feeding (with no specification as to what type of feeding is allowed or possible in the game and no specific rules); and they can, at any time during the game session, suggest other actions either privately to the game supervisor (GS)

or publicly for discussion with the other players. Then comes the wild boar player (PW), who must maintain or help the wild boar population thrive and distribute his individuals (40 initially) on either part or all of the landscape. These objectives are specified on the cards at the disposal of each player, which also specify the actions they may undertake (Figure 3). Actions have no financial costs, but at the end of each round, a set of indicators is updated on an Excel sheet (Figure 4).
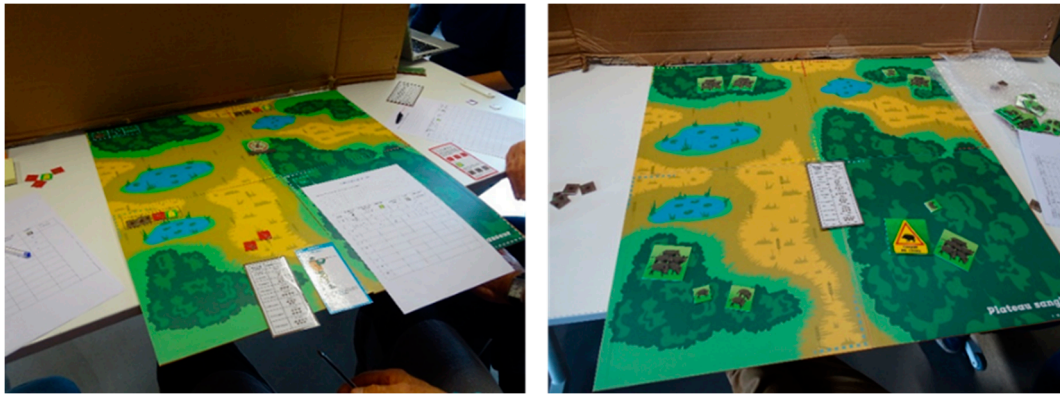

Figure 3. On the left, the board used by the hunting managers with cards, tokens and sheet of paper listing the indicators is shown. On the right, the board used by the wild boar player is shown.
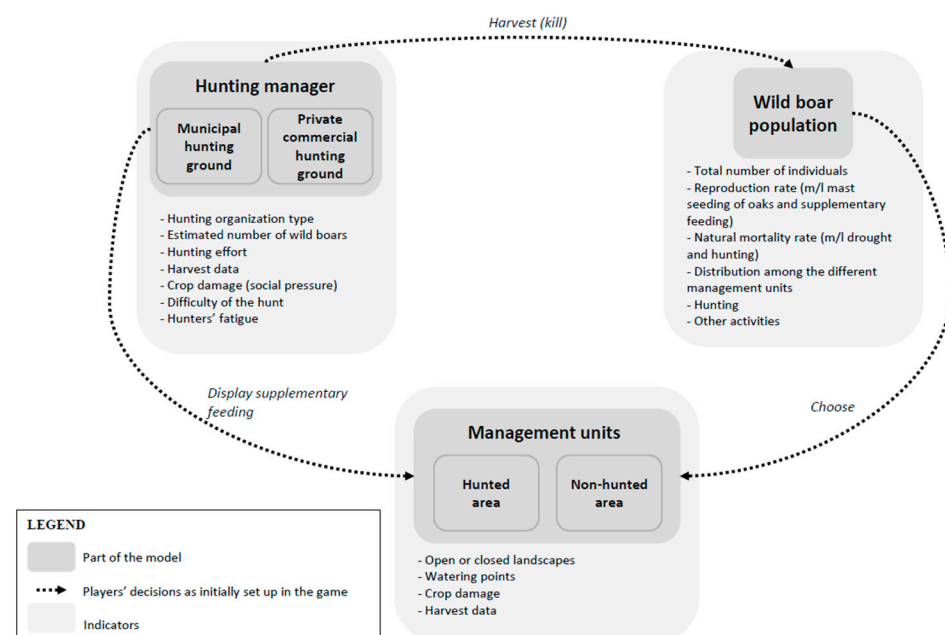

Figure 4. Set of actions and indicators for each role.

