
Environmental enrichment and its effect on the behaviour of 4 ocelots : a descriptive study

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OBJECTIF DU TRAVAIL

Cette étude a pour objectif 1) d'analyser les effets de 3 différents types d'enrichissements environnementaux (nourriture, odorat et manipulation) sur le comportement individuel des 4 ocelots du « Centre de Sauvetage Las Pumas » situé dans la ville de Cañas dans la province de Guanacaste au Costa Rica, 2) de trouver l'enrichissement le plus efficace pour chaque ocelot individuellement et 3) de comparer ces résultats entre les 4 ocelots.

RESUME

Cette étude s'est déroulée sur une période de 5 semaines allant de février à mars 2020. 4 ocelots ont chacun été observés durant 4 sessions quotidiennes de 20 minutes. La première semaine d'observation était utilisée comme étant la semaine contrôle sans enrichissement. Durant les 3 semaines qui ont suivi la semaine contrôle, un enrichissement différent a été mis en place chaque jour. Au total, trois différentes catégories d'enrichissement ont été utilisées (nourriture, odorat et manipulation). Chaque catégorie comportait 5 enrichissements différents. Le comportement de chaque ocelot a été observé et analysé. Les enrichissements ont été mis en place durant l'observation de 15 heure. Les autres séances d'observations se sont déroulées à 7 heure, 11 heure et 19 heure afin d'étudier l'impact de l'enrichissement sur le comportement de l'animal durant le restant de la journée. Les enrichissements qui n'ont pas pu être réalisés au moment prévu ont été mis en place durant un jour de la cinquième semaine (qui avait été laissée libre spécifiquement pour pouvoir rattraper des jours perdus). Avant le début de l'étude et donc de la semaine contrôle, une première semaine a été utilisée pour se familiariser avec les animaux et les méthodes d'observations.

Cette étude met en évidence le fait que les 3 différentes catégories d'enrichissements sont capables d'influencer les comportements des 4 ocelots au moment de la mise en place de l'enrichissement et durant une période suivant celle-ci. La catégorie d'enrichissement « nourriture » est celle ayant le plus d'impact sur le comportement des ocelots au moment de la mise en place de l'enrichissement

alors que la catégorie d'enrichissement manipulation est celle dont l'influence a persisté le plus longtemps. Cependant chaque ocelot a ses propres préférences dans chaque catégorie d'enrichissement.

Environmental enrichment and its effect on the behaviour of 4 ocelots : a descriptive study.

AIM OF THE WORK

The aim of this study is (1) to see if 3 different types of enrichments (food, scent and manipulation enrichment) have an individual effect on the 4 ocelots living in the Sanctuary at Las Pumas Rescue Center (Centro de Rescate y Santuario Las Pumas) located in the province of Guanacaste (Costa Rica), (2) to find the most efficient enrichment (the one that is able to decrease the most of the abnormal behaviour and to have the strongest impact on the animal welfare) for each ocelot individually and (3) to compare these results between the 4 ocelots.

SUMMARY

This study took place over a 5 week period between February and March 2020. The 4 ocelots were observed during four sessions of 20 minutes each, everyday. A first week of observation, without any enrichments, was used as the control week for the study. The three following weeks were used as enrichments week. Every day, a new enrichment of a different type (food, scent and manipulation enrichment) was introduced in each enclosure. The behaviours of each ocelot were noted and analysed. Each type of enrichment comprises 5 different enrichments. The enrichments were implemented at the observation of 3 pm. The other observations were realised at 7 am, 11 am and 7 pm to study the impact of the enrichments during the rest of the day. During the last week, enrichments that could not be done, during the 3 weeks scheduled especially for observation with enrichment, were realised at that time. Before the beginning of the study and thus the control week, a first week was used to familiarise with the animals and the observation method.

This study highlights the fact that the three different types of enrichments were able to influence the ocelot's behaviours at the moment and during a couple of hours after implementation. Food type enrichment was as intended the ones that had the most impact on the ocelot's behaviour at the moment of implementation while the manipulation type of enrichment had influence during a longer period of time. However, each ocelot had their preferences in each different type of enrichment.

Remerciements

Table des matières

1. Introduction

Environmental enrichment is used in zoos and rescue centers to provide a better quality of life to captive animals by supplying environmental stimuli that have a positive effect on the behavioural, psychological and physiological well-being [Shepherdson, 1998; Swaisgood & Shepherdson, 2005]. This has as principle to modify the enclosure by adding or changing the environment to provide the opportunity to the animal to express new behaviours [Swaisgood & Shepherdson, 2005] or develop their natural ones. Indeed, spatial restriction in captivity and insufficient stimulation is the perfect combination to induce boredom, lack of motivation and abnormal behaviours in felids [McPhee, 2002].

Ocelots (*Leopardus pardalis*) are medium-sized cats classified in the order of the carnivores [Massara et al, 2015; Sunquist et Sunquist, 2002]. They occupy currently a territory going from southern Texas to northern Argentina [Sunquist et Sunquist, 2002; Aprile, 2012] and live in tropical and subtropical habitats [Sunquist et Sunquist, 2002]. During the day, they rest hiding in logs, cavities and dense foliage [Aprile, 2012] but they hunt on the ground during night [Sunquist et Sunquist, 2002; Emmons, 1988]. Ocelots are becoming active one or two hours before sunset and are active twelve to fourteen hours a day. Indeed, they rest between dawn and late afternoon [Sunquist et Sunquist, 2002] even if Di Bitetti and colleagues (2005) as well as Sciabarrasi and colleagues (2017) reported a cathemeral pattern of activity. Ocelots travel about 3 to 7 kilometers per night [Emmons, 1988 (2); Sunquist et Sunquist, 2002]. Small nocturnal rodents (< 1 kg) dominate the diet but big males can sometimes feed on larger mammals (> 1 kg) [Emmons, 1988]. The hunting behaviour is composed of two techniques, a slow hunting walk and a move-and-sit method [Sunquist et Sunquist, 2002 (3); Emmons, 1988]. In their territory, they leave scent marks such as urine spray and uncovered faeces [Sunquist et Sunquist, 2002]. They are solitary animals but not asocial. Emmons (1998) reported a case of a male and a female staying together for several hours outside of breeding period. The jaguar, the puma, the anaconda and the boa constrictor are among his principle enemies [Aprile, 2012].

A good enrichment plan is able to affect the animal's behaviour, to increase it's welfare and to reduce stereotypical behaviours such as pacing [de Araujo Sena et al, 2018; Weller et Bennett, 2001 (11)]. Food variations, odours enrichments and manipulation enrichments are able to reduce stereotypical behaviours (such as pacing and self grooming) [Weller et Bennett, 2001; Resende et al, 2011; Skibiel et al, 2007; de Araujo Sena et al, 2018] , physiological and morphological changes in captive animals [O'Regan and Kitchener, 2005].

Skibiél and colleagues (2007), showed with their study that inexpensive and easy-to administer enrichment objects can affect in a positive way the behaviour of captive felids.

The aim of this study is (1) to see if 3 different types of enrichments (food, scent and manipulation enrichment) have an individual effect on the 4 ocelots living in the Sanctuary at Las Pumas Rescue Center (Centro de Rescate y Santuario Las Pumas) located in the province of Guanacaste (Costa Rica), (2) to find the most efficient enrichment (the one that is able to decrease the most of the abnormal behaviour and to have the strongest impact on the animal welfare) for each ocelot individually and (3) to compare these results between the 4 ocelots.

2. Material and methods

2.1 The rescue center

The « Las Pumas Rescue Center » is located in the city of Cañas situated in the province of Guanacaste (one of the seven provinces of Costa Rica) in the North-Pacific side of the country. It was founded in 1989 by a couple from Switzerland and is the oldest rescue center of Costa Rica. It is certified by GFAS (Global Federation of Animal Sanctuaries) which ensures their animal welfare conditions and safety measures.

The rescue center has the mission of rescuing, rehabilitating and releasing Costa Rican wildlife as well as guaranteeing their quality of life. It is composed of the Sanctuary (open to visitors) and the Rescue Center (which is closed to public) under the supervision of DMV Martha Cordero Salas. The animals in the Sanctuary are wildlife animals that couldn't be released due to different reasons (inadequate behaviours, accustomed to humans, vision issues). The Center is specialised in wild cats but also takes care of all the other wild species that can be found in Costa Rica. Among the animals of the Sanctuary, we can find a jaguar (*Panthera onca*), three pumas (*Puma concolor*), four ocelots (*Leopardus pardalis*), one jaguarundi (*Puma yagouaroundi*), two scarlet macaws (*Ara macao*), four species of parrots (*Amazona auropalliata*, *Amazona autumnalis*, *Amazona farinosa*, *Pionus senilis*), 2 species of monkeys (*Cebus capucinus* and *Ateles geoffroyi*) and other wild animals like white tailed deers (*Odocoileus virginianus*) and collared peccaries (*Peccary tajacu*), as well as an area for farm animals with rabbits, guinea pigs, a sheep, a goat and some chickens.

2.1.1 Animals of the study

The 4 ocelots studied in this work are 3 males (Rayito, Max and Nicoa) and 1 female (Chata).

Rayito

Rayito is an approximatively 11 years old male that was brought to the rescue center when he was a baby. He was found by rangers near Ostional Beach, in Carillo (Guanacaste, Costa Rica) alone. The whereabouts of the mother are not clear, but she was probably killed. At his arrival at the center in November 2009, the veterinary noticed that he was suffering of bilateral cataract and rickets. Rayito is extremely well used to humans and is constantly in search of contact with them. He suffers from stereotypes like over-grooming (licks and sucks the tip of his tail) and pacing. He was changed from

enclosure 3 weeks before the beginning of the study. In his new enclosure, there is a little managing space of safety cubicle (which is located very close to the path where the tourists walk) in which he can be trapped when the caretaker needs to enter in his enclosure. The veterinary and the biologist of the center remarked that when the door of this little cage is closed, resulting in the fact that he can not enter in the little cage, the over-grooming is strongly diminished. The change of enclosure also helped to diminish the over-grooming.

Max

Max is an approximately 9 years old male that was brought to the rescue center in August 2012. He was confiscated by Arenal-Tempisque Conservation Area (SINAC-MINAE) staff when he was 10 months old. He was living with a human family. The family found him on the side of the road and wanted to keep him as a pet. He was fed with an unadapted diet. Some days, he is lame on the right forelimb and could not be released because he is too much used to humans. He likes to come close to the fence or lay down in his safety cubicle close to tourist and vocalise when he sees some humans.

Nicoa

Nicoa is a 4 years old castrated male that arrived to the rescue center in November 2016 when he was only 3 months old. He was found in a little paddock by a family near Nicoya (Guanacaste, Costa Rica) and was sent to SINAC officers, who brought him to the center. At his arrival, he was diagnosed with bilateral cataract and endured a surgery, but this could not increase his vision and he was therefore not able to be released. It seems like he doesn't see very well during night because of his bilateral cataract. He is, like Rayito, extremely attracted by humans and he likes to stay close to the fence when he is active. He lives in the same enclosure as Chata and was therefore castrated to avoid reproduction.

Chata

Chata is a 6 years old female which was brought to the rescue center in 2014 at only 7 months old. She was confiscated from a family that kept her as a pet and her owners gave her an inappropriate diet which led to a growth delay. She is also very used to humans which kept her from being released.

2.1.2 Enclosures

Rayito and Max have separated enclosures while Chata and Nicoa share one. The enclosure of Rayito is 10m (long) x 6m (wide) x 4m (high), the enclosure of Max is 16m (long) x 10m (wide) x 4m (high) and the enclosure of Nicoa and Chata is 16m (long) x 10m (wide) x 4m (high). Each enclosure is made with iron grid and is composed of one big enclosure and one smaller safety cubicle in which the ocelot can be trapped if the caretaker needs to enter in the big enclosure. They have naturalised enclosures composed of trees, branches, platforms, logs, two small rivers in the enclosure of Max and a pond with current water in the enclosure of Rayito and in the enclosure of Nicoa & Chata (which allow them to drink whenever they want and, avoiding lack of water). Each enclosure was created to have different levels of height, which is very important for ocelots and felines in general. There are diagonal, vertical and horizontal trunks that permit the ocelot to be at different heights.



Image 1 : Pictures of the different enclosures

2.2 Methods

This study was realised during a period of 5 weeks between February 2020 and March 2020. The first week was used to discuss the modalities of the project with the veterinary of the center and her biologist-ethologist collaborator. In the mean time, observations were made to be able to create a complete ethogram of the ocelots behaviours. That week was also used to practice the observation and the collect of data during different times of the day and with different methodologies (hand-writing with tables, use of an application). This was done in order to evaluate the best way of collecting data, to familiarise with the animals, to be able to differentiate them (specially Chata and Nicoa living in the same enclosure) and get the animals used to me (as objective that my presence did not interfere with their behaviour during the study).

Based on the observations of the first week, a total of 14 behaviours was observed. This allowed to create an ethogram.

2.2.1. Ethogram : list of behaviours

1. *Resting (RE)*: Laying down with eyes opened or closed whitout being attentive to the environment / sleeping.
2. *Alert (AL)*: Careful observation of the environment when lying down / sitting / standing whitout moving, responsive to a stimuli.
3. *Human interaction (HI)*: Coming close to humans, vocalising when seeing humans, looking at humans, being attracted to humans.
4. *Exploration (EX)*: Sniffing in movement / sitting / lying, paying attention to the environment in movement or patrolling.
5. *Self-grooming (SG)*: Licking some part / the whole body in a lying / sitting or standing position with the purpose of grooming.
6. *Marking (MA)*: rubbing, scratching, spraying or licking an unanimated object.
7. *Hunting-playing (HU)*: Moving towards food, leaping, pouncing, grabbing, catching, tracking, sitting and waiting before food, ambushing, playing with food or with an unanimated object.
8. *Eating (EA)*: Licking, biting, chewing or swallowing food.
9. *Social interaction (SI)*: Positive interaction between 2 individuals. This could be licking, vocalising whitout aggressivity, coming toward another individual in a gently way to interact with him.

10. *Aggressive behaviour (AG)*: Negative interaction between 2 individuals. This could be blows thrown by paws, vocalising, baring fangs, coming towards another individual in an aggressive way to interact with him.
11. *Hiding (HI)*: running away and hiding somewhere because of fear.
12. *Locomotion (LO)*: Moving slowly or fast without sniffing or paying attention to a particular object/food and with the purpose of moving from a point A to a point B without taking any detour.
13. *Physiological (PH)*: Urinating, defecating, drinking
14. *Stereotypes*: Pacing (PA), over-grooming (OG)

Vocalisation was taken as an independent behaviour too but not noted as one because it was always expressed complementary to another behaviour. During the night observation, the behaviour « non visible » was also added. It was very difficult to follow and see the ocelots in movement during the entirety of the observation because of the darkness and the low power of the lamp that was used to watch the ocelots. During the first week, two different techniques have been tried for the night observations. The first one, was the use of a red headlamp to avoid disturbance caused by light the most possible. The second method was the use of a normal headlamp. Finally, the use of the normal headlamp was chosen for night observations. Indeed, the red headlamp was not powerful enough to be able to follow the ocelots in the dark but even with the normal headlamp, the ocelots could not be seen when in the middle of the enclosure. To avoid an overestimation of some behaviours when the ocelot could not be seen, the behaviour « non visible » was used. Resting and alert behaviour are considered as inactive behaviours while the other ones are considered as active behaviours. The stereotype behaviours were noted independently as pacing or over-grooming and not as stereotypes.

2.2.2 Observation method

Everyday, 4 observations of 1 hour were realised. During this one hour of observation, each ocelot was observed during 20 minutes. Every observation time was started by the enclosure of Rayito followed by the enclosure of Max and ending with Nicoa's and Chata's enclosure. Each ocelot was thus observed during a total of 1 hour and 20 minutes a day (4 observations of 20 minutes for each ocelot a day).

The first observation started at 7:00 am and ended at 8:00 am (Rayito: 7 am - 7:20 am, Max: 7:20 am - 7:40 am, Chata and Nicoa: 7:40 am - 8:00 am). The second observation of the day started at 11:00 am and ended at 12:00. The third observation was from 3:00 pm till 4:00 pm and the last

observation was from 7:00 pm to 8:00 pm. This observation time allowed to observe the ocelots during their active time because they are essentially active during night. The observations were realised from Monday to Friday. When one day of the week could not be used for observations, the Saturday of the same week was utilised.

