Marwell Wildlife

Ostrich Recovery Project

Niger advisory visit report

July 2017

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Ostrich Recovery Project
Niger advisory visit report

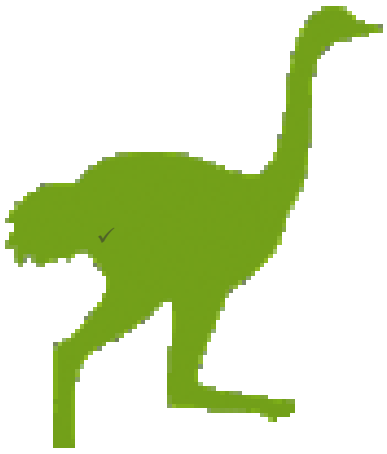
EXECUTIVE SUMMARY

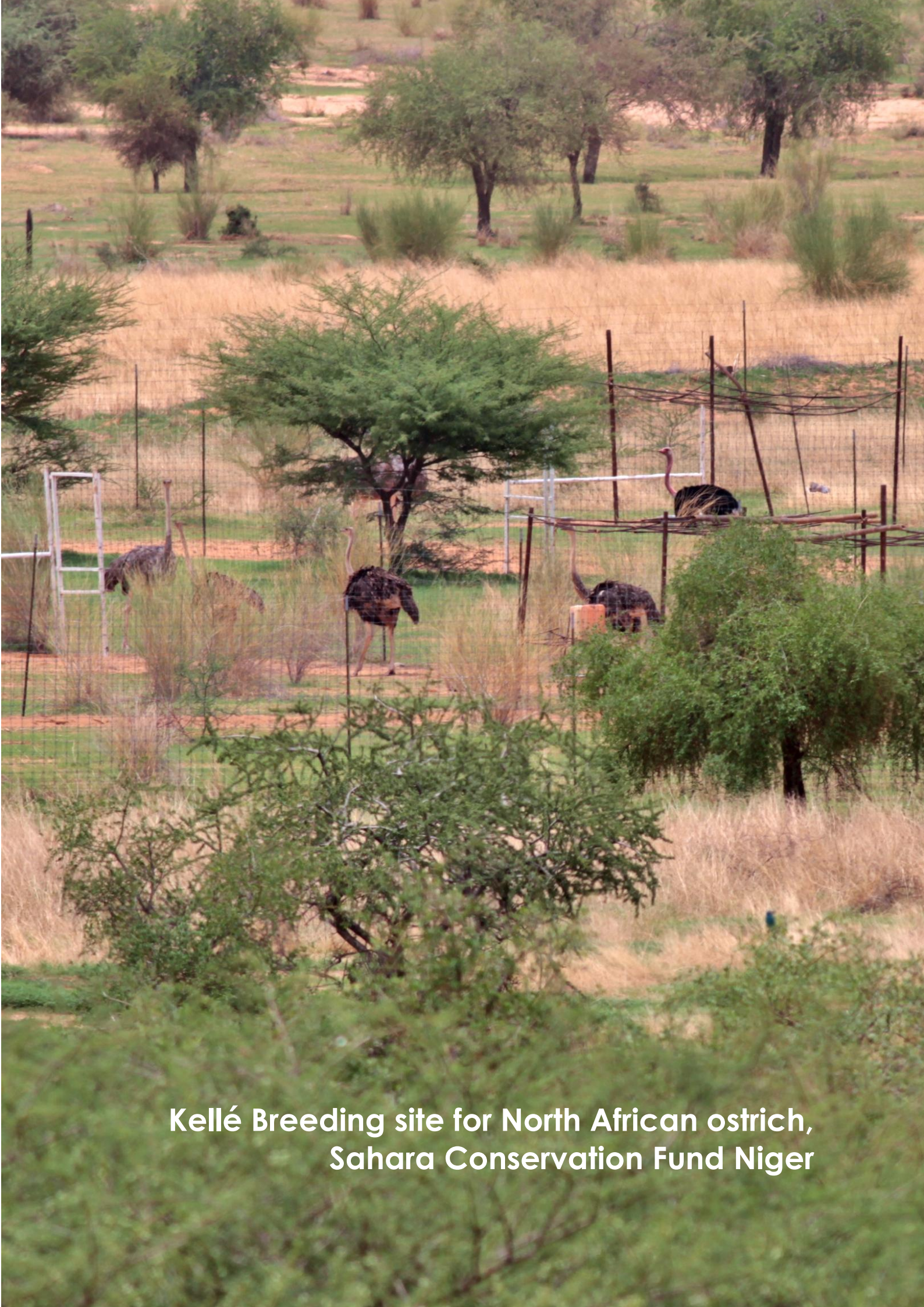
Within the framework of the North-African Ostrich (*Struthio camelus camelus*) Recovery initiatives, Marwell Wildlife and the Sahara Conservation Fund reinforced their partnership in order to link the expertise gained in Tunisia on the ostrich natural behaviour and reproduction and the captive breeding project implemented in Niger. Marwell's field biologist, Dr. Marie Petretto, went to Niger from the 10th to the 21st July 2017. The purpose of her mission was to help the staff of Nigerien breeding sites to better identify the inadequate situations, effectively face management difficulties and significantly improve the results.

The mission included an advisory visit of Kellé breeding site and a comprehensive 6-day training course on ostrich farming delivered to the people working in the three local breeding sites for the Conservation (namely Kellé, Iferouane and Maïné), as well as to five local students applying to a position in an ostrich ranch in Niamey.

In this document, we report our observations supported by the literature and experiences and consequently provide documented recommendations, summarized and prioritized in the Table 1. The main points we raise are related to:

- ✓ Ostrich behaviour: there is an urgent need to test solutions to solve the behavioural disorders;
- ✓ Health: there is a extremely high risk of Newcastle Disease to mitigate;
- ✓ Breeders' fecundity: it is of major importance to properly check and record the events related to eggs;
- ✓ Staff capacity: continuing capacity building will benefit to the staff who demonstrated excellent learning skills.