For example, if there are more than 5 wild boars in a hunting management unit (which also comprises cultivated areas and pastures), damage occur. If damages occurs again in the same unit during the following round, the game supervisor informs the hunters that farmers are complaining and asks them to discuss adaptations to wild boar and damage management. If damages occur once more in the following round, a drive hunt for regulation purposes is organised in the unit suffering from damages. Hunting managers may also be confronted with hunters' fatigue if they have used a maximum hunting effort for two consecutive rounds or difficulty finding wild boar footprints if they have harvested at least half of the population in their management unit. These indicators must be reported by each player on a sheet throughout the game in order to help them follow the game and feed the debriefing afterwards. With few rules to follow, players must otherwise act

on the basis of their own knowledge and experience, which can then be discussed in the debriefing to achieve the knowledge elicitation objective, while the time constraints add some stochasticity.

2.3.3. The Biological Module: A Simplified Model of Wild Boar Population Dynamics

The RPG relies on a very simplified model of these population dynamics (Figure 5), based on (i) the literature and information gathered from local experts during previous interviews and previous research and (ii) the objectives of the RPG. Some elements, such as the mast seeding of oaks and supplementary feeding, are, therefore, voluntarily put forward in order to stimulate discussion and debate during the debriefing. The mast seeding of oaks, for example, is much studied in the French literature [40,41] and could be relevant for one of our case studies (the Gorges du Gardon Biosphere Reserve), considering its landscape characteristics. It is, however, less relevant in the wetlands of the Camargue Biosphere Reserve, where oaks are less abundant and more localised and where other factors may play a more important role. This simplified population dynamics model is applied to each sub-population of wild boars distributed in each of the four management units. This gives us four new numbers, which are then summed up to give the wild boar player the new number of individuals to be distributed in the next round.
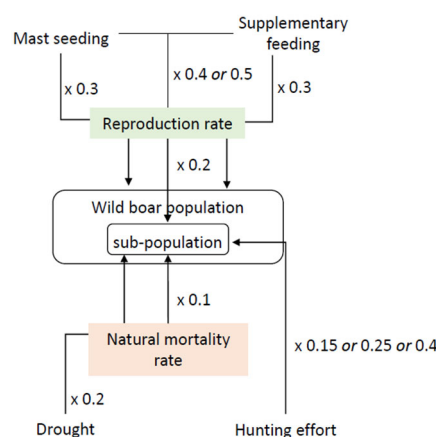

Figure 5. Simplified biological module to be discussed and complexified with the participants. The reproduction rate is 0.2, but it can vary over time depending on mast seeding and supplementary feeding. If a player uses supplementary feeding or if there is important mast seeding during that round, the reproduction rate increases to 0.3. If both apply (mast seeding and supplementary feeding), the reproduction rate increases to 0.4 or 0.5 if the player decides to use extra supplementary feeding. The mortality rate is 0.1, but if there is a drought in that round, it increases to 0.2. In addition to this comes the harvest rate, which is 0.15 if the player hunts a little (one gun), 0.25 if he/she hunts a bit more (2 guns), and 0.4 for a greater effort (3 guns). If one of the hunting managers asks for an even greater hunting effort, 2 wild boars per extra gun are added to the hunting bag.

2.4. Setting up the Game

The players are first given a short anonymous questionnaire to assess their knowledge of and attachment to wild boars and to collect basic socio-economic characteristics. They are then assigned a role. This can be performed either randomly or purposefully, depending on the players' profiles or the objectives of a specific game session. The rules are explained by the game supervisor during the first 10 min, using a short PowerPoint presentation to facilitate the description of the game, its roles and rules. At this point and during the first round, the players can ask for additional information.

The four players are distributed around two boards representing the same landscape (Figure 6). The three hunting organisation managers face the same board and can communicate at any time, but they do not have access to the second board on which the wild boar player distributes his individuals. They can only guess where the wild boars are and at

what density by looking at the footprints that the wild boar player displays on their board. The game coordinator sits close to the players to be able to follow their different actions and update the software.

Figure 6. Players sitting around both board games (second game session) along with the game supervisor (at the top) and two invited observers (bottom right-hand corner) who did not take part in the game.

Each round (representing one hunting season) is organised as follows (Table 1). To further constrain the players, additional events (drought, important mast seeding of oaks, but also the organisation of trails that may impede hunting activities) can be announced by the game supervisor at specific and pre-defined rounds during the session (a session consists of 10 rounds).

Table 1. Organisation of a round.