To note the observation, two different types of tables were employed. For Rayito and Max, a table of 4 column (Behaviour, Comment, Time and Duration) was used (Annex 1) and for Chata and Nicoa a table of 5 columns (Individual, Behaviour, Comment, Time and Duration) was utilised (Annex 2). The date and the weather were noted before each observation. During these 5 weeks, the climat was approximately the same with a temperature carrying between 25°C and 35°C depending on the time of the day. The mean temperature of the different observations times are visible in table 1. The wind varied between no wind at all, slight gusty winds, moderated gusty winds and severe gusty wind.

Observation time	7 am	11 am	3 pm	7 pm
Mean temperature	27°C	31,5°C	32°C	29°C

Table 1: Mean temperature for each observation time during the 5 weeks of the study.

For the observation of 7:00 pm, a headlamp of the brand Rayovac was used.

The second week of observations was from 17th - 22nd February 2020. This was the control week. No enrichment were placed in the enclosure. On Wednesday 19, observations could not be realised because of an emergency in the clinic. This observation was realised on Saturday 22. The same pattern of observations was used as mentioned above.

2.2.3 Enrichments

The three following weeks (from 24 February to 13 March) were used for the enrichments. Every day for a total of 15 days (from Monday till Friday during 3 weeks), a new enrichment was placed in the enclosure at 3:00 pm. 3 different types of enrichment were used :

1. Food enrichment : the purpose was to make the feeding a challenge.
2. Scent enrichment : the purpose was to stimulate the sense of smell.
3. Manipulation enrichment : the purpose was to stimulate the explorative and hunting-playing behaviour.

Each type of enrichment was put in place on a one in three day schedule (table 2) and incorporated 5 different enrichments :

1. Food :
 1. Blood + hidden meat
 2. Meat attached to a rope on a pole
 3. Dead chicks
 4. Living rat
 5. Blood ice cream with little pieces of meat in it
2. Scent :
 1. Vanilla scent
 2. Cinnamon scent
 3. Logs and faeces of preys
 4. Channel n°5 perfume
 5. Logs and faeces of other wild cats
3. Manipulation :
 1. Frozen watermelon
 2. Coconut with feathers
 3. Pumpkin
 4. Cardboard box
 5. Frozen coconut with cow skin

Table 2 shows the calendar with the implementation of each enrichment

Food Enrichment	Scent Enrichment	Manipulation Enrichment
Blood + hidden meat 24/02/2020 26/02/2020	Liquid vanilla 25/02/2020 27/02/2020	Frozen watermelon 26/02/2020 28/02/2020
Meat attached to a rope on a pole 27/02/2020 29/02/2020	Cinnamon powder 28/02/2020 02/03/2020	Coconut with feathers 02/03/2020 03/03/2020
Dead chicks 03/03/2020 04/03/2020	Logs and faeces of preys 04/03/2020 06/03/2020	Pumpkin 05/03/2020 07/03/2020
Living rat 06/03/2020 09/03/2020	Perfume Channel n°5 09/03/2020 10/03/2020	Cardboard box 10/03/2020 14/03/2020
Blood ice cream with little peaces of meat in it 11/03/2020 15/03/2020	Logs and faeces of other wild cats 12/03/2020	Frozen coconut with cow skin 13/03/2020 16/03/2020

Table 2 : Calendar of the different enrichments.

The date in black is the one that was planned.

The date in red is the one when the enrichment was actually implemented

Remark : Because of the Coronavirus crisis, the study had to be ended one day before the schedule end. The enrichment with logs and faeces of other wild cats could not be put in place because I had to leave Costa Rica earlier. It was fixed that the biologist collaborator of the center would do this observation the day after I left but because of a lack of time due to the Coronavirus and the closing of the center to the public, this enrichment could not be studied at all. The enrichment « logs and faeces of other wild cats » was chosen to be put aside and the enrichment « coconut with cow skin » was chosen as last enrichment since there were staff variations and no tourists and that could also affect the data.

The last week (from 16 March to 20 March) was left open with no observations in case of one enrichment could not be done during the 3 previous weeks. This allowed us to have some more days to catch up the lost days.

Indeed, like seen in table 2, on some days no observations could be performed because of emergencies (emergencies, releases) of or surgeries in the clinic. This is the reason why each day is not followed by another day of observation and why there is sometimes a couple of days between two different enrichments.

4. Results

4.1 Do the enrichments have an effect on the behaviour of the ocelots individually?

As reminder, food enrichment had as aim to make the feeding a challenge (increasing the hunting and exploration behaviour), scent enrichment had as objective to stimulate the smell (increasing the marking and self-grooming behaviour) and the manipulation enrichment had as objective to stimulate the hunting-playing behaviour. The enrichments were considered to be effective if the objectives were reached.

Rayito

Figure 1 is a summary of all the behaviours expressed by Rayito during the 3 pm observations during the 4 situations (control week and the 3 types of enrichments). The percentages represent the total time of the behaviour expressed during the 3 pm observation for each situation (the control week and the 3 types of enrichments).

It shows an important decrease of the resting (RE) behaviour between the control week and the 3 different types of enrichments. On the other hand, there is an important increase of the alert (AL) and exploration (EX) behaviour during the 3 types of enrichments .

While the food enrichments were able to increase the alert (AL) behaviour, the proportion between inactive (resting and alert) and active behaviours (all the behaviours except for the resting and alert behaviours) decreased importantly during the food enrichments compared to the control week. This is because of an absent of resting (RE) behaviour and an important increase of exploration (EX) behaviour during food enrichments. It was also capable to trigger Rayito's hunting (HU) behaviour and to focus the feeding of the animal mainly on the food enrichment. Thus, it can be considered that the food enrichment achieved the objectives.

The scent enrichments provoked also a strong decrease of the resting (RE) behaviour and an important increase of the alert (AL) and exploration (EX) behaviours. This is the reason why the proportion between inactive (resting and alert) and active behaviour was divided by more than 1.5 during the scent enrichment compared to the control week. But more important, it was able to trigger the marking (MA) behaviour and to increase the self-grooming (SG) behaviour. It was also able to increase strongly the physiological (PH) behaviour which in this case was drinking. In the same way as for the food enrichment, it can be thus consider that the scent enrichment had an effect on the behaviour of Rayito.

Regarding the manipulation enrichment, the resting (RE) followed the same path as the 2 other enrichments and the alert (AL) and exploration (EX) behaviours increased strongly too. Indeed, just as for the 2 other types of enrichments, the proportion between inactive and active behaviours was divided nearly by 2. The hunting (HU) and exploration (EX) behaviours had even a stronger increase than during food enrichments. The manipulation enrichment was thus considered efficient. On the other hand, the three enrichments increased also the human interaction (HI) behaviour. This could be due to the fact that we had to enter in the enclosure to place the different enrichments and that, like mentioned before, Rayito is strongly impacted by the presence of humans looking at him. This could also explain the slight apparition of the pacing behaviour.

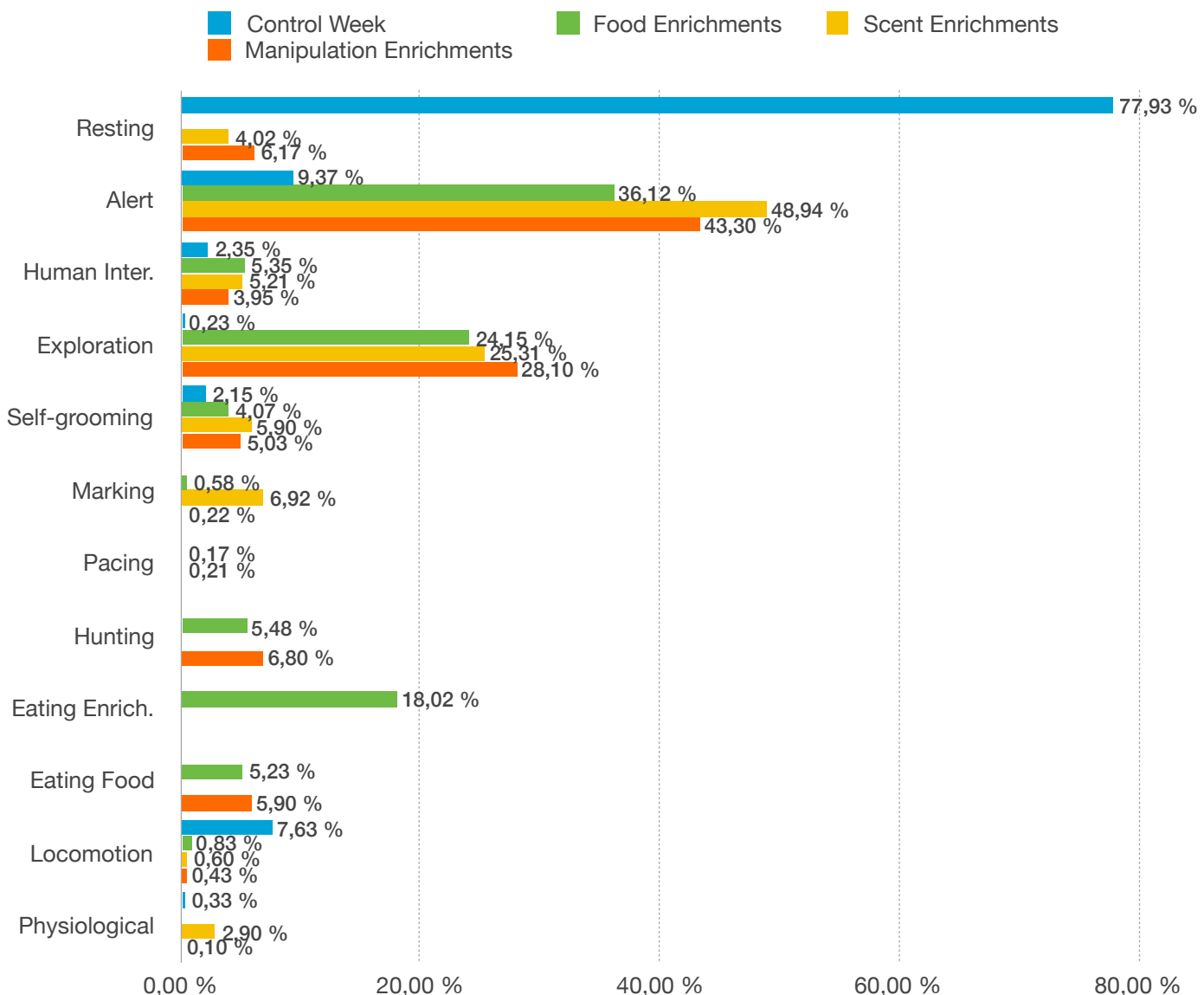


Figure 1 : Summary of Rayito's behaviours during the 3 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentages represent the total time of the behaviour expressed during the 3 pm observations for each situation (control week and the 3 types of enrichments) : resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Pacing (PA), Hunting (HU), Eating Enrichment (EA ENRICH.), Eating food (EA FOOD), Locomotion (LO), Physiological (PH)

Figure 2 shows the information collected during Rayito's 7 pm observations. The resting (RE) and alert (AL) behaviours have strongly increased during the 3 types of enrichments compared to the control week. On the other hand, human interaction (HI), exploration (EX) and pacing (PA) behaviours have strongly decreased compared to the control week. This figure brings to light that the 3 enrichments could possibly have had as effect an increase in inactive behaviour and a decrease of the active behaviour during the 7 pm observations. This could be explained by the fact that Rayito was more active during the 3 pm observations and was thus more tired during the 7 pm observations. It can be considered that the 3 types of enrichments have still an effect a couple hours after that they were put in place.

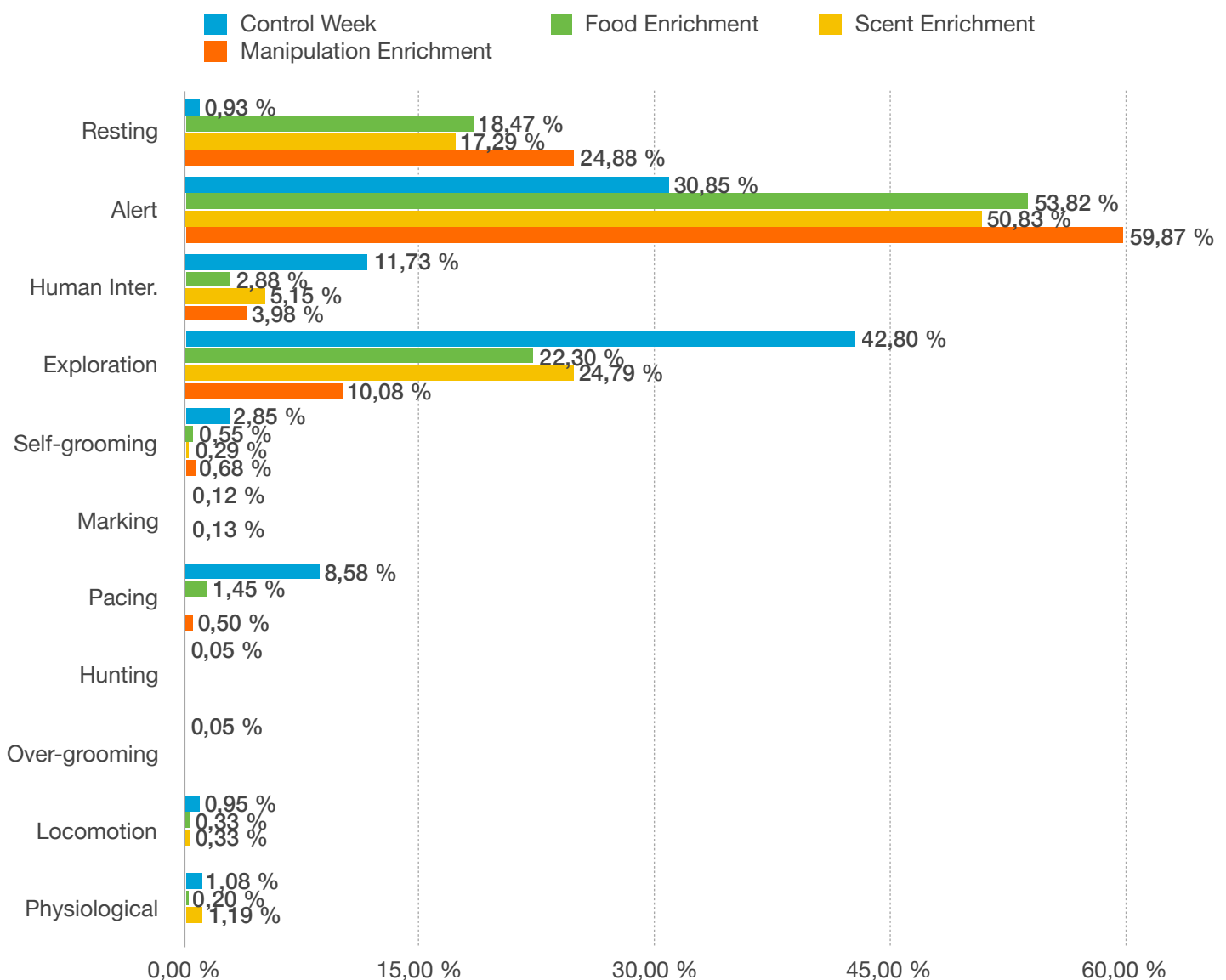


Figure 2 : Summary of Rayito's behaviours during the 7 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 pm observations for each situation (control week and the 3 types of enrichments) : resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Pacing (PA), Hunting (HU), Over-grooming (OG), Locomotion (LO), Physiological (PH)

Figure 3 represent the percentage of each behaviour expressed during the 4 situations at the 7 am observations. The resting (RE) and alert (AL) behaviours have both increased with the 3 types of enrichments compared to the control week. On the other hand, exploration (EX) and pacing (PA) have both decreased. With an increase in the inactive behaviour and the decrease of active behaviour, it could be considered that the enrichments still have an effect after a whole night. However, some 7am observations were not done directly the following day of the enrichment but sometimes after a couple of days. I can thus not conclude that the 3 types of enrichments really had an effect on Rayito's behaviour or if his behaviour was impacted by something else.