Kellé Breeding site for North African ostrich,
Sahara Conservation Fund Niger

Table 1 : Summary of the recommendations made in this document

Recommendations	Section	Priority
Chicks to be more habituated to human presence and handled during their first 18-24 months (until sexual maturity)	1.2.1	2
To build traditional woody walls that do not have to be fully opaque but enough to provide a resting area where the birds can hide when they see an "intruder" (i.e. visitor)	1.2.1 1.4.1	1
To keep the juveniles together in large paddock: do not keep any bird alone. Pairs may appear naturally after sexual maturity, what will help to identify the best breeders.	1.2.1 1.4.1	1
To implement the oral route protocol for Newcastle Disease vaccination And, in the future, vaccinate the ostriches before release	1.2.2	1
To establish a procedure for carcass and other biological wastes disposal	1.2.3	2
To measure at least once a week in 10 tanks randomly selected; compile and keep the records for at least two years for monitoring purposes	1.3.1	2
To put together the information about breeding events in a digital database	1.3.2	1
To compile data about non-hatched eggs in a digital database from the next breeding season	1.3.2	1
To mitigate the risk of jackals' predation (which is expected to increase when a larger number of chicks will be hand-reared): dig a trench under the wire fences and bury large stones sealed with cement	1.3.3	1
To anticipate the threat of crows' predation on young chicks by setting some aviary-kind enclosure to protect the youngest chicks To cover the small enclosures available (30x85m) by bird nets	1.3.3	1
To maintain a permanent source of water for wildlife outside the enclosure seems to be a thoughtful option.	1.3.3	2
To do some basic enclosure tidiness as a way of removing hiding places for cobras and to provide ventilation bags and to teach the staff how to intubate an ostrich	1.3.3	2
To refurnish the drug kit with anti-inflammatory, a1-adrenergic blockers, diuretics and benzodiazepines each time the expiry date is reached	1.3.3	2
To experiment the nest protection to improve the hatchability (if natural incubation)	1.4.1	2
To keep the breeders in trios or harem to maximise the egg production (and natural incubation)	1.4.1	1
To check carefully the next eggs to determine whether they are non-fertile or dead	1.4.2	1
To monitor Julien's foraging and feeding behaviour, in conjunction with his Body Condition	1.4.2	1
To provide basic veterinary nurse courses to the site manager	2.4	2
To provide practicals on ostrich capture to the Centre staff	2.4	2
To assist with artificial incubation when it will start	2.4	2
To refurnish in surgical instrument (suture and post-mortem), disinfectants...	2.4	1

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INTRODUCTION

Following the meeting held in November 2016, Marwell Wildlife and the Saharan Conservation Fund (SCF) agreed to join their efforts to contribute to the recovery of the North-African subspecies of the biggest bird on the planet. Over the last years, the two organisations have simultaneously been supporting initiatives in Tunisia and Niger, according to two different but complementary strategies. In Tunisia, actions are oriented toward ecosystem restoration within fenced protected areas: this includes releasing animals and recreating flocks that forage and breed naturally in their natural habitat; in Niger, the option of intensive captive breeding has been preferred, with the hope to increase the numbers and be able to potentiate the remaining genetic pool by producing chicks to be relocated where needed.

The option in Niger brings some technical challenges that SCF and its partners such as Wildlife Conservation Network (WCN) are dealing with. Good quality infrastructures have been built in Kellé South Niger (N 14,26759°; E 10,10320°) and will be soon improved by solar containers that will allow to incubate and hatch eggs not only from the local breeders but from elsewhere in Niger and in the region. However, captive breeding and artificial incubation of Red-necked ostriches is not a straightforward replication of the intensive ostrich farming methods commonly used in Southern Africa or Australia –or better, it has to be inspired by the first steps when they started farming non-domestic ostriches. Beside the logistical constraints of setting a hatching unit in a remote area, there are behavioural and ecological components to take into account to succeed either with eggs production than with raising chicks potentially able to repopulate the depleted areas.

The purpose of this mission was to link the expertise gained in Tunisia on the natural behaviour and reproduction of the North-African ostrich (*Struthio camelus camelus*) in order to help the Nigerien breeding sites to face management difficulties and improve results. Additionally, the Marwell team has helped their Tunisian partners with several attempts to hand rear chicks: sharing this experience may help to set up appropriate procedures and facilities to do so in the sub-desert steppes of Niger.

The mission comprised several activities:

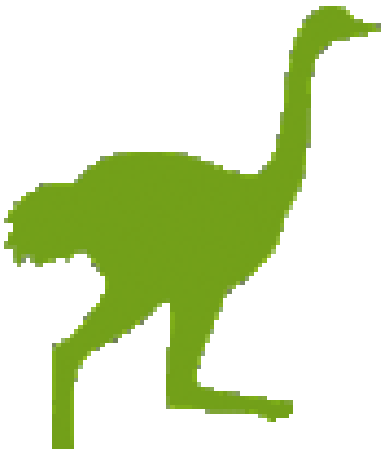
- audit the Kellé site in order to identify the needs and possible improvements: review procedures, history and results together with the site manager, prepare the staff to the arrival of the new infrastructures;
- delivering of a comprehensive training course on ostrich farming to the people working in Kellé, Iferouane and Maïné, as well as to five local students applying to a position in an ostrich ranch in Niamey.

We report our observations supported by the literature and experiences in order to provide documented recommendations.

Advisory visit of Kellé ostrich reproduction site

Chapter

1



1. Advisory visit of Kellé ostrich reproduction site

1.1. Method

The method applied during the advisory visit of Kellé has been inspired by the key criteria or objectives set out by the standards of the International Federation of Organic Agriculture Movements (IFOAM). Measures (2004) proposed an auditing system formulated in order to meet the needs of the farmers involved: we adapted the method to select the indicators to assess the effectiveness of Kellé as an ostrich farm for conservation purposes (Table 2).