Step	Details
1	The game supervisor specifies (if necessary) the characteristics of the round (important mast seeding of oaks, drought, special event).
2	The wild boar player - Distributes his animals over part or all of the landscape on his board; - Displays the corresponding number of wild boar footprints on the hunters' board.
3	The hunting managers decide - If and how they want to hunt; - Whether they want to feed the wild boars.
4	The game supervisor, who has updated the different indicators, can now inform the players (hunting bags, crop damage, hunters' fatigue, regulation drive hunt).

At the end of the ten rounds, a debriefing is organised between the players, the game supervisor and an observer who must be present throughout the session to take notes (players' attitudes, quotes, etc.) while the game supervisor is busy coordinating the game and updating the software. The players are first asked to clarify their strategy and reasoning and explain how these might have evolved over the course of the game. The game coordinator then discusses the main issues raised by the game, namely hunting decisions, wild boar behaviour and population dynamics, using comparisons with typical scenarios or other game sessions. Finally, the players can share their thoughts on the game itself and suggest improvements.

3. Results

On the basis of the game sessions conducted so far, the following section examines the potential of the WILD BOAR(D) GAME to meet the objectives of (1) promoting dialogue

and knowledge-sharing and (2) discussing hunting, wild boar behaviour, the relationships between both and (other) means of wild boar management.

3.1. Game Implementation

We conducted 3 game sessions, either in the Gorges du Gardon Biosphere Reserve (1 session) or in the Camargue Biosphere Reserve (2 sessions), with a total of 12 participants who were involved in wild boar hunting or management, half of whom had previously participated in the research project. Players reported different levels of knowledge about wild boars (ranging from 3 to 9 on a scale of 1 to 10) and hunting (seven players were wild boar hunters themselves), and various sources of information, either through personal or professional activities and observations or through second-hand information (academic or grey literature, discussions with other stakeholders). Players also reported different levels of attachment to wild boars (ranging from 2 to 10 on a scale of 1 to 10). All sessions were audio-recorded and then transcribed.

3.2. Knowledge Elicitation and Sharing

The design of a role-playing game is a long process in which a balance has to be found between simplicity and complexity, realism and playability [38]. Here, we decided to favour simplicity and genericity, which ultimately fostered a quick appropriation of the game, regardless of the participants' initial knowledge of wild boar and hunting and did not prevent the players from pointing out real-life situations or issues. All players played out the roles assigned to them, even though they sometimes initially expressed disgust at the role they were assigned (i.e., two out of the three participants who were assigned the PC role). When asked during the debriefing how he had managed the gap between his role in the game and his real-life profile (a protected area manager involved in the conflict with hunters in the Gorges du Gardon), PC3 replied: "It wasn't my role. I wasn't gonna defend other interests that go against my initial role, which is to make money, to satisfy my shareholders". (references to the participants are based on 1/their role in the game and 2/the session they took part in. Here, for example, it refers to the participant who played the manager of the commercial hunting organisation (PC) in the third session (3)).

While they were able to distance themselves from their real-life perspective, the players were also able to make links with what they actually experienced in their daily lives. Most of the participants immediately associated unit D with an area in their field of operation which is or had been seen as a refuge area for wild boar.

> *PA3: He's making his population grow in the non-hunted area, we have to act, we have to do something.*
>
> *PC3: It's the military camp.*
>
> *PW3: That's right, it's the military camp.*
>
> *PC3: There are snake eagles over there, we can't hunt or the ecologists are gonna come down on us.*
>
> *PB3: Anyway, if it's the military camp, you can't hunt as you want [. . .]. It's not quite the military camp though because hunting is not forbidden in the military camp.*

The WILD BOAR(D) GAME is therefore useful for documenting real-life situations and issues. Supplementary feeding, for instance, is one of the main issues addressed in the game, and we wanted to discuss the different types of feeding that exist and their respective implementation and impact on wild boars. First, participants provided details as to the different practices and the potential gap between what is allowed and how hunters actually operate. In the third session, one of the participants (PB3) reminded the other players of the rules regarding diversionary feeding: "Diversionary feeding, that's when the hunting season is closed, when there are damages on crops to draw wild boars out of the crops, but normally it goes with fences to protect the crops, or hunting, close-up shots to frighten them off or kill them when they wanna come close to the crops. The department won't

allow diversionary supplementary feeding unless there are other protection systems". In the Gard department, diversionary feeding can be authorised for one year by the FDC30, which must consult with the other organisations representing farmers and the State in the district and under specific conditions (in terms of the locations, frequency, type, and quantity of grains displayed). In the game sessions, however, only once did a player ask whether supplementary feeding was authorised. It was otherwise spontaneously used. At the previous session, PA2 also drew a distinction between diversionary feeding (to prevent damage to sensitive crops), supplementary feeding for conservation purposes (provided all year long to increase the population in the long term), and supplementary feeding to attract wild boars, lead them to specific areas and increase hunting efficiency. Participants, therefore, pointed out the issue of controlling supplementary feeding.