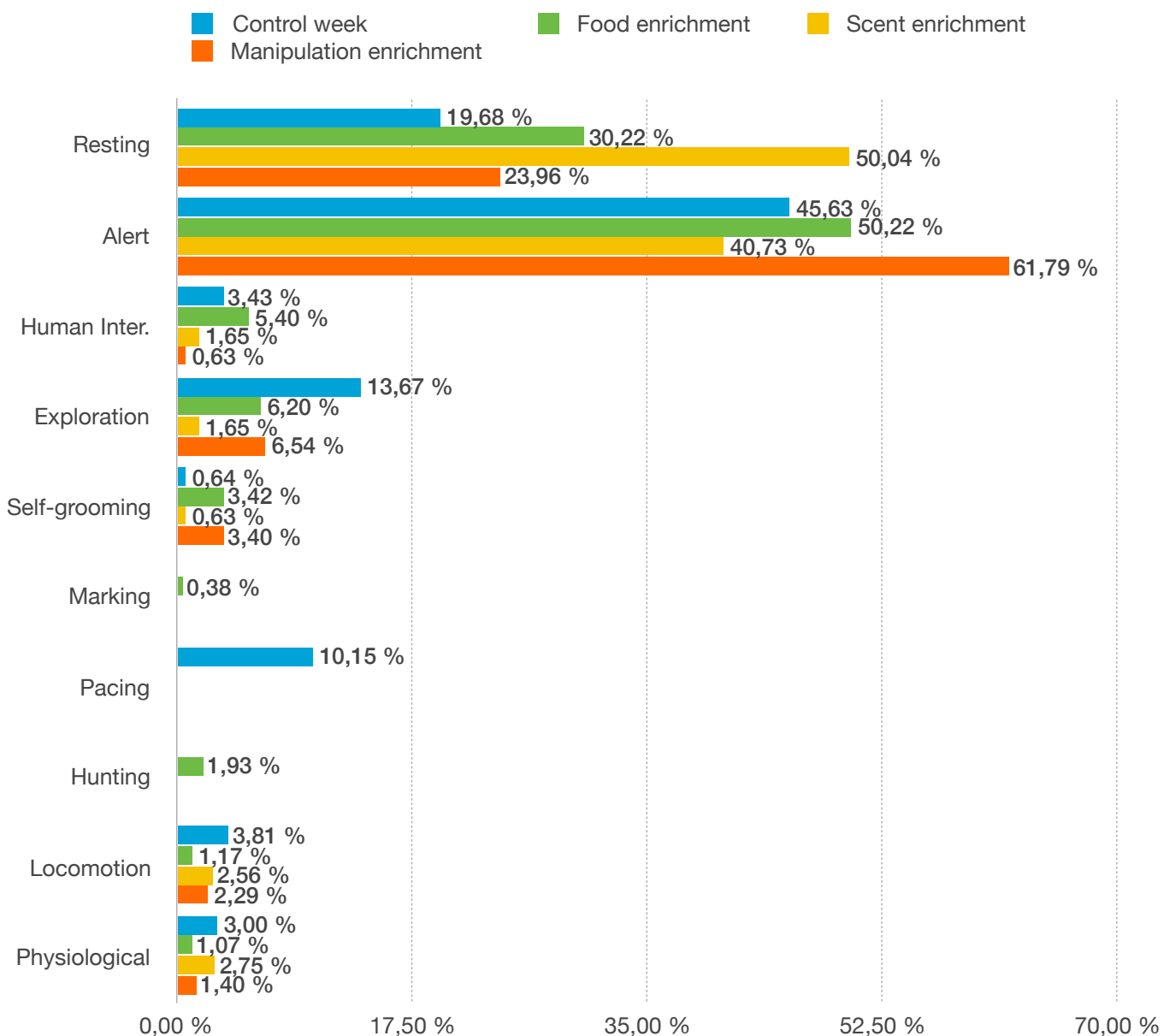


Figure 3 : Summary of Rayito's behaviours during the 7 am observations. Each color represent s one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 am observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Pacing (PA), Hunting (HU), Locomotion (LO), Physiological (PH)

Regarding the 11 am observations (Figure 4), no big difference on Rayito's behaviour could be seen with or without enrichment except for a slight decrease of the human interaction (HI) behaviour with the enrichments. The resting (RE) and alert (AL) behaviours were the most expressed during control week and stayed like that in approximately the same proportions with the 3 types of enrichments. The hunting behaviour (Hu) that surged during the food enrichment can be explained by the fact that one day a grison from the enclosure next of Rayito's enclosure escaped and found refuge on the roof of Rayito's enclosure. This explains his hunting (HU) behaviour and his decrease in alert (AL) behaviour during the food enrichment type. Indeed, during the 11 am observations of the other 4 days, no hunting behaviour at all was noticed.

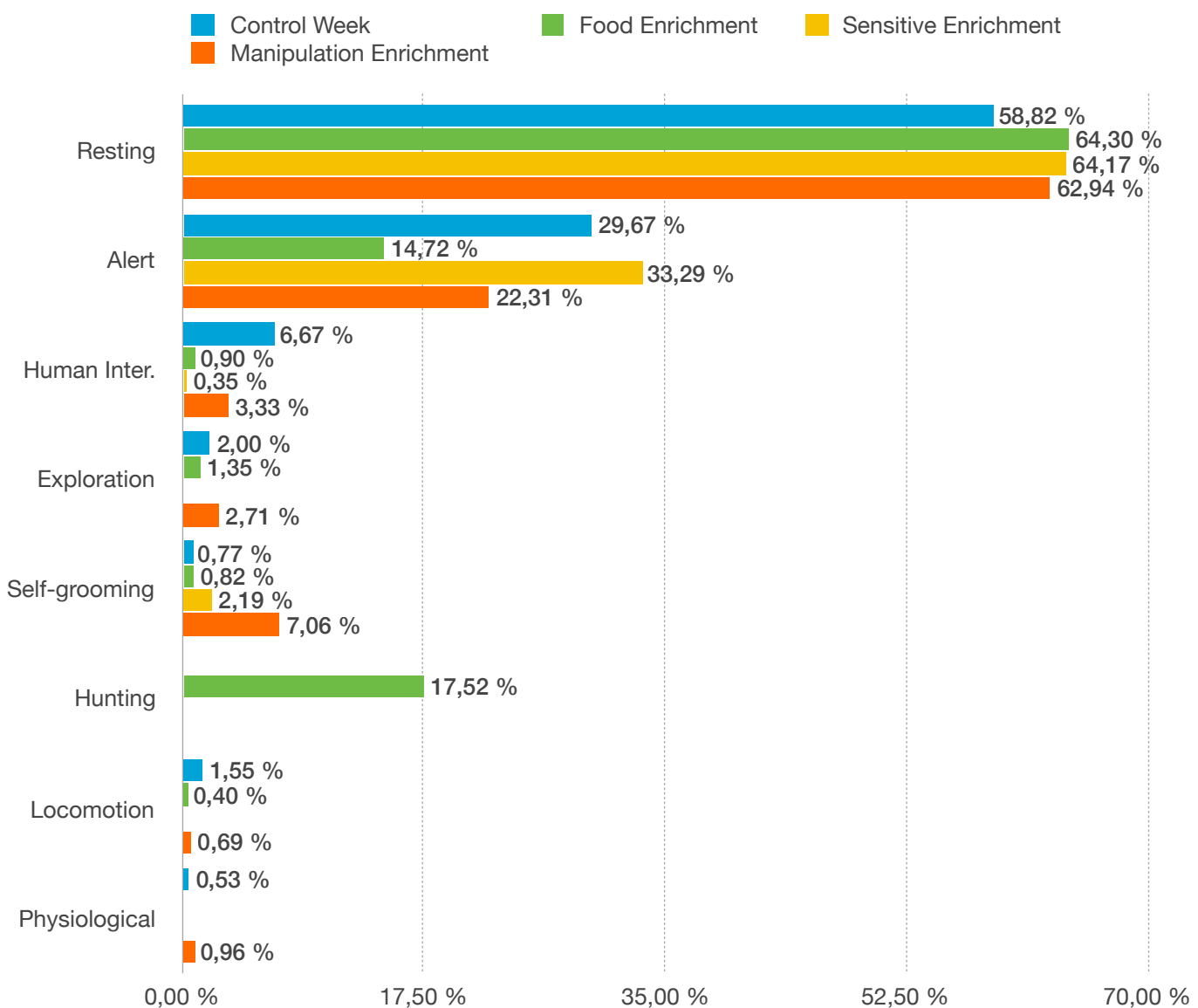


Figure 4 : Summary of Rayito's behaviours during the 11 am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 11 am observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Hunting (HU), Locomotion (LO), Physiological (PH)

Max

Figure 5 shows a summary of Max's behaviour during the 3 pm observations in the 4 situations (control week and the 3 types of enrichments). Globally, we can see that the time spent by resting (RE) decreased strongly between the control week and the 3 types of enrichments. In the same way, there is a strong increase of the exploration (EX) behaviour with the 3 different types of enrichment. On the other hand, the human interaction (HI) behaviour decreased with the 3 types of enrichment compared to the control week even if this one was already low.

Regarding the food enrichment, we can see that it was able to trigger the hunting (HU) and eating (EA) behaviour with a preference for eating the enrichments more than his normal food. The inactive behaviour (resting and alert) has decreased in an important manner while the active behaviours (all the behaviours except for resting and alert) have increased. With a strong decrease of the proportion inactive/active behaviour and an increased time spending hunting and eating, it can be considered that the food enrichment reached the goals and could have a positive effect on Max's behaviour.

The scent enrichment, was able to increase the self-grooming (SG) and marking (MA) behaviour. The exploration (EX) behaviour increased even more with the scent enrichments than with the food enrichments. Just like with the food enrichment, the proportion of inactive/active behaviour decreased strongly. The scent enrichments can be considered as effective on Max at the moment of their implementation.

The manipulation enrichments caused a lower decrease of the resting (RE) behaviour than the 2 other enrichments but a bigger increase of the exploration (EX) behaviour. It was also able to trigger the hunting (HU) and eating (EA) behaviour but in a lesser degree than the food enrichment. However, even if the difference is less remarkable than with the food enrichments, the manipulation enrichments were still able to reach the objectives by decreasing the inactive behaviours, increase the exploration (EX) behaviour and trigger the hunting-playing (HU) behaviour.

Control Week Food enrichment Scent enrichment
 Manipulation Enrichment

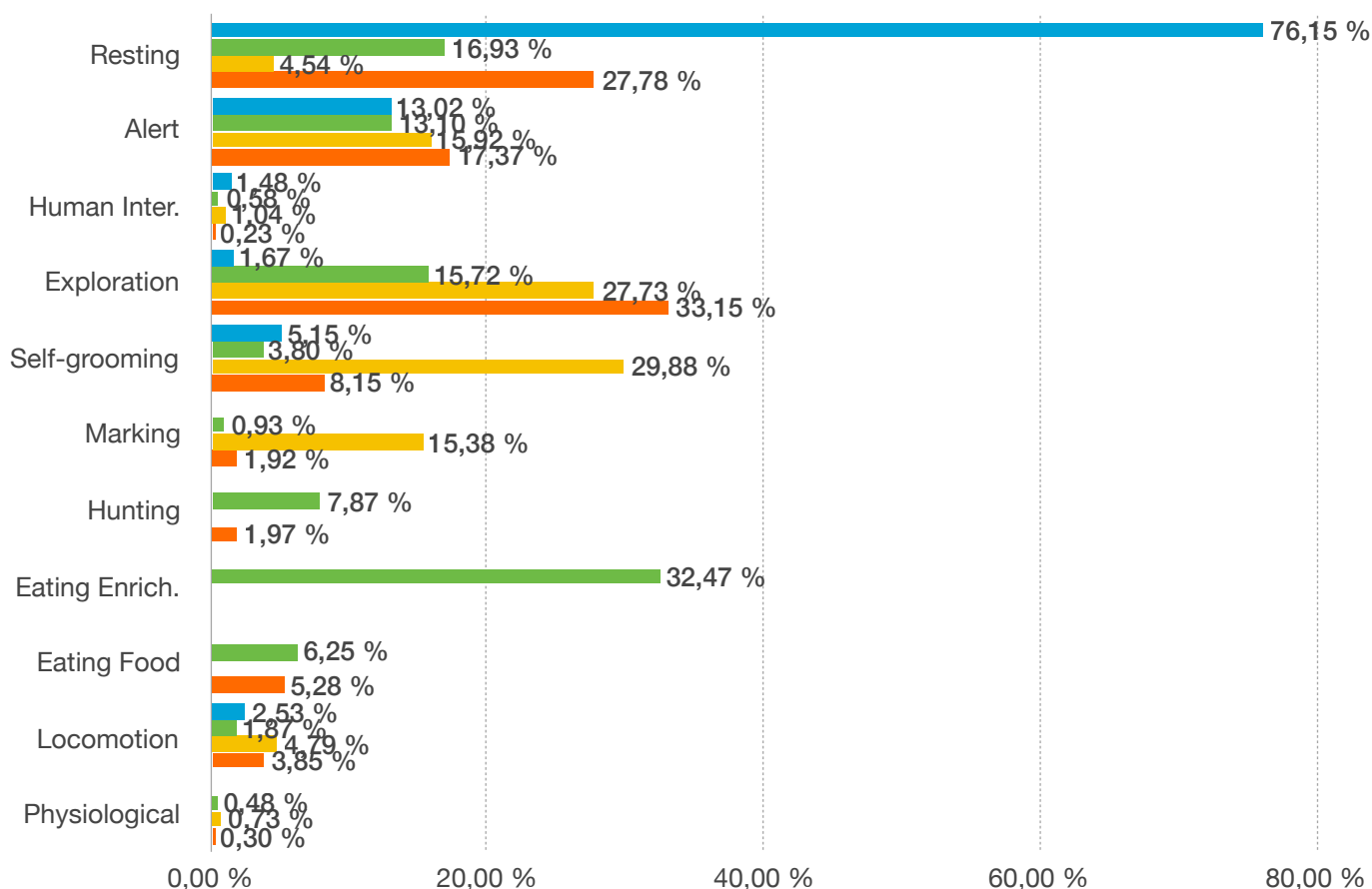


Figure 5 : Summary of Max's behaviours during the 3 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 3 pm observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Hunting (HU), Eating enrichment (EA ENRICH), Eating normal food (EA food) Locomotion (LO),

Figure 6 shows the information about Max's behaviours during the 7 pm observations for the control week and the 3 types of enrichments. Globally, we can see that there is no big difference between the control week and the scent enrichments contrary to the food and manipulation enrichments.

For the food enrichments we see that the resting (RE) behaviour strongly increased compared to the control week. In the mean time the exploration (EX) behaviour has strongly diminished. There is also an increasing of the self-grooming (SG) enrichment and a strong decrease of the « non visible (NV) behaviour ». This means that he was more visible and spent less time on exploration. Indeed, Max was moving a lot during the 7 pm observations and it was thus difficult to see him during the whole observation. A decrease of the « non visible (NV) behaviour » is associated with a decrease of the exploration (EX) behaviour and thus an increase of the inactive behaviour. Food enrichment could still have an effect on Max behaviour a couple of hours after their implementation.

Concerning the scent enrichments, as mentioned before, no big changes of behaviour can be seen compared with the control week. Resting (RE), alert (AL), exploration (EX) and « non visible (NV) » behaviours have approximatively the same values. There is however a slight increase of self-grooming (SG) and marking (MA) behaviour. It seems that the scent enrichment was not responsible for big modification in the behaviour pattern of Max during the 7 pm observations but some effects were still seen after a couple of hours of implementation. The results of the manipulation enrichments follow more or less the results of the food enrichments with an increase of the resting (RE) behaviour and a decrease of the exploration (EX) and « non visible (NV) » behaviour. This type of enrichment could also still have an effect on Max's behaviour a couple of hours after their implementation.