We did not therefore endeavour to assess every component of every criterion because it would have been excessively time consuming, neither did we focus on monitoring activities (much of this is already being undertaken by SCF) but instead attempted to monitor the outcome of the farming system and practices.

Table 2 : Auditing procedure

Principle	Organic Agriculture Goals	Objectives	Monitoring to Identify Performance
Health	Sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible	Maintain of pasture and terrain	Control of bush fires Control of the river bank Control of the enclosure features
		Mitigation of disease transmission risk	Watch and monitor wildlife health Prophylactic treatments Regular health screening
		Avoidance of pollution	Identify and quantify pesticide use Identify and quantify farm waste Identify and quantify other wastes
Ecology	Based on living ecological systems and cycles, work with them, emulate them and help sustain them	Food production	Assess the food (pasture) available on site Check quality of food imported Water management (quantity & quality)
		Breeding season	Monitor display, mating and laying down Monitor eggs quality
		Biodiversity and landscape	Prevent predator impact Competitor impact Conservation plan in place and acted on
		Non-renewable energy	Biomass: % of crop replaced Wood Fuel: generator use
Care	Managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment	Animal management	Monitor animal behaviour Herd structure (composition, age, sex-ratio)
		Health records	Mortality Injuries and diseases
		Fertility	Number of eggs/chicks produced Number of unfertile eggs Number of early or late embryo death
Fairness	Build on relationships that ensure fairness with regard to the common environment and life opportunities	Social function	Number of labour units Staff training Community engagement
		Use of appropriate technology	Observations on both appropriate technology and actions such as incubator... Identification of inappropriate actions
		Decentralisation	Information where available on input miles and product miles

1.2. Principle of Environmental Health

1.2.1. Maintain of pasture and terrain

The enclosures in Kellé site are well built, in good quality material. Wire fences are well visible to satisfyingly prevent the birds to run into it while panicking.

The routine maintainance is being completed by the site staff, under supervision of the site manager:

- Laying out the ephemeral river bank as the fast current tend to destabilize the posts of the enclosure currently occupied by the rescued addax: this comprises setting breakwater (series of sand bags placed at an angle of the bank) and placing gabions
- Checking the internal side of the wire fence to make sure that no metal wire could hurt the ostriches (common cause of captive ostrich death is exsanguination following neck injury)
- Checking the integrity of the fence (people and predator proof)
- Setting and maintaining efficient fire break

The facilities are made of two blocks of enclosures of which only one is currently used for the ostriches. It has been designed following the farm model, with an alternation of large paddocks and smaller pens (Figure 6). In literature, farmed ostriches are kept in group sorted by age (or size) until they are either slaughtered or put to reproduction: the enclosure dimensions vary between 0.1 and 2.5 ha (Campodonico 1992; Deeming 1996; Jarvis 2015) and houses from 2 to 12 adults; the example of the Bophuthatswana farm (South Africa) highlights the fact that ostriches coming from the wild required larger enclosure (Campodonico & Masson, 1992).

This point meets the experience gained in Tunisia where various pairing scenarios have been practiced: it seems to be a common trait for the non-domestic ostriches to be easily stressed and disturbed by anything unusual (Marwell team's field observations and Cloete, 2001; Jarvis, 2015; Kummrov, 2014; Smith & Duerr, 2008). If they haven't been habituated to human presence from the very first stages, any operation run around and inside the enclosure becomes a major source of disturbance, that can lead to a chronic stress syndrome and impact on performances by suppressing the immune system (Shini et al., 2010) or decreasing the hormone activity (Hall et al., 1978; Satterlee et al., 1993). Releasing those animals in larger areas may be the only solution to improve their welfare and consequently increase lifespan and breeding performances.

We recommend the chicks are more habituated to human presence and handled during their first 18-24 months (until sexual maturity).

approaching tradition with innovation

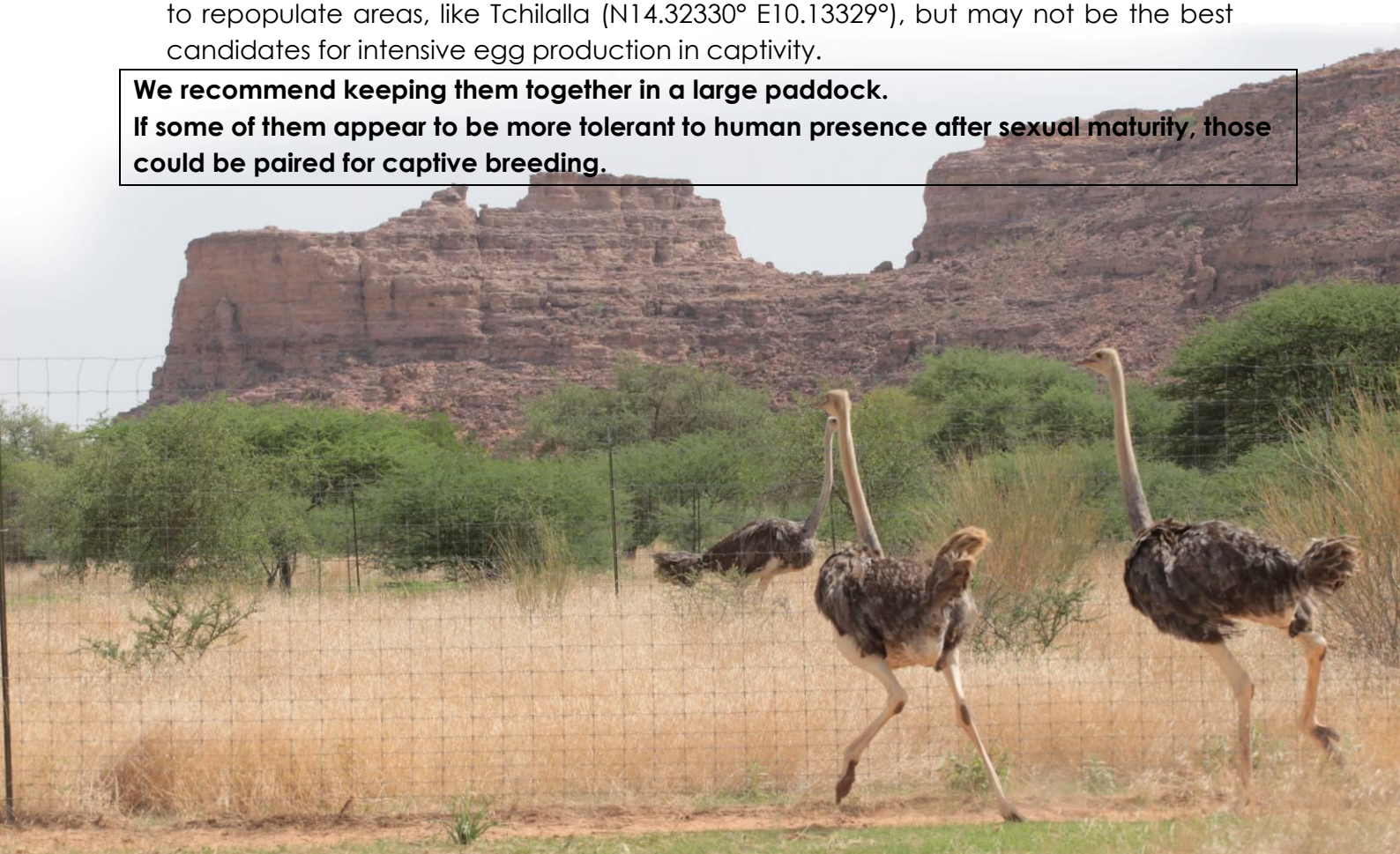
Additionally, many studies on captive wildlife agree on the benefit of the environmental enrichment (Shepherdson, 1998 & 2001; Shepherdson DJ., 1994): it would often provide better benefits than simply increasing the pen dimensions. Preliminary behavioural assessment suggests the young ostriches in Kellé would benefit from some kind of refuge where they could hide when unknown visitors approach: this natural behaviour is observed with all the breeders kept in the larger and vegetated paddock; whereas the juveniles fail to find a safe place and go into a panicked run along the fence. One got injured while I first came and visited, even though I was not even entering the pen.