> *PB3: I use supplementary feeding but I'm keeping it for myself because we're not allowed to normally. I mean we're not allowed unless we have a special authorization from the department [i.e., district level].*
>
> *PC3: Yes, but nobody checks.*
>
> *PB3: Those who ask for an authorization, they get controlled. They've told where they put the grains, so they get controlled. The others they don't say anything about where they put the grains, so they don't get controlled.*
>
> *PA3: So, it's the ones who do things properly that get controlled...*

As such, the game clarified the potential influence of supplementary feeding on wild boar behaviour. While supplementary feeding is a very simple component in the biological module (Figure 5), it actually covers a wide array of practices which must be better defined when investigating the role of supplementary feeding on wild boar behaviour. Moreover, wild boar responses to supplementary feeding may differ depending on the context.

> *GS [to PW2]: Have you considered supplementary feeding?*
>
> *PW2: Absolutely not, never. No because I didn't feel like I needed it.*
>
> *PB2: Of course you do. In my opinion, wild boars, when there's a protected area with hunting grounds in the neighbourhood, they preferably go where there's supplementary feeding, whether it's diversionary or... It depends on the environment but in similar conditions...*

Finally, the participants insisted on the need to consider the potential influence of supplementary feeding that does not target wild boars but other game species.

> *PA2: In the Bouches-du-Rhône, the problem is some people deviate because there's no regulation on supplementary feeding for small game [...].*
>
> *PB2: Of course, a wild boar doesn't feed on corn only, he's gonna go for wheat too.*

As the interactions and dynamics in the game are very simple, several players stressed that they struggled to understand the interactions between the elements of the system (e.g., what caused damage to crops or the link between hunting effort and hunting bags) and were, therefore, unable to anticipate damage or hunting bags, which led to very different situations, which were later discussed in the debriefing (Figure 7). This may also be explained by the fact that these dynamics are partly driven by the decisions of the wild boar player and not, as in other games, based on pre-defined models. It also highlighted how complex and context-dependent socio-ecological systems involving wild boars are, as illustrated by this brief discussion between two players in the third session:

> *PC3: I wanna make money, and so have lots of wild boars, but mostly I wanna know the tricks of the trade, I wanna know how I can have lots of wild boars.*
>
> *PB3: There aren't any tricks of the trade for that.*

Nevertheless, we tried to compensate for the limitations of some simplifications by addressing them in the debriefing, which was crucial and as important as the game itself, and

adapting the collective discussion by adding some elements from the literature to answer some of the players' questions about wild boar behaviour and interactions between wild boar and human activities. Thus, both the game itself and the debriefing provided an opportunity to explore cause-and-effect relationships and to see that, as in the real world, these relationships are complex and changing. The RPG session also contributed to knowledge-sharing on different topics, such as the differences between hunting organisations and hunting types, the contributions of hunting organisations to damage compensation, rules, or the possible cascading effects of practices like supplementary feeding.
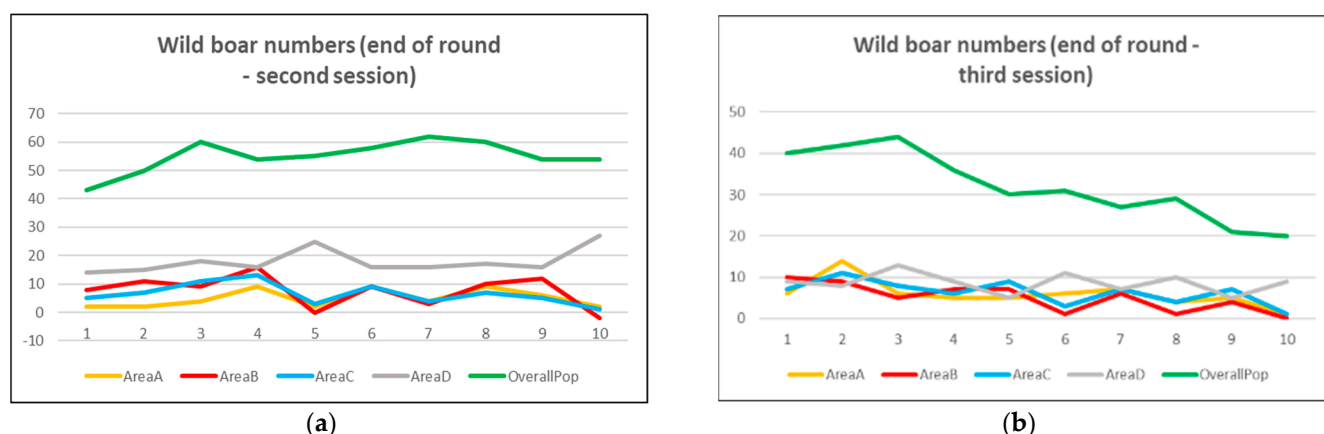