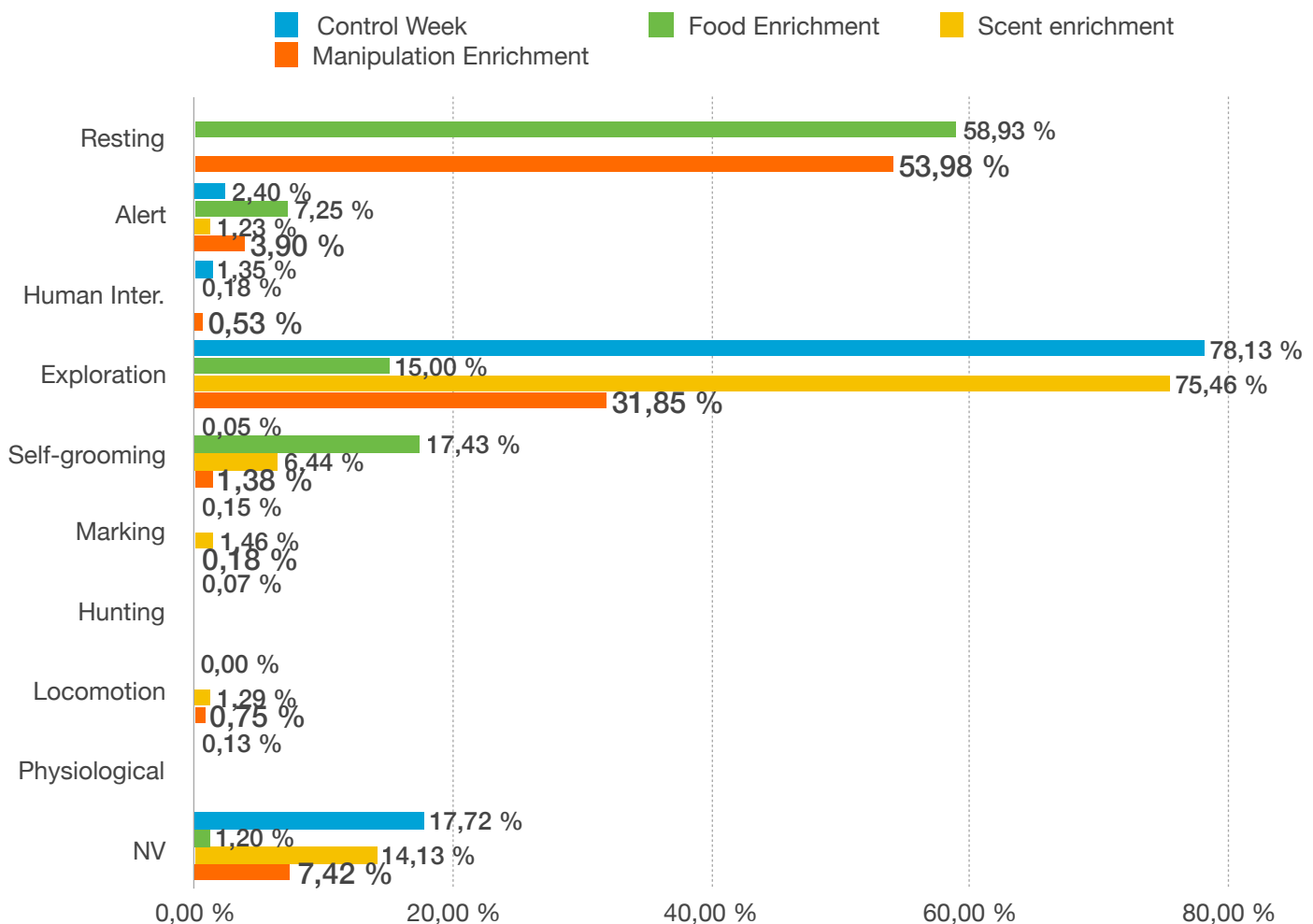


Figure 6 : Summary of Max's behaviours during the 7 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 pm observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Hunting (HU), Marking (MA), Locomotion (LO), Physiological (PH), Non visible (NV)

Figure 7 represents the information about Max's behaviour collected during the 7 am observations for the control week and the 3 types of enrichments.

Globally, there is no big changes in behaviour between the control week and the 3 different types of enrichments. For the 4 situations, the time spent in resting (RE) behaviour is approximately the same as well as alert (AL) behaviour. Self-grooming (SG) is slowly increased during manipulation enrichments but it is not possible to claim that this increase is actually due to the enrichments. It could be that the 3 different types of enrichments have no effect on Max's behaviour after a night (or more) .

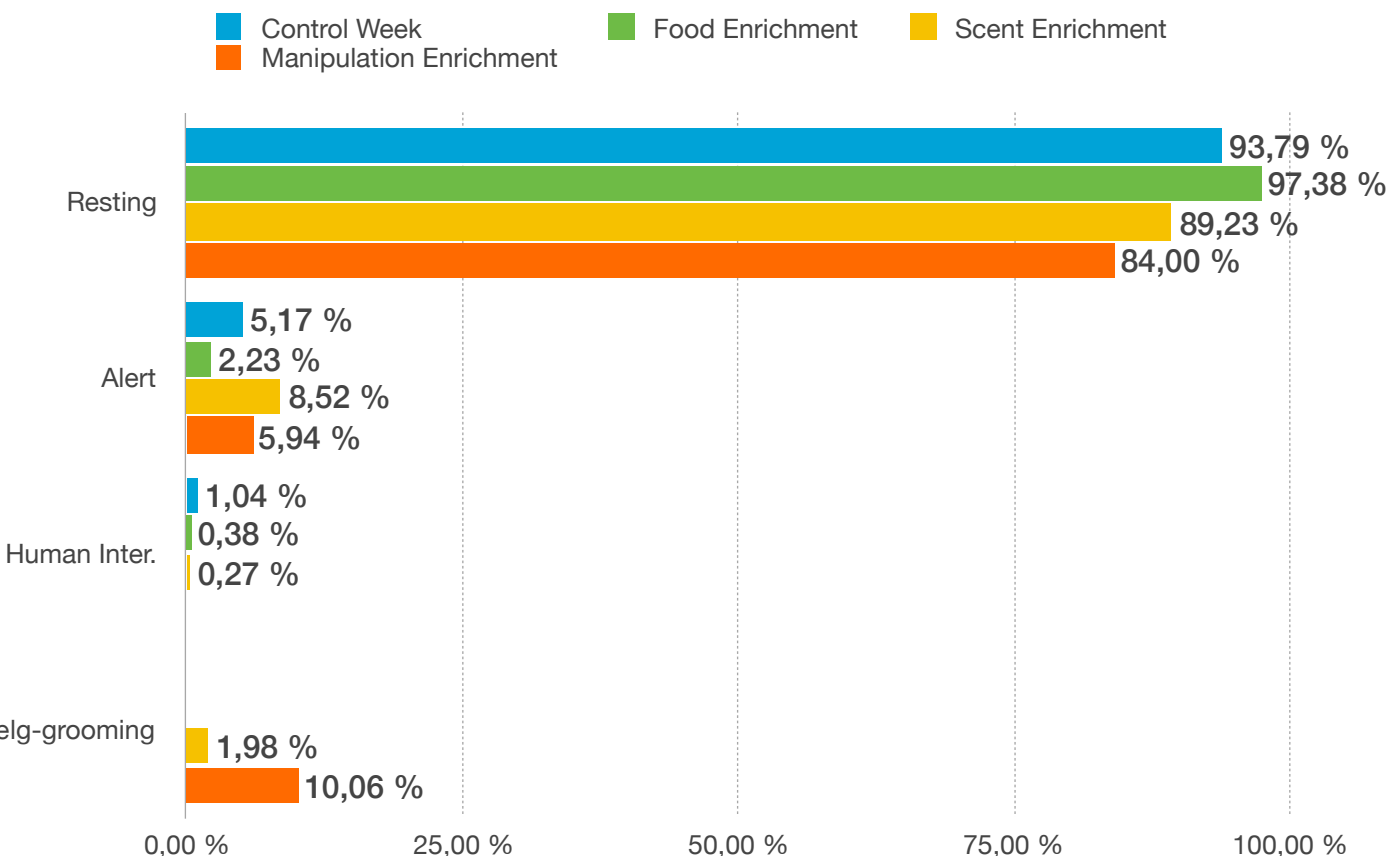


Figure 7 : Summary of Max's behaviours during the 7 am observations. Each color represent one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 am observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Self-grooming (SG)

On figure 8, it can be seen the information about Max's behaviour during the control week and the 3 different types of enrichments at the observations of 11 am. Like for the 7 am observations, no big difference is noticed in Max's behaviour between the control week and the 3 different types of enrichments. Resting (RE) stays the most important behaviour with alert (AL) behaviour. The

increase of the exploration (EX) behaviour during the food enrichment is due to the same reason as the increase of Rayito's hunting behaviour namely the grison that escaped. Indeed, Max's enclosure is next to Rayito's enclosure and was thus stimulated by the grison escape. This is thus not due to the food enrichment. The fact that the alert (AL) behaviour is increased compared to the control week and the 2 other types of enrichments could be explained by the fact that during these enrichments he was laying down in the little enclosure that is always open (it was thus his own choice) and was thus closer to the visitors as well as to the noise than when he stays in his log high up. He was thus more attentive during these observations.

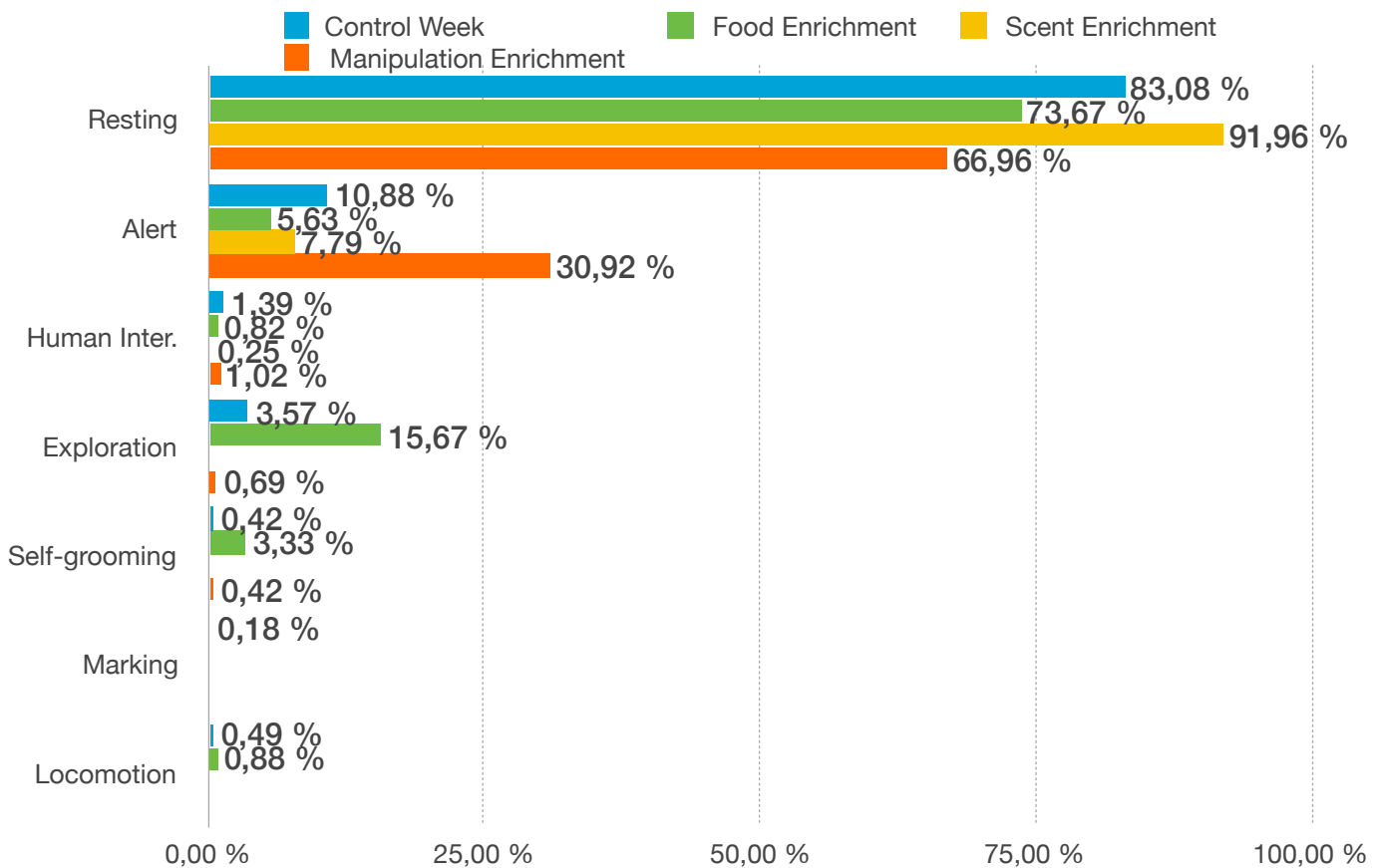


Figure 8 : Summary of Max's behaviours during the 11 am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 11 am observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Locomotion (LO)

Nicoa

Figure 9 is a summary of Nicoa's behaviours values obtained during the observations of 3 pm for the control week and the 3 different types of enrichment. Overall, there is an important decrease of the resting (RE) behaviour with even absence of this behaviour during food and manipulation enrichments. The alert (AL) behaviour diminished too except for the manipulation enrichments where it increased.

During food enrichment, the exploration (EX) behaviour increased in an important way. Hunting (HU) and eating (EA ENRICH) were triggered too by the food enrichments. With a very important decrease of the inactive behaviour (RE and AL), the important increase of exploration (EX) behaviour and the apparition of hunting (HU) and eating (EA ENRICH) behaviours, it is considered that the food enrichments achieved the objectives.

With an important increase of the exploration (EX) and the apparition in an important way of the marking (MA) behaviour, it can be considered that the scent enrichment also had an effect on Nicoa's behaviour. However, the self-grooming (SG) behaviour diminished and even reached the lowest level between the 3 types of enrichments. It could be that Nicoa used so much time to mark (MA), by rubbing and rolling mostly, that he left out his self-grooming (SG) behaviour at the moment that the scent enrichment was placed.

Even if the alert (AL) behaviour increased during the manipulation enrichment, the total of inactive behaviour still decreased in an important way due to the absence of resting (RE) behaviour. The proportion of inactive/active behaviours strongly decreased during the manipulation enrichment compared to the control week. The manipulation enrichments were able to increase strongly the exploration (EX) behaviour and to trigger the hunting (HU) behaviour. Indeed the exploration (EX) and hunting (HU) behaviours were respectively 2,82% and 0,00% during control week and increased to 36,57% and 13,82% respectively during the manipulation enrichments. It can be considered that the manipulation enrichments were able to stimulate Nicoa's exploration and hunting behaviour and thus reached the objective.

An interesting observation is the aggressive (AG) behaviour. While there was none during control week, it appeared with the food enrichments and only with that type of enrichments. This could be competence for food or simply the fact that Chata was really interested by this type of enrichment and wanted to keep it for herself. On the other hand, social interaction (SI) behaviour appeared during the 3 different types of enrichments in approximately the same manner. This could be due to

the fact that they were more active and thus more in contact with each other. Human interaction (HI) behaviour decreased too during the 3 types of enrichments which is a positive thing knowing that he is like Rayito very attracted to humans. However it is not an important decrease.