Figure 1 : example of traditional fences that could be placed in the small pens in order to provide refuge to the birds

We recommend building traditional woody walls (Figure 1**) that do not have to be fully opaque but enough to provide a visual hide to the birds.**

For more mature birds, such as those juveniles in Kellé, it is likely to be too late for any kind of behavioural therapy: training them would be time-consuming and risky. Management should therefore be adapted for them. They could potentially be used to repopulate areas, like Tchilalla (N14.32330° E10.13329°), but may not be the best candidates for intensive egg production in captivity.

We recommend keeping them together in a large paddock.
If some of them appear to be more tolerant to human presence after sexual maturity, those could be paired for captive breeding.



1.2.2. Mitigation of disease transmission risk

Figure 2 : a domestic pigeon from Kellé village showing symptoms that evocate Newcastle Disease (17/07/17)

While staying at Kellé, a villager came to us with a sick pigeon with neurologic symptoms (Figure 2): he explained that he recently had a high level of mortality in his dovecote. The clinical examination suggested Newcastle disease (ND), with very little doubt; samples have been collected for confirmation in Niamey. Further inquiries revealed that the disease is enzootic in the area (it is even known to be the main cause of mortality in poultry); several turtle doves were also observed unable to fly within the ostrich breeding site.

This should be reported as a major concern and a risk to mitigate as ND remains to be the worldwide most important infectious disease of poultry. This epizootic is a notifiable disease in Niger as in many other countries. ND is due to a viral pathogen transmitted by bird droppings and expectorations; in its highly virulent form (velogen), it can cause about 100% of mortality. Prophylactic vaccination is the major tool for the control of ND in poultry and other birds (Ruemphet et al., 2012). Thus, the ostriches kept in a breeding centre must be vaccinated. Both the LaSota live and inactivated oil emulsion vaccines seem to be well tolerated following conjunctival or subcutaneous application, respectively; after the vaccinations, high antibody titres are detected in hemagglutination inhibition and virus neutralisation tests (Bolte et al, 1999). Routine vaccination is performed by the Nigerien veterinary services but they use an eye-drop vaccine which cannot be used on a stressed out ostrich.

We recommend the oral route vaccination protocol according to the following protocol (Bouzouaia, pers. comm.)**:**

- ✓ For the adults, live ND vaccine by oral route, in drinking water, every 4 months. Do not provide water the day before to make sure that the ostriches will drink the dose. Note that oral route is very well tolerated by birds, and up to four chicken doses could be given per ostrich.
- ✓ For the newborns, a subcutaneous injection of inactivate vaccine (make sure to do it on the lower part of the neck to facilitate any possible wound treatment if a non-vet practices the injection); at day 1, a live ND vaccine could be given *per os*, then at 10 days and 4 months; after that the chicks can be synchronized with the adults' protocol.

Another interesting point has been published by Ruenphet et al. (2012): they

demonstrated that the introduction of vaccinated ostriches in a flock of unvaccinated birds may allow a transmission of antibodies against ND even several months after introduction. This may happen either through the environment or the dropping where live vaccine virus can survive and naturally infect other ostriches foraging in the area.

For the future, we recommend vaccinating the ostriches before release.

Several researchers reported poor results using the hemagglutination inhibition test for ostrich sera, with a high percentage of false negative (Allwright, 1996; Ruenphet et al., 2012; Williams et al., 1997).

In case vaccination effectiveness needs to be checked, it is recommended doing a microneutralization test or standard enzyme-linked immunosorbent assay (ELISA) test using biotinylated rabbit anti-ostrich immunoglobulin G antiserum.

1.2.3. Avoidance of pollution

No pesticide is used at Kellé; however, residues could be introduced into the farm through the supplementary food or by vectors if used in the surrounding fields. This does not appear to be a major concern but the managers must be aware of the potential threat and make sure to mitigate it.