Figure 7. Wild boar population trends in each management unit and across the landscape in two game sessions. (**a**) The overall population increased in this session despite an overall higher hunting effort compared to (**b**), which could be explained by the slightly more abundant supplementary feeding and by the wild boar systematically taking refuge in the non-hunted area (D). In the (**b**) session, the wild boar player was more attentive to the strategies of each hunting manager and navigated between the different areas, distributing the animals in a more balanced way, thus exposing them more.

> *PW3: On the military camp, we really don't mind supplementary feeding, well, containing wild boars on the camp.*
>
> *GS: With diversionary feeding?*
>
> *PW3: Yes, that's what the department allows. But we told them we could do more than that. We don't have damage, there's no risk for our vehicle—they weigh 30 tons—we have few buildings.*
>
> *PA3: But there's also the biodiversity. It may have no impact on the military activity, but maybe for biodiversity, if they dig and turn the soil upside down. . .*
>
> *PW3: Yeah, I hadn't thought about that. . .*

This confirms the potential of the WILD BOAR(D) GAME as a tool for learning about social–ecological systems [42].

3.3. Hunting Practices: Effort Levels and Efficiency

In the Gard department, increased hunting effort was considered to be the main lever for wild boar management [43]. However, the game sessions confirmed that, in practice, the hunting effort depends on a variety of factors. For instance, different hunting efforts may be driven by policy but also by the different objectives of the hunters. While in the first session, PC1 constantly used both supplementary feeding and a maximum hunting effort and obtained the highest hunting bag (28 wild boars killed compared to 11 for PA1 and 17 for PB1), in the third session, the participant who was given the same role was more cautious, scaling his hunting effort between 1 and 2, and almost stopped using supplementary feeding after the 5th round as it did not seem to be the main driver of PW3's behaviour. These objectives may be driven by personal agendas but also by collective

dynamics and social pressures. In the third session, both municipal hunters were concerned about crop damage and acted accordingly by increasing the hunting effort individually and collectively (they organised, in addition, to drive hunts in their respective areas, a collective drive hunt in both management units) and, in addition, PA3 cleared the landscape in order to deprive wild boars of refuges. However, in two of the three sessions held so far, the players stressed that the lack of financial pressures (as the players had no financial costs or benefits associated with their actions) was less of an incentive than the social pressure indicated by the game supervisor when the damage occurred.

Moreover, in line with the literature [44], the players finally highlighted the difference between hunting effort and hunting efficiency, thus questioning the direct link between hunting effort and hunting bag or wild boar catchability. In the third session, PB3 pointed out the seasonality of hunting efficiency based on weather conditions and hounding dogs' behaviour: "When it's dry in August, there's no scent on the ground, the dogs miss the wild boars, and they don't find them [. . .]. Sometimes, no matter how much effort you put into it, if there's no scent on the ground because it's too dry, or if the dogs are tired. . . They [the hunters] don't kill much; it's just to say that they've tried because it's not efficient". In the second session, the participants were this time very careful to organise hunting in detail. First, they asked whether different types of hunting could be used (drive hunts and stalking) since they considered it would have a different impact on the wild boar population.

PA2: Each hunting type has its pros and cons and also an influence on the way your population is gonna react.

GS: So, what would have changed if we had included stalking?