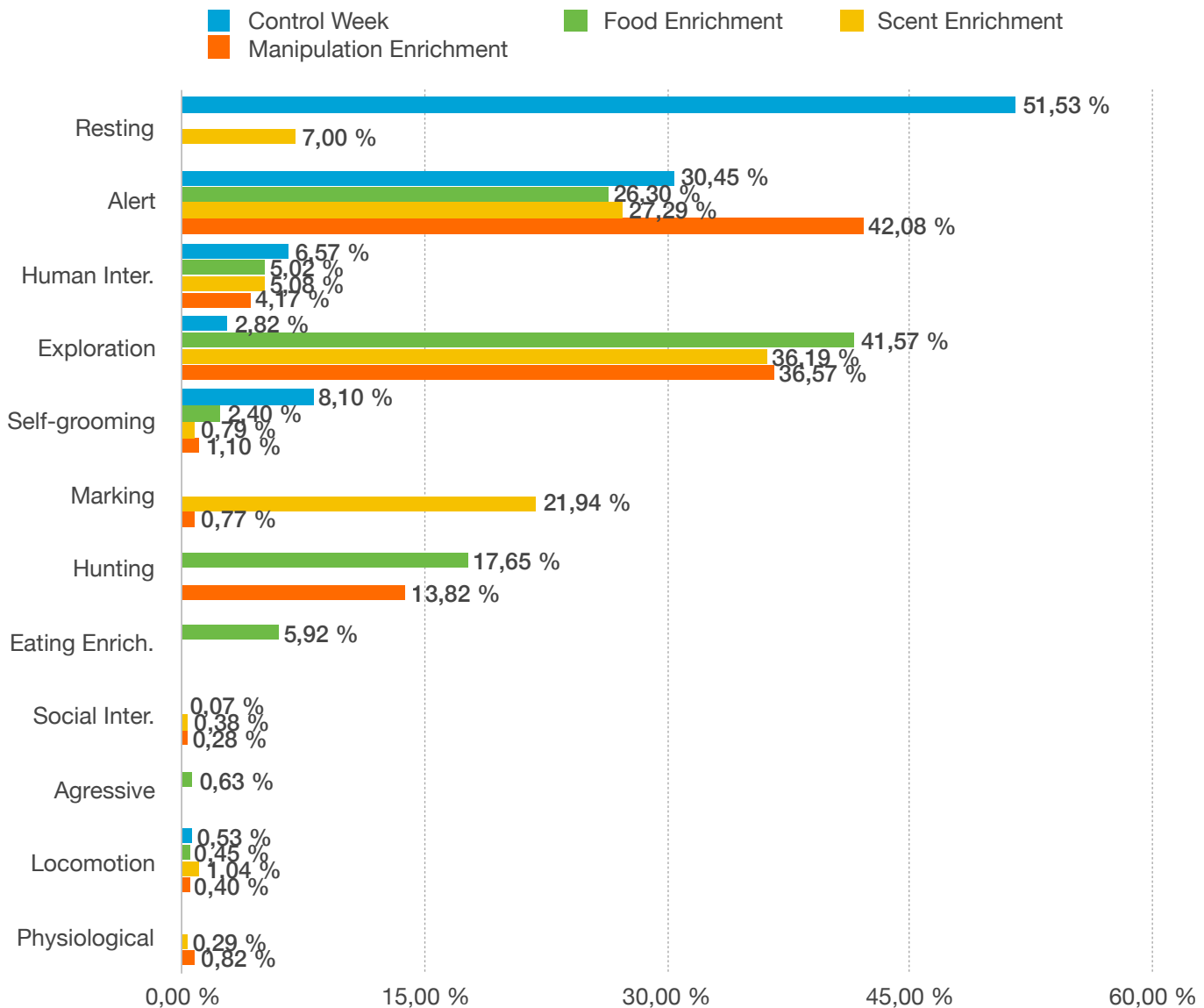


Figure 9 : Summary of Nicoa's behaviours during the 3 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 3 pm observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Hunting (HU); Eating enrichment (EA ENRICH), Social interaction (SI), Aggressive interaction (AG), Locomotion (LO) and Physiological (PH)

Figure 10 represents the information about Nicoa's behaviour obtained during the 7 pm observations in the 4 situations. Globally, his resting (RE) behaviour didn't change at all but his alert (AL) behaviour increased with the 3 types of enrichment compared to the control week. The exploration (EX) behaviour stayed approximately the same as well as the self-grooming (SG) and the « non visible » behaviours. This figure shows that Nicoa was more visible and had a more important alert (AL) behaviour with the manipulation enrichments. Human interaction behaviour (HI) decreased with the 3 types of enrichments compared with the control week. There was an increase of the inactive behaviour and a decrease of the active behaviour with the 3 different types of enrichments. This could be due to the fact that he was more active during the 3 pm observations and thus tired afterwards. It could be that the 3 types of enrichments still had some effects a couple of hours after the implementation but the manipulation enrichment was the most efficient at that time.

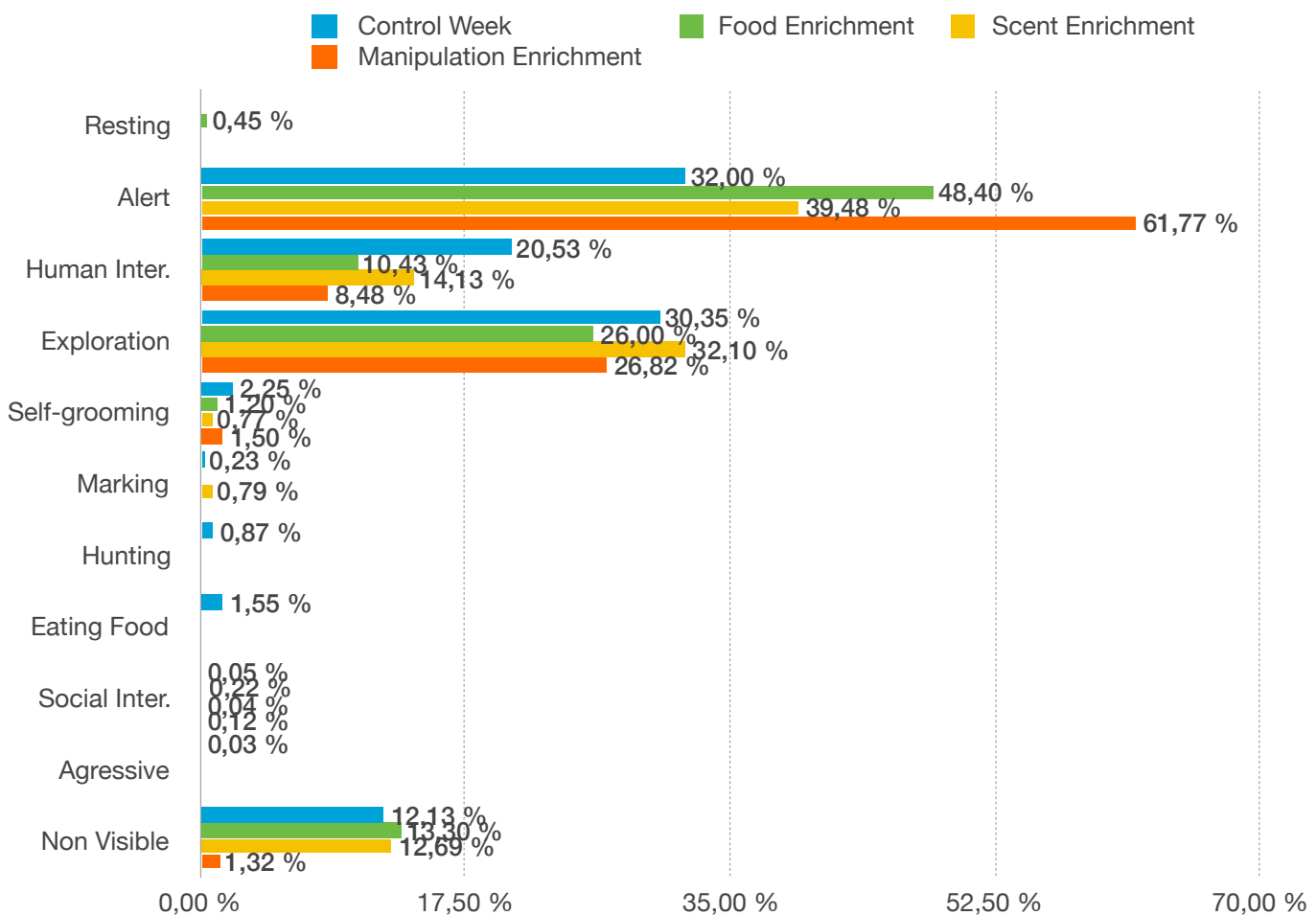


Figure 10 : Summary of Nicoa's behaviours during the 7 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 pm observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Hunting (HU), Social interaction (SI), Agressive interaction (AG), Non visible (NV)

The observations of 7 am between the control week and the 3 different types of enrichment did not change (Figure 11). Indeed, during the control week, Nicoa was resting during 92,47% of his time at the 7am observations. During the food, scent and manipulation enrichments he was resting respectively 92,03%, 90,38% and 97,21% of his time. The proportion between inactive and active behaviours stayed approximately the same with or without enrichment. Thus it can be considered that the enrichments had no effect on Nicoa's behaviour after one night (or more).

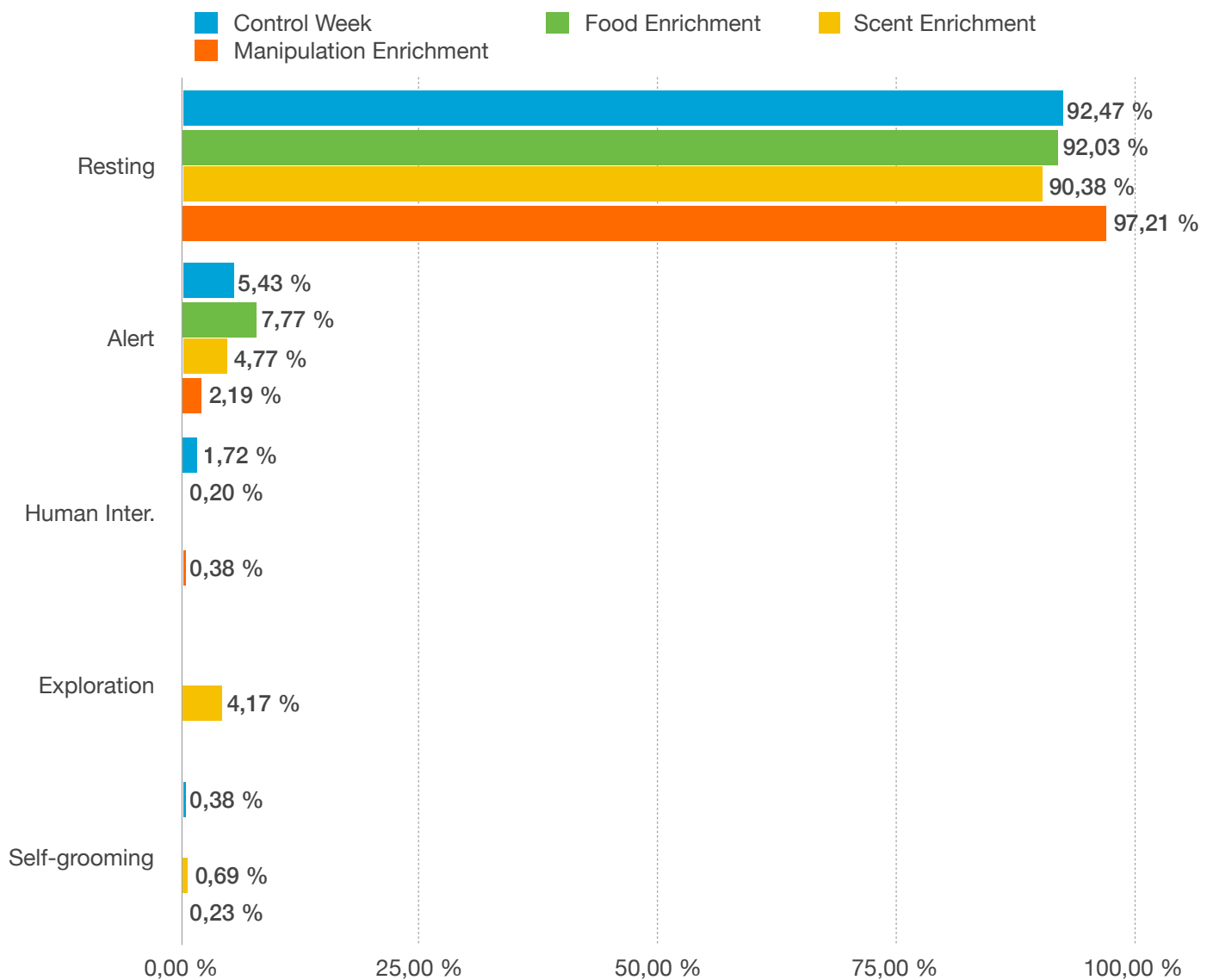


Figure 11 : Summary of Nicoa's behaviours during the 7 am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 am observations for each situation (control week and the 3 types of enrichments): Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG)

At the 11 am observations, the proportion of inactive behaviour and active behaviour during control week compared to the 3 different types of enrichment stayed approximately the same too (Figure 12). The only change that was noticed, was the time spent on alert (AL) behaviour during the scent and manipulation enrichments. While the resting (RE) behaviour decreased, the alert (AL) behaviour increased. This is mainly due to days when there were a lot of tourists in the center and Nicoa paid thus more attention to them, since, as said before, he is attracted to humans. It can be thus considered that the 3 different types of enrichments had no effect on Nicoa's behaviour at the observations of 11 am.

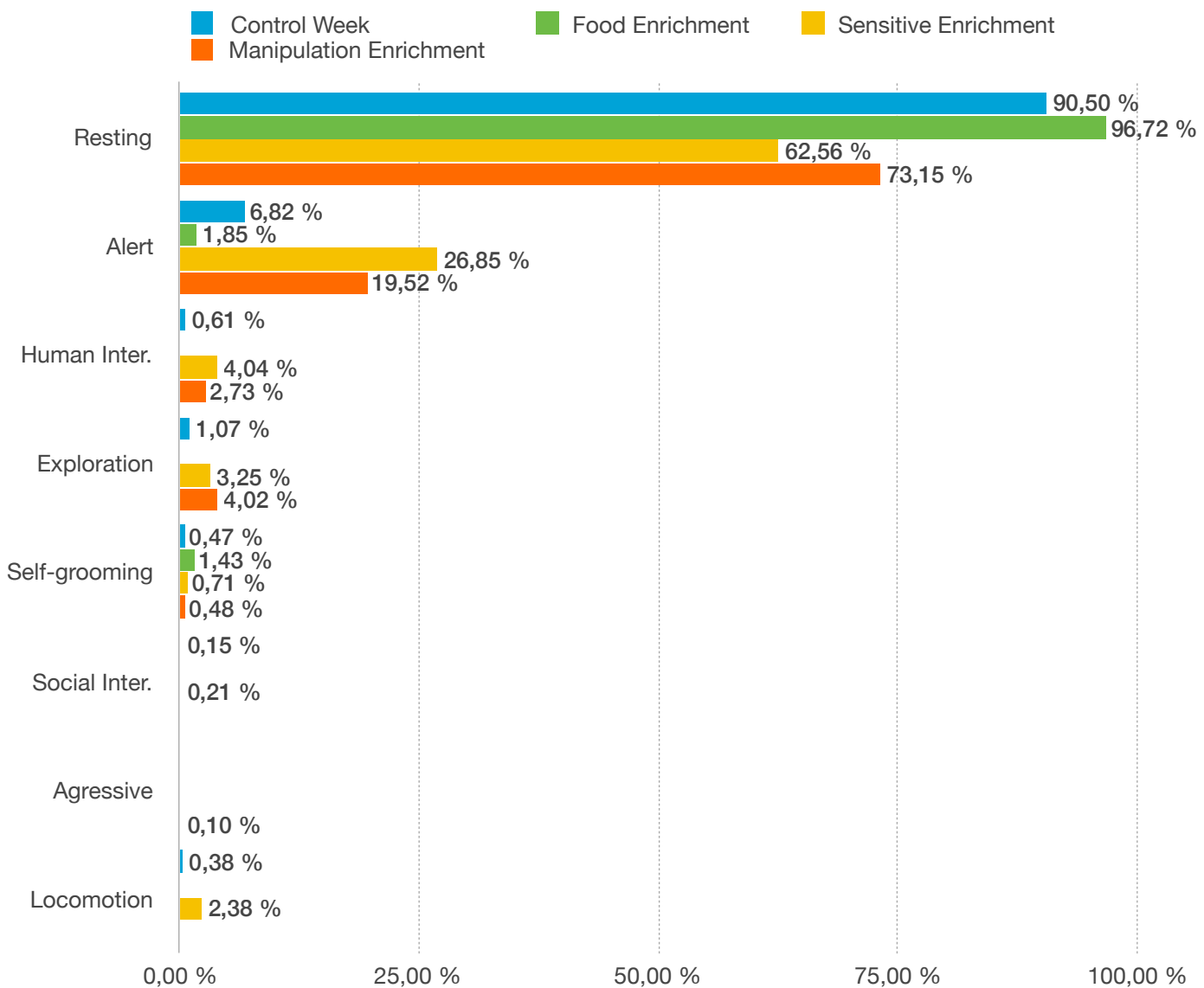


Figure 12 : Summary of Nicoa's behaviours during the 11 am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 11 am observations for each situation (control week and the 3 types of enrichments):

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Social interaction (SI), Agressive interaction (AG), Locomotion (LO)

Chata

Figure 13 is a summary of the information obtained during Chata's 3 pm observations for the control week and the 3 different types of enrichment. During the control week, the majority of her behaviour was inactive (resting and alert) behaviours with an important part of self-grooming (SG) too.