There is no strong procedure to dispose of the waste produced by the farm, e.g. droppings. This may have a medium-term impact on the soil quality within the paddocks and consequently on the pasture. Dead animals are buried, which could be a source of pathogen transmission by leachate from these burial sites (Joung et al., 2010).

We recommend establishing a procedure for carcass and other biological waste disposal (Pollard et al. 2008; Willis 2003).

The routine work of the staff includes the collection of other waste on site, such as plastic bags or other objects that could be ingested by the ostriches.

1.3. Principle of Ecology

1.3.1. Food production and water management

The food available has been assessed and recommendations were made by SCF's partners. No sign of nutritional unbalance could be observed either in the animals (body condition, deformities, pica) or through recent medical records.

The site manager conscientiously checks the quality of food imported and the quantity: this is essential to the farm monitoring.

Even if the red-necked ostriches are well adapted to drought, a good water supply will determine performances. It is also a requirement for captive–bred animals that cannot forage for vegetation for higher water content. In Kellé, they receive approximately 25 litres per adult and per day, given out twice a day, which is about 2.5 times more than the recommendations for farmed ostriches (Ostrich business chamber, BSM 11 Version 3.3, 2012). This can be easily explained by the highest average evaporation rate and possible loss or spoliation by other wild animals. The water is currently brought to site in tanks but a water drilling is under construction.

During the visit, some pH paper has been provided to monitor the water quality: a pH between 6.0 and 7.6 is expected; as well as less than 5mg/L of suspended solids and 2-4 mg/l of free chloride (Ostrich business chamber, BSM 10 Version 3.3, 2012).

We recommend measuring at least once a week in 10 tanks randomly selected and the records should be compiled and kept for at least two years for monitoring purposes.

1.3.2. Breeding patterns

The site manager carefully monitors any event related to the breeding such as display, mating, laying and clutch size. These data are essential to monitor the farm performances, implement the adapted solutions and share expertise gained with other sites.

We recommend putting together the information in a digital database.

A first analysis of the breeding history was undertaken with the site manager, which helped to produce the recommendations of this report, but a consistent record will allow remote assistance and advices from worldwide experts.

One of the concerns raised by SCF was the likely high risk of consanguinity: indeed, continuous breeding of purebred lines of finite size results in an increase of homozygous loci. The appearance of lethal alleles and undesirable traits may thus become more frequent under such a system (Pirchner, 1969). This leads to a reduction in fitness and an impaired reproduction rate. For instance, an increase of 10% in inbreeding depression has led to a 2.3% decrease in milk production in dairy

cows (Wall et al., 2005): inbreeding has thus been demonstrated to be detrimental to fertility and its correlated traits in dairy cows. The South-African ostrich are often considered to be an inbred population (Jarvis, 1996). However, in contrast to the latter statement, literature has confirmed that these breeds exhibit superior reproduction performance in comparison to the Zimbabwean breed (Cloete et al., 2008). This suggests that ostriches are less sensitive to inbreeding than mammals. In the absence of molecular analysis of the remaining pool of North-African available, breeding even closely related animals seems to be a reasonable strategy in order to increase number. The development of reference site for the artificial incubation combined with a regional assessment of the genetic diversity could be the best solution to reduce the supposed current rate of inbreeding.

The staff of Kellé tried to monitor the eggs' quality, but lack of knowledge did not allow to accurately report the condition of the non-hatched egg: it is not really possible to track what is the proportion of infertility or early deaths. A specific lecture was given to the park managers and the guards to allow them to better understand the issue in egg production. We provided a detailed course on egg hatchability, embryo development and egg candling; an evaluation of the knowledge gained was performed at the end of the mission (see section 2) and the participants demonstrated a good understanding of the concept and techniques taught.

We therefore recommend the park manager starts compiling data about non-hatched eggs in a digital database from the next breeding season.

1.3.3. Biodiversity and landscape

In the context of ostrich farming, the biodiversity management must include the protection of the captive animals and their resources from free-ranging predators (jackals, crows) and competitors (crows, monkeys).

Jackals

Reports of evidence of jackals' intrusion were made: this led to the death of a young chick in one of the enclosure last month. This threat is well-known in Tunisia and the solution to bury the fence at about 1-meter deep in the ground appears to be very efficient. In Kellé, the fence underneath is not secured below ground (Figure 3).

Figure 3 : evidence of jackals' intrusion under the fence

The easiest solution to mitigate the risk of predation (which is expected to increase when a larger number of chicks will be hand-reared) would be to dig a trench and bury large stones sealed with cement.

This would stop the wild canids getting in. Any other kind of buried fence could work, as long as it does not come apart when the jackals dig around it.

We do, however, acknowledge that anti-predator behaviours will be important to future success of released birds: the captive-bred birds will remain exposed through the fence and it might be interesting to monitor their response to the presence of canids. Canids won't be the main threat to the released ostriches, as they do not attack adult birds: they might impact on the nest and young chicks, but from the experience gained in Tunisia, we are confident they will learn quickly how to protect their offspring. Larger carnivores, such as hyena, may be of more concern: a pre-release strategy could help, by exposing progressively the released birds to the natural threats. Releasing ostriches in a flock is likely to be a condition to success.

Crows

They have been identified as the main threat to young ostrich chicks; they also are a cause of food and water spoiling. Currently, the Centre staff spend considerable amount of time watching the enclosure and chasing the crows; scarecrows have also been set up.

These solutions might have been sufficient to-date but are not cost-effective as the limited number of Centre staff would have to be better valued with the number of chick increasing.

We thus recommend anticipating the threat by setting some aviary-kind enclosure to protect the youngest chicks. The small enclosure available (30x85m) could be covered by bird nets.