PA2: Well then you can lower your hunting effort even more. For example, if you wanna make your population go up, you go stalking and make selective shots [. . .]. To go back to hunting efficiency, if you include stalking, you're not gonna have the same hunting efficiency and the same impact on your population compared to drive hunts where the biggest impact is gonna be in terms of disturbance.

PC2: With different types of hunting, you don't kill the same individuals. The ones that escaped the drive hunt, well you can get them by stalking.

Second, they decided to add watchtowers and asked for shooting orders either for game conservation (PA2) or for security purposes (PB2). In all three sessions, the players, at some point, decided to coordinate their actions and hunt together in order to increase hunting efficiency.

Consequently, while the biological module simply included hunting effort (low, medium or high) as a proxy for the influence of hunting on wild boar population dynamics and behaviours (Figure 5), the latter are actually very differently influenced by hunting depending on hunting type, hunting intensity (hunting frequency, number of hunters, number of dogs), the hunters' objectives and their abilities as well as their dogs' and other environmental variables.

Hunting rules, current practices and potential innovations could further be discussed in the game. On the other hand, as hunting was at the core of the game, and players were given little information about the other actions they could take, there was a risk that hunting would remain the sole focus of the game sessions, preventing the players from discussing other means of managing wild boar damage, as was also the aim of the game. However, in all of the sessions, the players raised the issue of fencing, and in the third session, PA3, who was keen to put an end to crop damage, also cleared his area of dense vegetation and suggested sterilisation, a solution which, as he pointed out during the debriefing, had been strongly rejected by the hunters when suggested in previous and formal meetings, but which was easier to discuss here given the friendly and playful atmosphere of the game.

4. Discussion

In the following section, we discuss the limitations inherent in the facilitation and implementation of the game before highlighting its main strength, i.e., its great adaptability

to the variety of geographical contexts in which wild boar hunting takes place, and finally emphasising the interest of this tool to discuss non-human agency.

4.1. Facilitating and Implementing the Game

When designing the game, we aimed at creating a device that could easily be implemented. On the player's side, the rules, actions, and tokens were minimal, so they were easily understood by the players, who quickly mastered the different steps. In addition, the game was not too long (2 h 30 min divided in half between the game and the debriefing), which we found was an important criterion for inviting otherwise busy participants and keeping their attention during the game. It was also designed for a small number of players, which, in turn, made it easier to recruit participants and facilitate discussion and observation during and after the game.

However, facilitating the game remains a tricky exercise. In the organisation tested so far, the game was facilitated by a team of two people (a game supervisor and an observer). The former had to perform several tasks at the same time (monitoring the players' actions, updating the indicators, answering the players' questions, responding to their suggestions, and enforcing the rules), which we tried to facilitate by automating some of the indicators' updates (hunting bags, damage to crops, difficulty of the hunt, hunters' fatigue, regulation operation), which also helped speed up the game. However, it still required a lot of attention from the game supervisor to ensure that all the data were correctly updated in the Excel sheet and that all the relevant information was passed on to the players. In addition, if the game supervisor was too busy, they could not deal with communication issues, such as the wild boar player passing on information to the hunting managers. If possible, we suggest that the game be run by a team of three, with the role of the game supervisor separated from that of the computer operator.

We also emphasise that since there is a relatively small number of pre-defined actions and suggestions that can be incorporated into the game, the game supervisor must also be adaptable and decide what can be included, how, and what must be left aside. For example, in the second session, when the players asked to hunt together in the non-hunted area, instead of having a regulative drive hunt to increase hunting efficiency, we simply redistributed the hunting bag between the different hunting organisations. As for the watchtowers, they were simply made visible on the board and could thus be taken into account by the wild boar player when distributing his individuals. Shooting instructions, on the other hand, were only spoken, without any computer input or any kind of materialisation on the board and were put up for discussion in the debriefing.