During food enrichments, the resting (RE) behaviour diminished in an important manner but the alert (AL) behaviour increased strongly. But the total inactive (resting + alert) behaviours still decreased during food enrichments compared with the control week. In the mean time, the exploration (EX) behaviour reached 38,08% whereas it was less than 1% during the control week. While the hunting (HU) behaviour was absent during the control week, it reached 5,70% with the food enrichments. The self-grooming (SG) behaviour decreased of 13% with the food enrichments compared to the control week. Chata was thus more active and it can be considered that the food enrichments were able to reach their objectives.

With the scent enrichment, resting (RE) behaviour was absent while the alert (AL) behaviour reached a peak. However, Chata's inactive behaviour was less important during scent enrichments than during the control week. These enrichments were also able to increase the exploration (EX) behaviour and to trigger the marking (MA) behaviour in an important manner. But Chata spent less time during scent enrichment on self-grooming than during the control week. With a decrease in the proportion of inactive/active behaviours during the scent enrichment compared with the control week, it seems that the scent enrichments were efficient to render Chata more active and to provoke an important marking (MA).

During the manipulation enrichments, the time spent resting (RE) diminished too but in a lower level than with the 2 other types of enrichment. In the mean time, alert (AL) behaviour increased too but also in a lower level than during the 2 other enrichments. In total the inactive behaviour during manipulation enrichments is approximately the same as during food and scent enrichments which are both diminished compared to the control week as mentioned before. The exploration (EX) behaviour underwent an important increase too during manipulation enrichments. Compared to the control week, self-grooming diminished but stayed an important behaviour during manipulation enrichments. It was also capable to trigger the hunting behaviour but not in an important way. With a good increase of the exploration behaviour but a poor increase in hunting-playing behaviour, the results about the manipulation enrichments are mitigated.

As seen with Nicoa, food enrichments triggered the aggressive behaviour of Chata. But an important difference is the fact that scent and manipulation enrichments were also able to provoke an aggressive behaviour with Chata. Indeed, during food enrichment, Chata was aggressive in a way that she physically attacked Nicoa when he approached the enrichment. However, during the two other types of enrichments, Chata did not attack specifically Nicoa with physical aggression but was aggressive by vocalisations and posture when they met in the enclosure. This could be explained by the fact that with food enrichment, she wanted to keep everything for herself while with the two other types of enrichments it was more like a repulsion behaviour when they met during exploration.

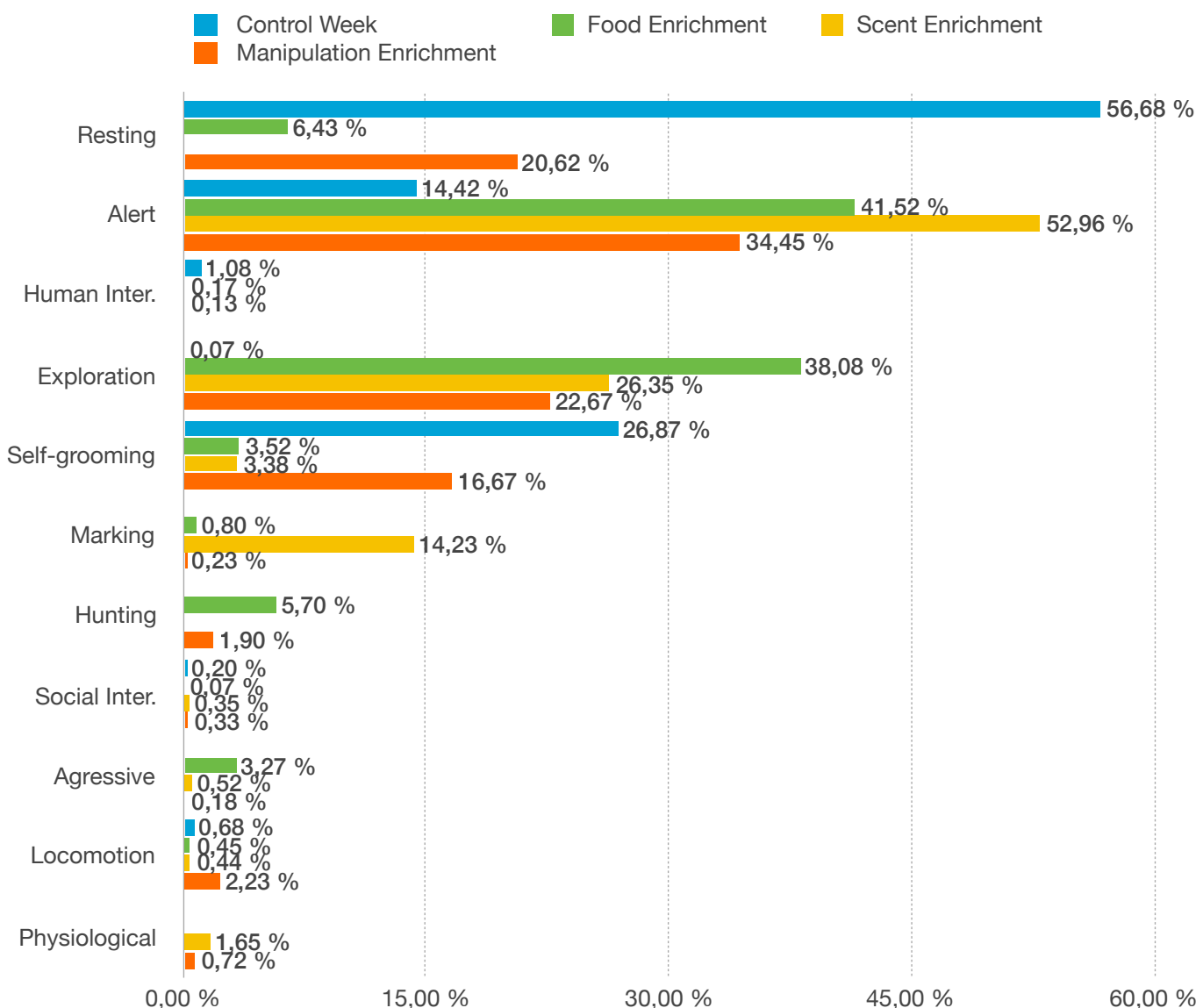


Figure 13 : Summary of Chata's behaviours during the 3 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 3 pm observations for each situation (control week and the 3 types of enrichments):

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Hunting (HU), Social interaction (SI), Aggressive interaction (AG), Locomotion (LO), Physiological (PH)

Figure 14 shows the different Chata's behaviours expressed during the 7 pm observations in the 4 situations. Overall, there is an augmentation of the resting (RE) behaviour and diminution of the exploration (EX) behaviour when comparing the control week with the 3 different types of enrichments.

During food enrichment, Chata spent more time with inactive (resting and alert) behaviour than during control week. She was also less exploring and spent less time eating food than during the control week. However, she was equally non visible during food enrichments and control week. The fact that she was less exploring but equally non visible could be because she was resting in a place that was non visible because she was tired after a peak of activity caused by the implementation of the enrichment at 3 pm. However, with an increase of inactive behaviour, it could be considered that food enrichments still had an effect on Chata's behaviour a couple of hours after their implementation.

The scent enrichment was also responsible of an increase in inactive behaviours and a decrease of active behaviour at the 7 pm observations compared to the control week. However, Chata spent much more time self-grooming during scent enrichment than during the control week. While this was not true during the 3pm observation (and thus at the moment of the implementation), it could be that Chata was too occupied with marking behaviour during 3pm observation and that the self-grooming behaviour came only later. This is certainly due to the scent enrichment.

The results of the manipulation enrichments follow the same trend than the 2 other types of enrichments. Except for the « non visible » (NV) behaviour that was increased compared to the control week. This type of enrichment could also still have an effect a couple of hours after its implementation. It is important to notice that human interaction (HI) behaviour was absent during the 3 types of enrichments.

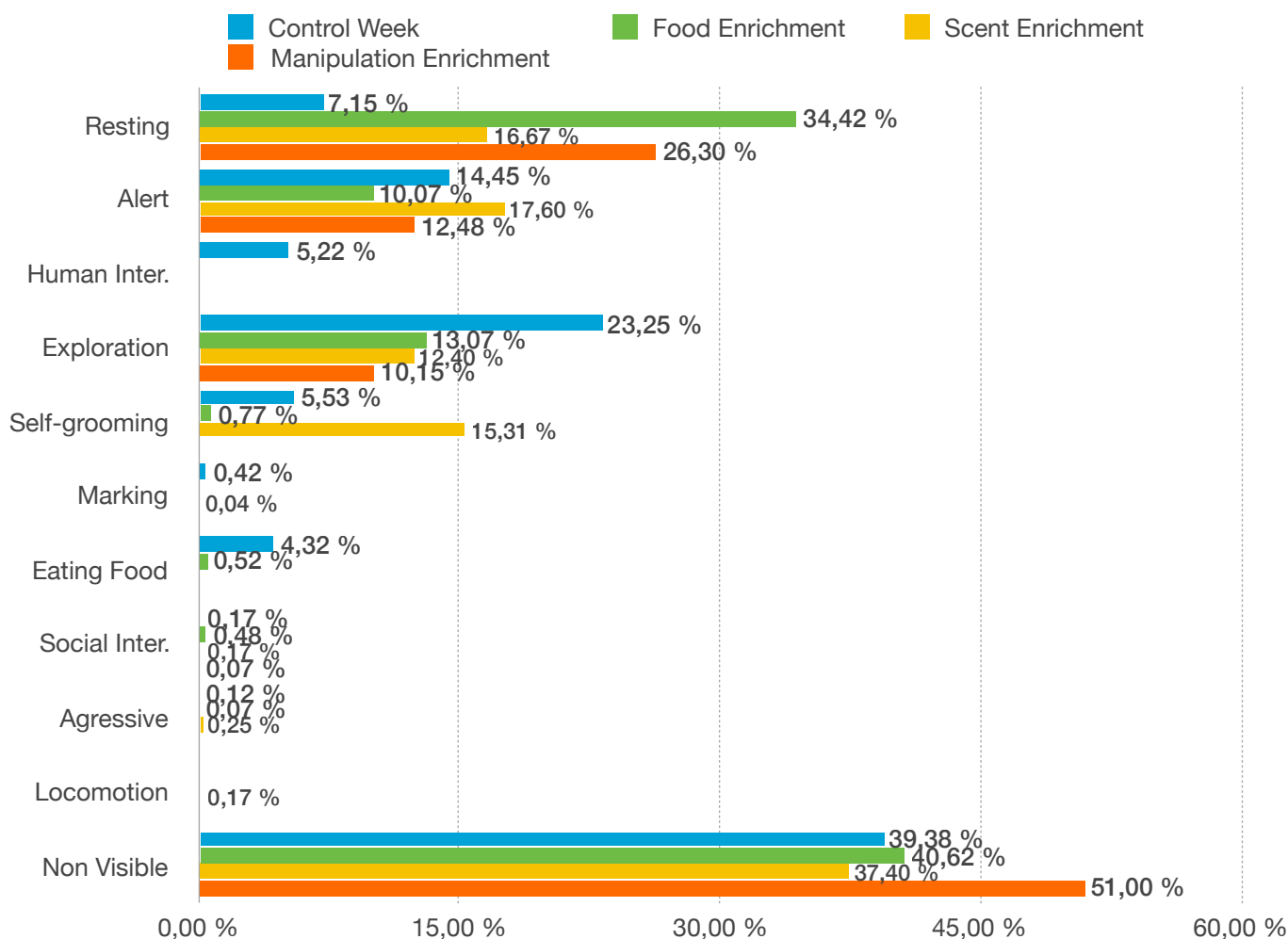


Figure 14 : Summary of Chata's behaviours during the 7 pm observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 pm observations for each situation (control week and the 3 types of enrichments):

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Eating food (EA FOOD), Social interaction (SI), Agressive interaction (AG), Locomotion (LO), Non Visible (NV)

Regarding Chata's 7 am observations, figure 15 shows that the same trend is followed during the control week and the 3 different types of enrichments. There is a slight increase of the resting (RE) behaviour during the enrichments but also a slight decrease of the alert (AL) behaviours. The proportion of inactive/active behaviours stays approximately the same between the control week and the 3 different types of enrichments. It seems that the enrichments had no effect on Chata's behaviours any more at the 7am observations.

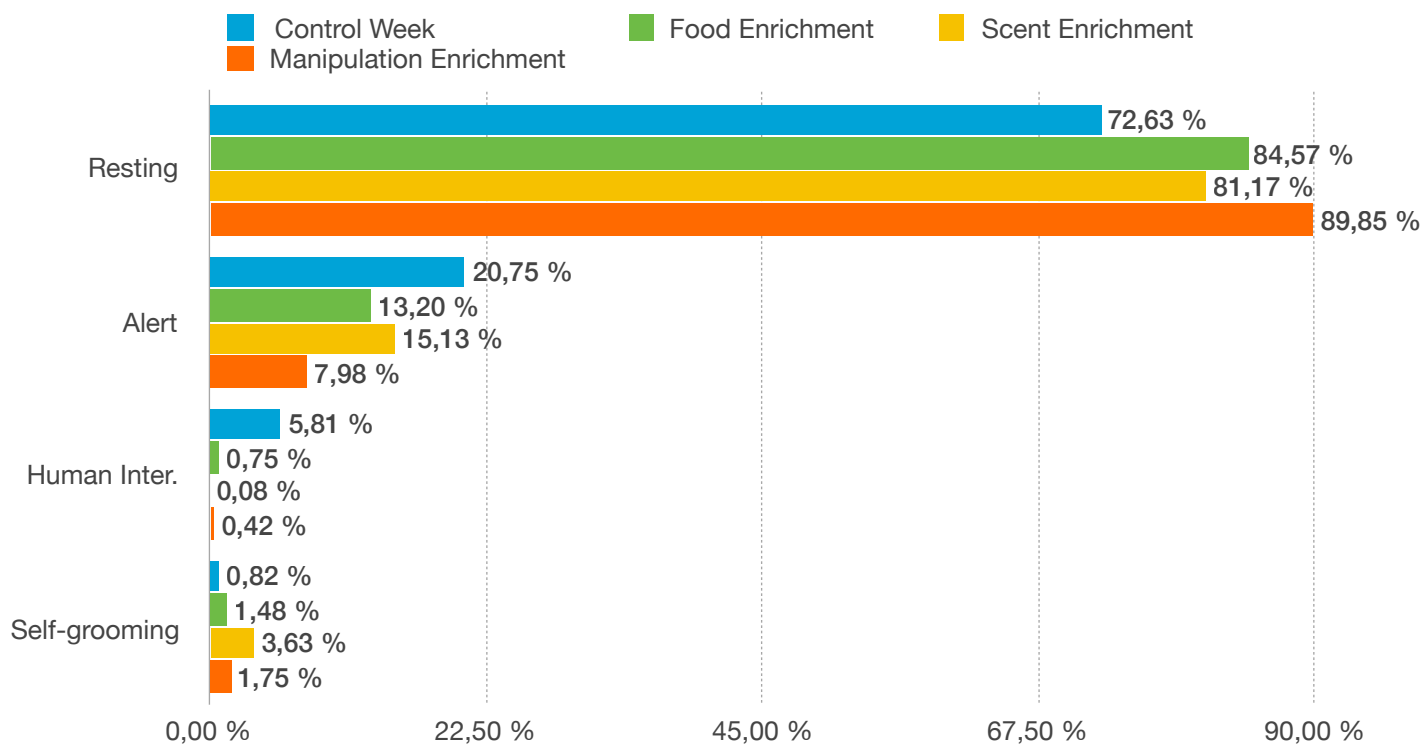


Figure 15 : Summary of Chata's behaviours during the 7 am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 7 am observations for each situation (control week and the 3 types of enrichments) :
 Resting (RE), Alert (AL), Human Interaction (HI), Self-grooming (SG)

The observation of Chata's 11 am behaviours for the 4 situations are visible on figure 16. In general, the proportion of inactive (resting and alert) behaviours and active behaviours stays approximately the same even if there is a slight increase of the inactive behaviours during the enrichments. Human interaction (HI) decreased during the observations with enrichments as well as marking (MA) behaviour. But the marking behaviour during the control week was seen during only one observation. During that observation, Chata was rubbing and licking a stone without any apparently particular reason. There is thus no evidence that the enrichments still had an effect on Chata's behaviour during the 11am observations.