Monkeys

As the visit happened during the wet season, no monkeys were observed on-site. However, the staff report hundreds of them coming to drink in the enclosures -they do not seem to care about ostrich food. The Centre staff have noticed that they prefer using the ephemeral pond when available: **the suggestion of maintaining a permanent source of water for wildlife outside the enclosure seems to be a thoughtful option.**

Venomous animals

A worrying mortality event in juveniles has been described by the site manager. Three young ostriches, housed in three contiguous enclosures, suddenly collapsed within a few minutes of each other: the first two died really quickly with muscular contractures described. The following day, a fourth young ostrich, kept in one of these enclosures, was also found dead. Only the third one recovered without any after-effect.

The description of the scenario pointed toward an envenomation with neurotoxin, very likely by a snake from the Elapidae family such as a cobra. And a cobra was actually found and killed by the Centre staff in the following days.

Cobras indeed induce very quick neurologic symptoms and the pathognomonic lid ptosis, and kill by paralysing the respiratory muscles, while the mamba would have induced noticeable muscarinic symptoms –not reported in this case. An animal recovering from a cobra bite would not show any after-effect nor wound. There are two cobra species in Niger, *Naja haje* and *Naja nigricollis*, but the second one is a spitter which would often cause symptoms starting from the eyes.

A viper bite was also observed in ostrich at least once in the past at Kellé: viper venom induces haemorrhages and necrosis; if death occurs, it would take hours and leave necrotic wounds on the bite site.

The incidence of snakebite in Niger is not accurately known but it is reported to be low or under-estimated as people tend to go to traditional doctors instead of hospitals (Adehossi et al. 2011). However, in this case, it caused the loss of three (almost four) potential breeders. Anti-venom could be kept at the site once a fridge will be available, but it is not easily available in Niger (Chippaux & Kambewasso 2002); actually, the press reports that it is not produced anymore... Most of the time, the clinical signs, in theory relatively specific, are not correctly analyzed by health officers (Chippaux, 2005). The respiratory distress after a cobra envenomation could have been treated by an artificial respiration if the staff had been trained to recognize and perform the medical care; this may also be a good first-aid skill.

The presence of scorpions was also noted (Buthidae, *Androctonus dekeyseri* observed during the mission): while it is unlikely that a scorpion sting is lethal to adult birds, it may cause the death of chicks. Buthidae venom is mainly muscarinic but is the result of multiple toxins: although controversial, immunotherapy is the only etiological treatment; administered early, it prevents many complications and improves the outcome (Chippaux, 2012). It can be useful to administer analgesics with an anti-inflammatory action. Many drugs aiming at cardiac treatment have been proposed to treat the hypertension, arrhythmia, heart failure, and pulmonary oedema associated with scorpion envenoming. Among the vasodilators, the a1-adrenergic blockers, such as the Prazosin, are an option worthy to be considered (if available); otherwise, dobutamine alone or in combination with diuretics or antiarrhythmics can help. Neuromuscular disorders are most often treated with drugs that inhibit the excitability of postsynaptic neurons: benzodiazepines, in particular Diazepam, help.

Snake envenomation is of greater concern than scorpions' (less than a third of human stung present systemic symptoms (Chippaux, 2012)): a snake put to flight would be able to hit consecutively several curious birds during its run; and bite again in the following days if it settled in the enclosure.

Tracheal tubes are already available on site (see appendix), we recommend providing ventilation bags and teaching the staff how to intubate an ostrich.

The drug kit should be refurnished with anti-inflammatory, a1-adrenergic blockers, diuretics and benzodiazepines each time the expiry date is reached.

It would be difficult to stop snake access to the pens (apart from raising mongooses together with the ostriches!), but they tend not to like open areas.

We suggest basic enclosure tidiness as a way of removing hiding places for cobras.

1.4. Principle of Care

1.4.1. Animals management

The Centre staff pay a lot of attention to the ostriches' welfare, but stress indicators remain quite obvious, particularly amongst the juveniles and young adults (Figure 4). A proper behavioural study could not be conducted during the time of the mission but very detailed observations reported by the site manager, who spent hours observing individual and social behaviour of each bird, confirmed the assumption of chronic stress syndrom. This is something that we had to deal with in Tunisia as well. That can be explained by the housing conditions that can be inadequate to some individual needs.

The pen sizes match the standard of most of the ostrich farm: recommendations variy from 0.1ha (Jarvis, 2015)) to 1ha (Campodonico & Masson, 1992) per mating flock; Brand (2012) recommends 0,25ha for pairs, trios or small flocks, what is the size of the smallest enclosures of the facilities (Figure 6). However, in Bophuthatswana (South Africa), larger enclosures have been preferred for ostriches collected in the wild (Campodonico & Masson, 1992); this meets the observations made in Tunisia.

It is important to bear in mind that most of the farming recommendations are made for the domestic and hand-reared variant of the species.

The exact origin of the current red-necked ostrich breeders is unknown but it is possible that some of the oldest animals were collected in the wild. Even if they have been born in captivity, they have not been used to human presence and still consider people as a potential threat. Indeed, most of the behavioural observations made by the site manager perfectly match the natural behaviours of the species. Well-being must be considered as an influencing factor of the reproduction success as important as the diet balance and we **recommend applying the following measures:**

- **Keep the young and juveniles in biggest group as possible (avoid lone animals)**
- **Provide resting areas where the birds can hide when they see an "intruder" (i.e. visitor)**
- **Experiment with nest protection to improve the hatchability (if natural incubation)**
- **Keep the breeders in trios or harems to maximise the egg production (and natural incubation)**

Figure 4 : Sub adult female kept alone, regularly displaying toward the males in the adjacent pen – clear pacing evidences are visible on the ground

Figure 6 shows the location of the 19 (3;9;7) ostriches on 30/6/17. There are three breeding pairs, but sub-adult females have already started to lay down eggs.