4.2. WILD BOAR(D) GAME: An Adaptable Game to Address Constantly Evolving Practices and (Other-Than) Behaviours

Given that the WILD BOAR(D) GAME emerged from a research-action project dealing with conflicts between hunters and protected area managers, these two stakeholder types have so far been our main audiences when organising game sessions. However, other stakeholders may be involved in human–wild boar interactions and wild boar (damage) management and may contribute to collective learning about wild boars. Furthermore, as hunting is central to the game, there may be an imbalance in the exchange of experience and knowledge. To avoid such drawbacks, the next game sessions should be open to other stakeholders, such as farmers or naturalists, both as players of this initial version and as new roles to open the game to other land uses and practices that may be influenced by wild boar behaviour, such as farming practices. Similarly, it is interesting to note that wild boar hunting also depends on the presence of other game species and local hunting culture. In the Camargue Biosphere Reserve, for instance, the intensity with which wild boar hunting is practised today also stems from a decrease in small game species and greater variability in waterfowl abundance and roosting or feeding habits. Opening up the game to other species would further contribute to exploring the complexity of human–wild boar interactions.

Similarly, the game can be adapted to other issues and settings and further contribute to research on conflicts about wildlife [45]. For example, several participants referred to the influence of urbanisation on both wild boar behaviour and hunting. The presence of wild boars in cities is becoming a frequent phenomenon [46–48], the implications of which could be easily addressed in the game by adapting the board.

4.3. Learning Processes and Conflict Mitigation Opportunities

While the game sessions clearly contributed to knowledge-sharing and learning processes, it is hard to identify whether this resulted from the game itself or from the mere bringing together of different stakeholders, which could have been achieved by other means (e.g., focus groups). However, as illustrated earlier, the playful atmosphere of the game helped in defusing potential tensions and encouraging discussions between people who may otherwise not have talked to each other. Moreover, we found that gathering a small number of participants helped limit power asymmetries and gave all players the opportunity to express themselves.

Nevertheless, this stresses the fact that further studies are needed that look at the long-term effects of role-playing games and other participatory tools [49]. While role-playing games may contribute to cognitive learning at the time of the session and in the short term, uncertainties remain as to their influence on individual and collective practices and social dynamics on a longer basis. With others [26,27], we argue that identifying local stakeholders willing to take up the torch once the research project is over may help achieve such objectives.

4.4. Taking the Wild Boar's Perspective

Moving to a less human-centred perspective is clearly challenging and raises both practical and ethical questions (how can we know the experience of other animals? Is it possible and desirable to remove our human lens? Are there ways to communicate and represent other beings without renewing some kind of domination?). These questions inevitably came up in the game design and implementation of the sessions. While the participants played out their roles well, it was clearly more difficult for the wild boar player, as the following statement illustrates. In the eyes of PW3, he took a more human perspective on supplementary feeding and saw it as a trap: "I adopted a survival strategy a wild boar would not necessarily have. If he sees supplementary feeding, he's gonna go eat. Me, I'm thinking "no, there's no point, it's to shoot me more easily". So, I'm not thinking the way a wild boar would. He's going for food, me I'm like, "no, it's a trap". Here, the wild boar player has access to a lot more information than an animal would in real life. Also, while the other players are interpreting an individual, the wild boar player has to deal with a whole and homogeneous population since, for simplicity's sake, we did not include sex or age differences, for example. Nevertheless, we found it interesting to have wild boars played by a participant, rather than displayed as a background model, in order to discuss learning processes or individual strategies in wild boar behaviour and to proceed beyond categories. For example, personality traits, such as boldness, may play a role in crop damage [50]. Adding and discussing more ethological dimensions in wild boar behaviour and human–wild boar interactions would further improve the role-playing game as designed so far. It could also be interesting in the future research and development of the tool to try to distinguish the social learning that results from the non-human perspective approach or simply from the role-playing in the game.

5. Conclusions

The aim of this paper was to present a design that would allow us to combine an interdisciplinary (geography and ecology) and transdisciplinary (academics and non-academics) approach. We wished to discuss local situations with a tool generic enough to be used in different contexts while encouraging discussion between participants. Here, we focused, in particular, on wild boar population dynamics and the influence of hunting on wild boar behaviour and movement, as our research stemmed from conflicts between

hunters and protected area managers. Our initial results show that exploring the problem of wild boar management through a role-playing game (WILD BOAR(D) GAME) with players having different areas of expertise fosters a better understanding of cause-and-effect relationships, differences in opinion and controversial issues while improving trust between the different stakeholders. It, thus, contributes to a better understanding of both complex and context-dependent social and environmental dynamics. Furthermore, integrating both human and non-human perspectives to discuss interactions between humans and wild boars is promising and offers interesting possibilities for further studies on human–wildlife conflicts. As such, the WILD BOAR(D) GAME experience contributes to research on multistakeholder dialogue and environmental problem solving.

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