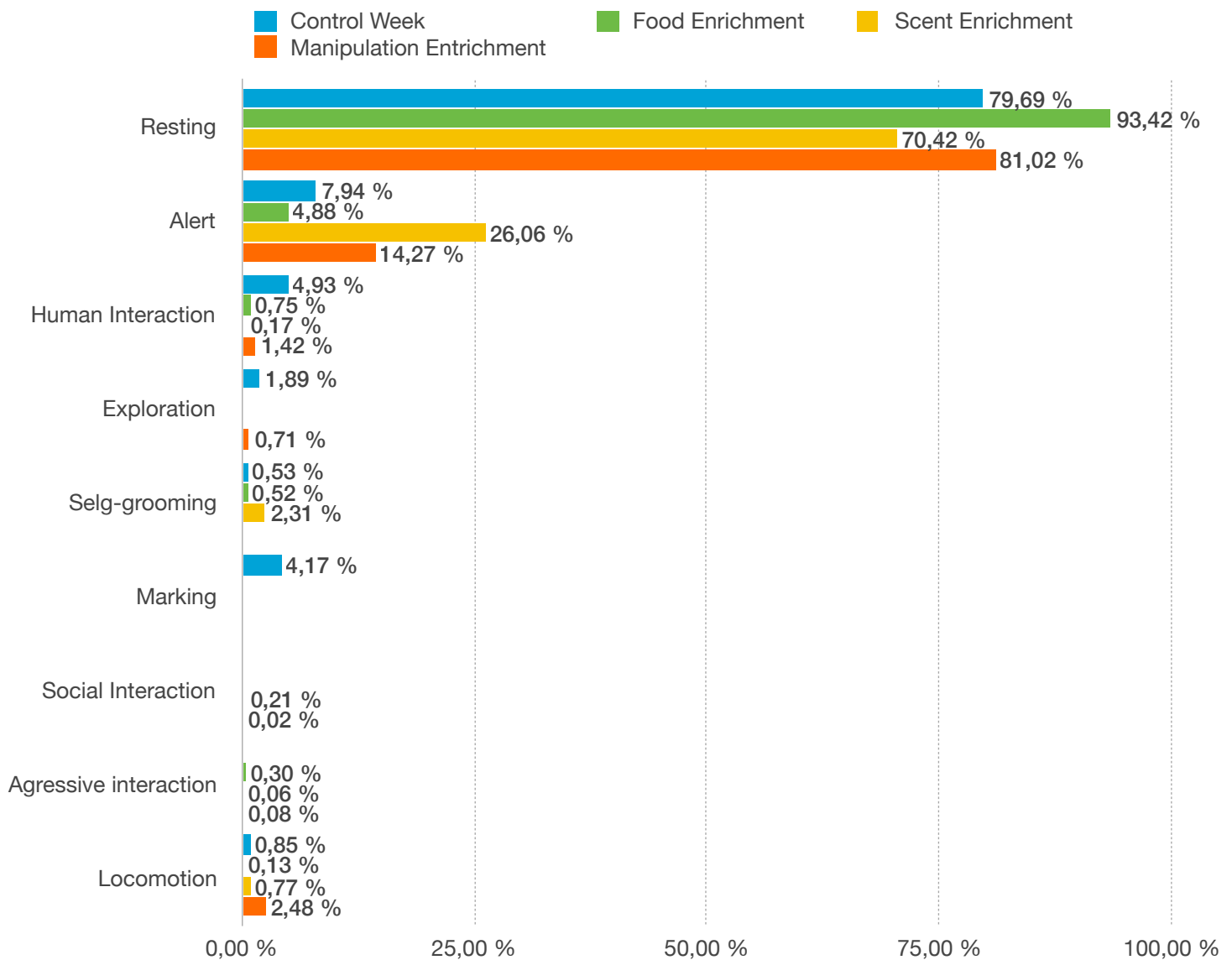


Figure 16 : Summary of Chata's behaviours during the 11am observations. Each color represents one of the 4 situations (control week and the 3 types of enrichments). The percentage represents the total time of the behaviour expressed during the 11am observations for each situation (control week and the 3 types of enrichments) :

Resting (RE), Alert (AL), Human Interaction (HI), Exploration (EX), Self-grooming (SG), Marking (MA), Social Interaction (SI), Agressive interaction (AG), Locomotion (LO)

4.2 Which enrichment provoked the most direct interaction for each ocelot individually at the moment of the implementation?

For this part of the study, the choice was taken to consider only the direct interaction with the enrichment at the time of the implementation. A percentage of direct interaction above 30% was considered as high interaction, between 10% and 30% as medium interaction and less than 10% low interaction. These numbers are subjective and not based on any statical study. It was considered at the time of implementation that more than 30% of the time spent in direct interaction with the enrichment was already a sufficient value. This part of the study does not talks about efficiency.

Rayito

By looking only at the percentage in table 3, it can be considered that the food enrichments were the most able to trigger direct interactions with Rayito. The scent enrichments and manipulations enrichments were not really effective to trigger direct interactions at the moment of implementation.

It is clear that the type of enrichment with the most impact on direct interactions with Rayito is the food one. Indeed, 3 of the 5 enrichments were able to draw Rayito's attention during more than 30 % of the observation time. Regarding the scent enrichments, they were able to increase importantly Rayito's marking and self-grooming behaviours. But these are not considered as a direct interaction with the enrichments (except marking when it's directly on the enrichment which wasn't all the time the case). If we take only direct interaction into account, we would consider that the scent enrichment type is not working on Rayito. However if we gather direct and indirect interaction (such as an increase of self-grooming, marking and exploration), we see that this type of enrichment is working.

The same analyse can be made with the manipulation enrichments. Only 1 of the 5 enrichments was able to exceed the rate of 30% direct interaction. Even more, the one above 30% is only at 30,17%. The « cardboard box enrichment » is considered as partially efficient because the percentage of direct interaction is 24,83% and thus situated between de 10 and 30%. But some manipulation enrichments such as the « coconut with feathers, cardboard box and the frozen coconut with cow skin » were used by Rayito between the 3 pm and 7 am observation even if this is not taken into account in this table (see table 3 section comment).

To conclude, Rayito had the most direct interactions at the moment of the implementation with the food enrichments. Among these, the enrichment « dead chicks » was the one that worked the best with a total time spent interacting directly of 68,92%. But, it can not be considered that the other types of enrichments were not efficient at all. Some triggered an interaction later, other triggered an indirect interaction. It is important to differentiate the efficiency of an enrichment with the total time spent by the animal interacting directly with the enrichment at the moment of implementation. The efficiency of an enrichment is a global result of the direct and indirect interactions. It is not because the scent enrichments did not triggered an important direct interaction that they are not efficient. The same analyse can be made with the enrichment « frozen coconut with cow skin ». If we take only into account direct interaction at the moment of implementation, it seems that this enrichment is not efficient. However, at the 7 pm observation, the enrichment was totally destroyed. This means that Rayito was interested by the enrichment at some point but we do not know how much time he spent on the enrichment.

ENRICHMENT	TOTAL TIME (S) A	TOTAL % B	LAST TIME (MIN) C	N°REP D	COMMENT	CONCLUSION E
Blood + hidden meat	35	2,92 %	5min 30	2	Wasn't attracted by the enrichment. The 2 times he went smelled the enrichment was during exploration	Low
Meat attached to a rope on a pole	0	0,00 %		0	The piece of meat was still there and untouched at the 7pm observation. Maybe it was a little bit high for him.	Low
Dead chicks	827	68,92 %	17min 15	18	There were still chicks at the end of the 3 pm observation, and at the beginning of the 7 pm observation but less than before. Same with the beginning of the 7 am observation.	High
Living rat	480	40,00 %	19min 41	12	At the observation of 7 am the next morning, Rayito still tried to catch the rat hidden in a log.	High
Blood ice cream with little pieces of meat	374	31,17 %	10min 44	8	Strangely, Rayito began suddenly to play with a wooden game that is in his enclosure since ever and stopped playing attention to the enrichment	High
Liquid vanilla	150	12,50 %	6min55	9	After 6min55s, Rayito continued to explore and began rubbing on a stone and self-	Medium
Cinnamon powder	10	0,83 %	5 min 17	1	Rayito smelled the enrichment just once during 10 sec and then continued to explore	Low
Logs and faces of prey	10	0,83 %	2min 07	1	Rayito smelled the enrichment just once when he was exploring but after that didn't pay any attention anymore to the enrichment	Low
Perfume Channel n°5	28	2,33 %	1 min 39	2	Rubbed just once and then stopped paying attention to the perfume	Low
Frozen watermelon	362	30,17 %	14min 21	17	Rayito was very attracted by the enrichment and tried to catch the watermelon in the pond.	High
Coconut with feathers	0	0,00 %		0	At the 7pm observation the coconut was still untouched but at the 7 am observation of the next day, it was destroyed	Low
Pumpkin	14	1,17 %	10min 17	1	Played just once with the pumpkin. At the 7pm and 7 am observation, the pumpkin was still at the same place and untouched	Low
Cardboard box	298	24,83 %	13min 13	15	After 13 min, Rayito layed down in the cardboard and began to rest. This is not taken into account as a direct interaction with the cardboard box. At the beginning of the 7 pm observation, the cardboard box is not at the same place anymore than at the end of the 3 pm observation	Medium
Frozen coconut with cow skin	0	0,00 %		0	Had no interest in the coconut. But at the beginning of the 7 pm observation, the coconut wasn't at the same place anymore and was destroyed.	Low

Table 3: Rayito's direct interaction with the different enrichments during the 3 pm observations.

A: Number of seconds spent in direct interaction with the enrichment

B: Total % is calculated by dividing the total time (s) with the total time of observation (1200s).

C: Last moment of direct interaction with the enrichment during the 20 minutes of observations

D: Number of direct interactions with the enrichment during the 20 minutes of observations

E: High degree of direct interaction = total % > 30%

Medium degree of direct interaction = 10 % < total % < 30%

Low degree of direct interaction = total % < 10%

An other important thing to analyse is the way the enrichment was implemented. For example, we can not really say that the food enrichment « meat attached to a rope on a pole » has no effect at all because it was attached too high. A lot of different variables can influence the animal behaviour at the moment of implementation. It is thus really important to make repetition with each enrichment and in different ways to be able to conclude if the enrichment is efficient or not.

Max

Table 4 reflects the results obtained about Max's direct interactions with each enrichment. Globally, food enrichments were really able to trigger direct interactions with Max. Indeed, 3 of the 5 enrichments were considered as high interaction, one as medium interaction and only one as low interaction. The enrichment « blood + hidden meat » is the one that triggered the lowest direct interactions. This could be because it looks the most like his normal diet which is a piece of beef.

The scent enrichment was contrary to Rayito's results, the second one with the highest direct interaction time with 2 medium interactions and 2 low direct interactions. An interesting fact is that Max had a direct interaction with « liquid vanilla » during only 8,17% but this is the scent enrichment that lasts the longest. Indeed, Max's last direct interaction with the liquid vanilla was after 10 minutes and 19 seconds while with the 2 medium direct interaction enrichments (cinnamon powder and perfume Channel n°5) it was respectively 6 minutes 51 seconds and 6 minutes 36 seconds. This can be explained by the fact that Max was maybe more attracted by the cinnamon powder and the perfume Channel n°5 and spent thus more time with it in a shorter period of time even if the numbers of interactions were the least with « liquid vanilla ».

Regarding the manipulation enrichments, it seems that they were not really efficient to provoke a direct interaction at the moment of the implementation with Max. They all provoked less than 10% direct interaction during the 3 pm observations. But, the coconut with feathers as well as the frozen coconut with cow skin were destroyed the next morning. It could be that Max's interest for these enrichments was triggered only after a couple of hours. The manipulation enrichment with most number of repetitions is the one with which Max spent the most time but also the one that lasts the less time (frozen watermelon had 7 repetitions for 9,83% direct interaction but with a last interaction only after 2 minutes 49 of the beginning of the observation). While the second enrichment with which Max spent the most time (frozen coconut with cow skin) lasts during 14 minutes and 53 seconds (6 repetitions for a total of 6,08% direct interactions).

To conclude, it can be considered that the enrichment that was the most able to provoke direct interactions with Max at the time of implementation was the living rat. The enrichments that

ENRICHMENT	TOTAL TIME (S)	TOTAL %	LAST TIME (MIN)	N°REP	COMMENT	CONCLUSION
Blood + hidden meat	5	0,42 %	4min 19	1	Smelled the enrichment just once during exploration	Low
Meat attached to a rope on a pole	571	47,58 %	10min 54	8	There was still a little piece of meat at the end of the observation but it was gone at the beginning of the 7 pm observation	High
Dead chicks	648	54,00 %	18min 17	13	There were still chicks at the end of the 3 pm observation, and at the beginning of the 7 pm observation but less than before. Same with the beginning of the 7 am observation.	High
Living rat	1002	83,50 %	19min 04	17	Max stopped eating the rat after killing him and let him whitout eating it completely	High
Blood ice cream with little pieces of meat	234	19,50 %	13min 18	5	Max was very attracted by the enrichment in the beginning and than stoped to go eat his normal food. When done he came back to lick the ice-cream before going back to his log.	Medium
Liquid vanilla	98	8,17 %	10min19	10	After 10min, Max stoped being attracted by the enrichment and continued to explore	Low
Cinnamon powder	266	22,17 %	6min 51	4	Max stopped being attracted by the enrichment after 6min51 but this triggers an important marking and self-grooming behaviour	Medium
Logs and faces of prey	108	9,00 %	7min 12	2	This enrichment had not a lot of effect on Max's behaviour. He explored the enclosure and stopped to smell the enrichment before continuing exploring	Low
Perfume Channel n°5	240	20,00 %	6min 36	6	Continued to explore and to mark during the observation but not at the place with the perfume	Medium
Frozen watermelon	118	9,83 %	2min 49	7	Max was really attracted in the beginning but this didn't last long	Low
Coconut with feathers	0	0,00 %	0	0	At the 7pm observation the coconut was still untouched but at the 7 am observation of the next day, it was destroyed	Low
Pumpkin	43	3,58 %	7min 16	2	Was eating at the beginning of the observation	Low
Cardboard box	55	4,58 %	16min 17	3	At the beginning of the 7 pm observation, the cardboard is located at the same place than at the end of the 3 pm observation	Low
Frozen coconut with cow skin	73	6,08 %	14min 53	6	It was not possible to see the enrichment at the 7 pm observation because of the darkness but the next morning, the coconut was destroyed	Low

Table 4: Max's direct interaction with the different enrichments during the 3 pm observations.

A: Number of seconds spent in direct interaction with the enrichment

B: Total % is calculated by dividing the total time (s) with the total time of observation (1200s).

C: Last moment of direct interaction with the enrichment during the 20 minutes of observations

D: Number of direct interactions with the enrichment during the 20 minutes of observations

E: High degree of direct interaction = total % > 30%

Medium degree of direct interaction = 10 % < total % < 30%

Low degree of direct interaction = total % < 10%

provoked the most direct interaction time was the food type.

Nicoa

Nicoa's direct interactions with each enrichment at the moment of implementation are summarised in table 5. The results about the food enrichments are more mitigated than with Max. Indeed, only 2 of the 5 food enrichments were efficient enough to provoke more than 30% of direct interactions. The 3 other ones, provoked less than 10% direct interactions and are thus considered as low degree of direct interaction. But an important information is the fact that with the « dead chicks » enrichment, Nicoa was hindered by Chata that didn't let him approach the chicks despite a great number of tentatives. Thus, if Nicoa was alone in an enclosure, he would maybe have had much more interaction with that enrichment. These results can thus not be analysed alone but need to be analysed in the context. The same observations were made with the enrichment « blood ice cream with little peaces of meat » even if it was in a lesser degree than with the « dead chicks ». The « dead chicks and blood ice cream » enrichments can not be considered as not efficient to provoke direct interactions with Nicoa. A repetition of these enrichments should be done with for example more space between the 2 piles of dead chicks and the 2 blood ice cream. This would give enough space for each ocelot to interact with his enrichment whitout being bothered by the other ocelot.

Regarding the scent enrichments, perfume Channel n°5 was the most effective to trigger direct interaction with a total of 50,58% and a last direction interaction over the 20 minutes of observation. The cinnamon powder seemed to be effective as well but with only 30,25% of direct interactions.