We propose the following changes in the group composition:

- Male Aoulaye (A) and female Maria have been the most prolific pair to date: it is not recommended to modify this breeding unit;
- Male Mustafa (M) has been recently paired with female Aicha (after his previous female died): they have been producing eggs but do not express the best parental behaviours. Because they are surrounded by many young females ready to breed, we suggest opening the enclosures n°4/5, n°8 and n°10, allowing four of them to join Mustapha and so create a harem (1;5). It will be possible to remove some of the females later, when there will be more mature males to pair them with. This proposition is based on individual affinity expressed during the visit and the observation made by the staff.
- Male Julien (J) is paired with a young female Salma, but even if their behaviour seems good, none of his eggs have ever hatched. Some concerns about his fertility have been raised: the site manager has thus been trained to better check the eggs to improve the diagnostic. In the meantime, it is suggested to add the two remaining sub-adult females currently kept in the enclosure n°9. This will create a harem (1;3).
- The two offspring of December 2016, currently kept separated in the enclosures n°2 and n°3, should be grouped: this may help to reduce their stress and is the best option to identify compatibilities and form future breeding groups. Additionally, their enclosure should be complexified by building hides in the enclosure (see 1.2.1).

Figure 5: juveniles in enclosure n°3 unsuccessfully trying to get away from intruders; note the lack of high vegetation in the enclosures n°3, 4 and 5 compared to the n°1 (in the background).

① *105m* **Aoulaye (M ;?)** **Maria (F ; ?)** **[*breeder code= A*]** *160m [1,7 ha]*	⑥ *76,5m* *32m [0,25ha]*	⑦ *30,5m* **Moustapha (M;?)** **Aïcha (F ; ?)** **[*breeder code=M*]** Suggested group : (1;5) - Mustapha - Aïcha - 4 Aoulaye's daughters • 2x A02/14 • A11/14 • A04/15 *160m [0,5ha]*	⑫ *85,5m* *32m [0,3ha]*	⑬ *122m* **Julien (M ; ?)** **Salma (F ; A02/14)** **[*breeder code= J*]** Suggested group : (1;3) - Julien - Salma - 2 Aoulaye's daughters (A11/14) *160m [1,95ha]*
	④⑤ **A02/14** **(0;2) adults** → *64m [0,5ha]*		⑪ **A11/14** **(0;2) adults** *32m [0,3ha]* →	
	③ **M12/16** **3 juveniles** *32m [0,25ha]* ↕		⑩ **A11/14** **(0;1) adult** ← *32m [0,3ha]*	
	② **A12/16** **4 juveniles** *32m [0,25ha]*		⑨ *32m [0,3ha]* ⑧ **A04/15** **(0;1) adult** ← *32m [0,3ha]*	

Figure 6 : Diagram of the enclosure with measurement and individuals repartition (group identification code based on: [father's initial] [hatching month / [hatching year]; in red, suggested changes in group composition to be applied before the start of the next breeding season

1.4.2. Fertility and fecundity

As we mentioned before, some concerns have been expressed regarding the fertility of one of the male breeders, Julien. Despite active reproduction and apparently good parental care of the nest, none of the eggs produced by the two females he has been paired with have hatched.

It appeared that the site manager did not know how to identify a fertile from a clear egg. The description of the eggs examined after unsuccessful incubation revealed some rotten eggs what could be due to microbial contamination or embryo death. Specific training to better understand low hatchability has been provided and the next eggs will be more precisely checked.

We recommend careful checking of new eggs to determine whether they are infertile or dead.

Some studies performed on ratite eggs revealed that spermatozoids could be observed around the yolk during the first days: this might be an alternative to check the male's fertility in the field.

Note that Nutrition plays a major role in infertility with obesity being the most common problem in male birds (Soley & Groenewald 1999). Excess fat deposits in male birds can reduce sperm production and obesity can be associated with overeating lush pasture during the breeding season (Badley 1997).

Many authors agree that the visual scoring of subcutaneous fat is non-destructive, relatively easy, and is a quick method of assessing fat stores of birds (Gregory & Robin 1998; Kaiser 1993; Meissner 2009). It can be assessed by palpating the keel and breast muscles. It, however, becomes challenging to estimate the bird's fatness from a distance due to the feathers; it may not even apply to the non flying birds (they do not have keel). Meyer (2013) demonstrated that a Body Condition Scoring (BCS) system could not be created with the ratite body characteristics; she did, however, appointe a Body Condition Index, which is calculated from the ratio of abdominal circumference and wither height, allowing for conclusions about their nutritional status. A similar index was proposed by Deeming et al. (1996). Mincham et al. (1998) concluded that both BCS and ultrasound can be used successfully to predict fat content and body composition in emus, even if the BCS appears to be more reliable than ultrasound.

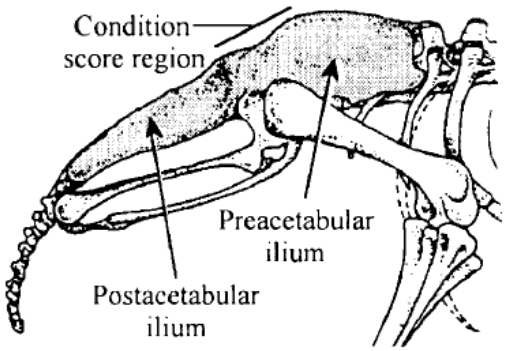


Figure 7 : Position used for condition scoring in live birds (modified after Minaar & Minaar 1992, in Mincham et al. 1998)

On the Blue Mountains Feeds website (http://blue-mountain.net), Holle describes the ostrich Body Condition Scoring as follow:

- ✓ when the backbone at the highest place on the bird's back is protruding above the surrounding flesh, the bird is too thin;
- ✓ when the backbone at the highest place on the bird's back is indented below the surrounding flesh, the bird is too fat and needs decreased feed—or a different feed formulation;
- ✓ the optimum Body Condition is when the backbone at the highest point on their back is perfectly even with the surrounding flesh.

This reveals a weakness of the North African Ostrich farming system at Kellé: as we are currently unable to palpate the breeders, it restricts the possibilities to accurately monitor the performances.