The manipulation enrichments were the most mitigated. Indeed, 4 of the 5 enrichments were triggered a medium degree of direct interaction. However, only one enrichment was totally efficient to provoke a high degree of direct interaction and at the limit of the rate (« pumpkin » with 30,33% of direct interactions). But 3 of the 5 enrichments had the last direct interaction after 15 minutes of observations. This means that Nicoa was still attracted after a couple of minutes even if he did not passed a long time on each enrichment. About the 2 different coconut enrichments, they were both completely destroyed at the beginning of the 7 pm observation while they were not at the end of the 3 pm observation. This means that Nicoa could have played with them between these 2 observations. But this can not be proven because of the presence of Chata in the same enclosure. I can thus not say if it was Nicoa, Chata or both of them that destroyed the coconuts. It is difficult to make a real conclusion about the most effective type of enrichment to trigger direct interaction for Nicoa because of the presence of Chata in the same enclosure. But the « living rat enrichment » was

ENRICHMENT	TOTAL TIME (S) A	TOTAL % B	LAST TIME (MIN) C	N°REP. D	COMMENTS	CONCLUSION E
Blood + hidden meat	48s	4,00 %	5min 07	2	Nicoa was directly attracted by the enrichment but then stopped paying attention to it	Low
Meat attached to a rope on a pole	435s	36,25 %	18min 58	14	There was still meat on the rope when the 3 pm observation ended but when the 7 pm observation started there was much less meat left	High
Dead chicks	102s	8,50 %	20min	11	All the repetitions were only tentatives to reach the chicks but Chata didn't let him approach them. At the beginning of the 7 pm observation, the chicks were still there but some were not at the same place than they were before.	Low
Living rat	970s	80,83 %	20min	7	Nicoa continued to play with the rat during minimum 1h after the end of the 3 pm observation.	High
Blood ice cream with little pieces of meat	71s	5,92 %	11min 32	8	After 11 minutes, Nicoa sets near the enrichments. Chata was really aggressive with Nicoa and hinder Nicoa to interact with the enrichments	Low
Liquid vanilla	94s	7,83 %	2min 23	3	Nicoa was attracted and marked on the vanilla in the very beginning. But after, he had no interest anymore in the vanilla but stayed active and continued to explore his enclosure.	Low
Cinnamon powder	363s	30,25 %	9min 50	6	Nicoa went directly to the enrichment and was really attracted to it during 9 minutes. After that, he was mostly alert with a little bit of self-grooming.	High
Logs and faces of prey	15s	1,25 %	7min 03	2	Nicoa smelled 2 times the enrichment while he was exploring and continued directly his exploration.	Low
Perfume Channel n°5	607s	50,58 %	20min	12	Continued to rub on the perfume at the end of the observation	High
Frozen watermelon	205s	17,08 %	8min 01	10	Nicoa was really attracted by the watermelon in the beginning. After 8 minutes, he stooped being attracted but continued to explore his enclosure. At 7 pm, the watermelon was still at the same place than at the end of the 3 pm observation	Medium
Coconut with feathers	205s	17,08 %	19 min 45	3	At the end of the 3 pm observation, one of the coconut was still intact but it was destroyed at the beginning of the 7 pm observation	Medium
Pumpkin	364s	30,33 %	18min 27	13	The pumpkin was able to keep Nicoa's interest during almost all the observation.	High
Cardboard box	284s	23,67 %	8min 55	10	The cardboard boxes are at the same place at the beginning of the 7 pm observation than at the end of the 3 pm observation.	Medium
Frozen coconut with cow skin	166s	13,83 %	16min 01	10	At the beginning of the 7 pm observation, the enrichments are completely destroyed.	Medium

Table 5: Nicoa's direct interaction with the different enrichments during the 3 pm observations.

A: Number of seconds spent in direct interaction with the enrichment

B: Total % is calculated by dividing the total time (s) with the total time of observation (1200s).

C: Last moment of direct interaction with the enrichment during the 20 minutes of observations

D: Number of direct interactions with the enrichment during the 20 minutes of observations

E: High degree of direct interaction = total % > 30%

Medium degree direct interaction = 10 % < total % < 30%

Low interaction = total % < 10%

definitely the one that provoked the most direct interactions with a total of 80,83% and with a last interaction noticed more than one hour after the end of the 3 pm observation.

Chata

Table 6 shows the ability of the enrichments to trigger Chata's direct interactions at the moment of implementation. Overall, 8 of the 14 enrichments were not able to provoke more than 10% of direct interactions with Chata. On the 6 left, only one is considered as fully efficient to provoke a high degree of direct interaction and 5 have a medium degree of direct interaction. Indeed, only the « perfume Channel n°5 » enrichment was efficient enough to be responsible of more than 30% of direct interactions. But as mentioned before, Chata had a very interesting behaviour with the « dead chicks and blood ice cream with little pieces » enrichments. Instead of acting directly with the enrichments, she had an aggressive behaviour against Nicoa. She stood guard and did not let Nicoa approach the enrichments while this was not the case at all with the 3 other food enrichments.

About the scent enrichments, the only one with a high degree of direct interaction was the « perfume Channel n°5 ». The liquid vanilla had a medium degree of direct interaction but also in the lower range with only 11,92% of direct interactions. The 2 other ones were not even able to provoke more than 5% direct interactions. Even more, they last not longer than 4 minutes. Globally, the number of direct interactions repetitions are very low with the scent enrichments.

Concerning the manipulation enrichment, only 1 of the 5 was efficient to have a medium degree of direct interaction with a rate of 10,25%. The 4 others have a low degree of direct interaction. Here as well, the number of direct interactions repetition are very low. Like mentioned with Nicoa, the 2 types of coconuts were destroyed at the beginning of the 7 pm observations while they were not at the end of the 3 pm observation. It took maybe more time for Chata to be interested by the enrichments than for Nicoa. But without concrete evidence of which ocelot destroyed the coconuts between 4 pm and 7 pm, it is impossible to take a conclusion about the time of influence of these enrichments on Chata or Nicoa.

To conclude, it seems that the type of enrichment that was the most effective to trigger direct interaction at the 3 pm observation was the food one. However, the enrichment that was the most able to trigger a direct interaction at the moment of implementation was the scent enrichment « perfume Channel n°5 ». Again, these results needs to be taken in a different context as the one about Rayito and Max. If Chata was alone in an enclosure, she would maybe have reacted differently, especially to the food enrichments.

ENRICHMENT	TOTAL TIME (S) A	TOTAL % B	LAST TIME (MIN) C	N°REP. D	COMMENT	CONCLUSION E
Blood + hidden meat	0	0 %	0	0	Chata explored a lot during the observation but wasn't attracted by the enrichment	Low
Meat attached to a rope on a pole	0	0 %	0	0	Impossible to say if it was Nicoa or Chata that ate the piece of meat that was still there at the end of the 3 pm observation	Low
Dead chicks	180	15 %	20min	13	On the 13 repetitions, only 2 were not aggressive behaviours to prevent Nicoa eating the chickens. At the beginning of the 7 pm observation, the chicks were still there but some were not at the same place than they were before.	Medium
Living rat	269	22,42 %	17 min 49	6	Chata killed her rat after 5min 51 and left him whitout eating him. But after she tried to hunt Nicoa's cat just one time	Medium
Blood ice cream with little pieces of meat	179	14,92 %	18min 36	15	Chata was very aggressive when Nicoa tried to interact with the enrichment. She sat and set before the enrichment to keep it for herself	Medium
Liquid vanilla	143	11,92 %	8min 28	4	Even if she hadn't not any direct interactions with the enrichment after 8min28, she continued to explore the enclosure actively. The direct interactions were principally marking behaviour. However, she didn't do a lot of self-grooming.	Medium
Cinnamon powder	54	4,50 %	2min 37	3	Chata went directly to the enrichment but got bored of it really quickly. During the rest of the observation, she was mostly alert.	Low
Logs and faces of prey	5	0,42 %	3min 38	1	Smelled just once the enrichment while she was exploring	Low
Perfume Channel n°5	474	39,50 %	11min 10	5	Continued to explore and to mark even if she didn't go back to the perfume after 11min 10	High
Frozen watermelon	0	0,00 %	0	0	Chata didn't pay any attention to the enrichment during the 3 pm observation. She was resting in a tree and did a little bit of self-grooming. At the beginning of the 7 pm observation, the watermelon was still at the same spot as were Nicoa left it at the end of the 3 pm observation.	Low
Coconut with feathers	92	7,67 %	3min 17	2	At the end of the 3 pm observation, one of the coconut was still intact but it was destroyed at the beginning of the 7 pm observation	Low
Pumpkin	123	10,25 %	13min 11	4	During the 3 pm observation, Chata rubbed herself once against the feathers of the enrichment « coconut with feathers » from 3 days before	Medium
Cardboard box	58	4,83 %	11min 16	4	The cardboard boxes are at the same place at the beginning of the 7 pm observation than at the end of the 3 pm observation.	Low
Frozen coconut with cow skin	17	1,42 %	2min 02	2	At the beginning of the 7 pm observation, the enrichments are completely destroyed.	Low

Table 6: Chata's direct interaction with the different enrichments during the 3 pm observations.

A: Number of seconds spent in direct interaction with the enrichment

B: Total % is calculated by dividing the total time (s) with the total time of observation (1200s).

C: Last moment of direct interaction with the enrichment during the 20 minutes of observations

D: Number of direct interactions with the enrichment during the 20 minutes of observations

E: High degree of direct interaction = total % > 30%

Medium degree of direct interaction = 10 % < total % < 30%

Low degree of direct interaction = total % < 10%

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4.3 Is it possible to generalize the results for all the ocelots ?

To analyse the efficiency of the enrichments on the ocelot's behaviour, we need to take into account the direct interactions and the indirect interactions at the moment of implementation but also the influence of the enrichment on the ocelot's behaviours during the other three times of observations.

Regarding the direct interaction at the moment of implementation, it can be considered that the food type enrichment was the most efficient on the ocelots, certainly on Rayito and Max. For Nicoa and Chata it is a little bit more complicated because of the fact that they are together in the same enclosure and that Chata had a dominant behaviour on Nicoa regarding the food enrichments. But it can be considered regarding the number of repetitions for Nicoa that he would have much better results if he was alone in an enclosure without Chata. If Chata was alone in an enclosure, she would maybe have reacted differently without a dominant behaviour and thus have more direct interactions. Among the food enrichments, it was the « living rat enrichment » that was the most efficient to provoke the highest degree of direct interaction for 3 of the 4 ocelots.

To see the results of the indirect influence of the enrichments, it was chosen to take a look at the inactive behaviours. The differences between inactive behaviours during each enrichment and the control week at the 3 and 7 pm observations were analysed. At 3 pm, the type of enrichment that had the most influence on the ocelots behaviours is the one that diminished the most the inactive behaviour. At 7 pm, it is the one that increased the most the inactive behaviour. Indeed, if the ocelots are less active at 7 pm than during the control week, it means that they were more active between 4 pm and 7 pm. This means that the enrichment had still influence on the ocelot's behaviour after the 3 pm observations.

Table 7 represents the percentage of inactive behaviour for each ocelot during the 3 pm and 7 pm observations. The 7 am and 11 am observations were not taken into account because, as seen previously, there was no real difference on the ocelots behaviours with or without enrichments during these times of observations. We can see that for Rayito, Nicoa and Chata, it is the food type enrichment that is responsible for the biggest decrease of the inactive behaviour at the observation of 3 pm. For Max, it's the scent type enrichment.

At 7 pm, the manipulation type enrichment is the one that had the most indirect influence on Rayito's and Nicoa's behaviour. Indeed, these are the one with the biggest increase of inactive behaviour. For Max and Chata, this was the food enrichment.

	CONTROL WEEK	FOOD	SCENT	MANIP
Rayito 3 pm	87,3 %	36,12 %	52,96 %	49,47 %
Rayito 7 pm	31,78 %	72,29 %	68,12 %	84,75 %
Max 3 pm	89,17 %	30,03 %	20,46 %	45,15 %
Max 7 pm	2,4 %	66,18 %	1,23 %	57,88 %
Nicoa 3 pm	81,78 %	26,3 %	34,29 %	42,08 %
Nicoa 7 pm	32 %	48,85 %	39,48 %	61,77 %
Chata 3 pm	71,1 %	47,95 %	52,96 %	55,07 %
Chata 7 pm	21,6 %	44,49 %	34,27 %	38,78 %

Table 7: Percentage of inactive behaviour (resting and alert) during the 4 situation for each ocelot during the 3 pm and 7 pm observations. The green percentage represents the enrichment that was able to decrease the most the time spent being inactive at 3 pm. The red percentage represents the enrichment that was able to increase the most the time spent being inactive at 7 pm.

5. Discussion

The efficiency of an enrichment can not be considered only as the percentage of direct interaction at the moment of implementation or the direct/indirect influence that it has on the animal. It needs to take into account the global impact of the enrichment on the animal's behaviour (which means the percentage of direct interaction, the direct and indirect influence on the behaviour and the amount of time on which the enrichment has an influence).

Overall, based on the descriptive results we can consider that the 3 different types of enrichments were the more efficient at the moment of implementation and continued to have some influence during a couple of hours on the ocelots' behaviours. Food enrichments were as intended the one that had the most impact on the ocelots at the moment of implementation. On the contrary, the manipulations enrichments were used not directly at the moment of implementation but some times later. However, each ocelot had their preferences in each different type of enrichment.

Nevertheless, it is important to evaluate the real effect on the behaviour of the enrichment. An enrichment that provokes an aggressive behaviour such as the « dead chicks » with Chata can not be considered as a good and efficient enrichment. Indeed, the objective of an enrichment is not to provoke only a new behaviour but to increase the well-being of the animal. By triggering an

aggressive behaviour on Chata counter Nicoa, we diminish the well-being of Nicoa without increasing the one of Chata. But this does not mean that these enrichments are to proscribe. Indeed, it would be necessary to repeat these enrichments different times and with different techniques (more space between the two piles of dead chicks for Nicoa and Chata, fasten the meat to the rope a little bit lower for Rayito) to be able to make a real conclusion about the efficiency of the enrichment. Some enrichments, such as « the coconut with the cow skin », are known in the center as being usually really effective at the moment of implementation but were not during this study. This could be due to different variables such as weather, number of tourists and should be thus repeated.

It would be also interesting to mix different types of enrichments together such as food enrichment with manipulation enrichment to make it more complicated for the animal. We could for example hide the « blood ice cream with little pieces of meat » enrichment in a cardboard box or put different cardboard boxes with different scent enrichments to see which one they like the most.

To be more interesting, a statistical study should be done. Indeed, this study being a descriptive study, no results could be considered as significative. Therefore, it could be interesting to do a statistical analysis on the information harvest during the study. During this study, it was not possible to do repetitions of the different enrichments. It would be very interesting to repeat the enrichments 2 or 3 times and to compare the results to be able to make a real definitive conclusion about the efficiency of each type of enrichment on each ocelot. As a matter of fact, a lot of different factors could have had an influence on the results. A more careful study should take the different factors like weather, affluence of visitors, repetitions and statistics into account. It would be even more interesting to compare the results of that study with this one.

To generalise the results obtained in this study on the entire ocelot species, it would need to have more subjects. Even then, it would be very difficult to generalise the results because, as seen with Chata and Nicoa, the living context of the animal has a great impact on how the enrichment influences the behaviour.

Setting up enrichments for captive animals provide them opportunities to express different behaviours and to display their natural behaviours. By putting the enrichments at 3 pm, we respect their natural cycle. Indeed, ocelots are becoming active 2 or 3 hours before dusk and rest during the day. The lack of space, boredom, static environment and stress caused by tourists are all factors that could lead to the development of stereotypes. Using enrichments can be considered as preventive

medicine to prevent the apparition of those stereotypes. As a matter of fact, while the stereotype is already present, it is much more complicated to make them disappear. And in most of the cases, these stereotypes will reappear when the enrichments are gone. An ounce of prevention is worth a pound of cure.

This study also showed that it can be sometimes very complicated to implement the enrichment at the moment that was scheduled. Actually, a lot of non planned events such as emergencies, lack of working staff, lack of material to build the enrichments happen and force to adapt the expected plan.

6. Conclusion

Enrichments are essential for the well-being of captives felines who have a totally different lifestyle than wild felines. They offer stimuli to promote as natural behaviours as possible and to face situation, such as stress induced by visitors, that the animal would not undergo into nature. Some are able to influence the behaviour at the moment of implementation while others will have an influence a couple of hours later. Some will last a very short time, while other will last much longer. The most important is to know each animal and evaluate directly on the field if the enrichment has a positive, a negative or no effect at all. To set up a good enrichment, it is important to observe and study the animal, his behaviours and his way of live. An efficient enrichment will operate as preventive medicine on the animal to avoid apparitions of stereotypes.

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