Given this difficulty, we tried to apply a simple size comparison between the three mature males (Figure 8): Julien and his female seemed indeed to be fatter than the other birds, with a rounder shape of the back (likely to testify to a bigger abdominal circumference). It was also noticeable that Julien is less anxious than the other mature birds. Indeed, he commonly comes and displays in front of visitors and his

paddock is the largest, the farthest from the buildings, and it may have more highly palatable plants (to be objectively assessed). According to Cooper et al. (2005) and McKeegan & Deeming (1997), an increased male vigilance causes a significant decrease in the food intake: in contrast, less disturbance will less interfere with the foraging behaviour; consequently, Julien may overeat the pasture available in his paddock.

Figure 8 : Comparison of the three males ((a) Mustapha; (b) Julien & Salma; (c) Aoulaye) in their paddock. The visual assessment of the body condition is very challenging: subcutaneous fat can hardly be seen on the back due to the plumage but Julien seems to have more developed breast and legs.

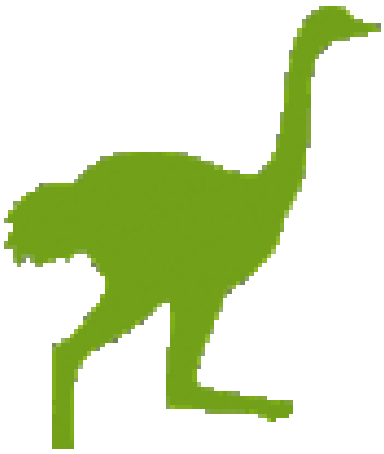
If a cock consumes excess calcium, zinc absorption is reduced with adverse effects on sperm production (Cooper 2000).

We suggest monitoring Julien's foraging and feeding behaviour. If it appears to be abnormal, he should be brought gradually to a lean body condition and "flush fed" 2-4 weeks before reproduction (Cooper et al., 2005)

Training course on ostrich farming

Chapter

2



2. Training course on ostrich farming

2.1. Context

Within the framework of a Nigerien project of the Ministry of Professional and Technical Education, the PRODEC (Capacity Building Project for Growth), financed by the World Bank's International Development Association (IDA), a five-day training has been organized at Kellé. This national project supports the implementation of short training courses in order to improve technical and professional skills in developing economical sectors.

Thus, five Master students from the Agronomy Faculty (Abdou Moumouni University, Niamey), candidates for a position in an ostrich commercial ranch in Niamey, attended a comprehensive course on ostrich farming, including notions in biology, nutrition, behaviour, pathology and project planning. The staff of the three sites involved in the North-African ostrich conservation -namely Kellé, Ifreouane and Maïné- also attended the course.

Some side sessions were also organized with the guards who do not speak any French: Maimounatou Ibrahim translated in each appropriate dialect, and the training was made very visual (with photos and videos) and practicals.

An evaluation methodology was applied to monitor the understanding and gain of knowledge (see appendices).

Additionally, private discussions were scheduled with the site manager in order to help her with specific needs and concerns she may have. These sessions were incredibly useful for both parties as the experience sharing allowed to build bridges between the Nigerien and the Tunisian strategies and to reinforce the regional effort for the subspecies conservation.

2.2. Participants

Figure 9 : group photo – from left to right, Kellé guard, Iferouane manager, student, Maïné guard, two students, Marie Petretto, Head of the Communal Environmental Services of Kellé, two students.

A total of eleven (11) persons participated in the courses.
Six local actors, involved at different levels in the North-African ostrich conservation:

- ✓ Ms. Ibrahim Mamadou Maimounatou, site manager at Kellé, Sahara Conservation Fund Niger
- ✓ Mr. Issaka Abdou Idrissa, Iferouane manager, Aïr & Ténéré Natural Reserve
- ✓ Mr. Haboubacar Adamou Mahaman, Head of the Communal Environmental Services of Kellé
- ✓ Mr. Maoudé Abdoulaye, guard at Maïné (and only person on site)
- ✓ Mr. Zacharia Idi, guard at Kellé
- ✓ Mr. Harouna Moussa, guard at Kellé

Five Master students from the Abdou Moumouni University, Niamey:

- ✓ Mr. Malick Amadou Inoussa
- ✓ Ms. Nana Hadiza Chitou Adamou
- ✓ Mr. Iro Nomaou Mahamadou
- ✓ Mr. Issifou Hamani Magagi
- ✓ Mrs. Hassana Moussa Moiou

We thought it important to reaffirm the international interest in the project and thus took the opportunity to meet with most of the authorities and stakeholders and introduce the objectives of the mission:

- ✓ Colonel Mariama Issa Omar, National Directorate of Protected Area (DFC/AP)
- ✓ General Mamadou Ousseini, Kellé site owner
- ✓ Mr. Mai Moussa Mai Salé, Traditional Head of Kellé Canton
- ✓ Mr. Idrissa Adam, deputy Mayor of Kellé

2.3. Training duration and mechanisms

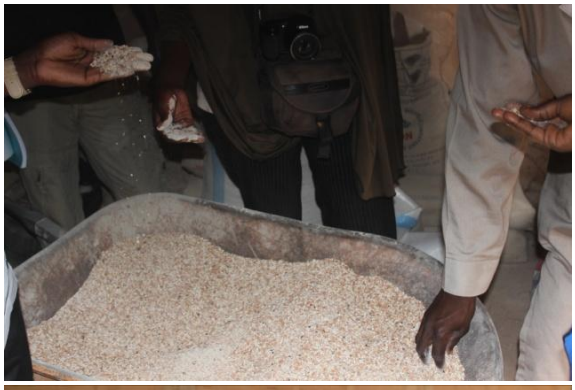
The formal training course lasted six (6) days from the 13st to the 18th July 2017, comprising 48 hours (8h - 13h, 17h - 19h and 20h - 21h). It was made up of theoretical sessions, practicals and workshops.
It took place at Kellé village for the theoretical part, kindly hosted by Mainounatou Ibrahim and Abba Mala Maman. Two visits at the breeding site and one visit to the future (pre)release site of Tchilalla were also organized.
Additionally, daily session were organized with the staff of Kellé breeding site (site manager and guards).

2.4. Training content

Five education themes were developed (see appendices). The preliminary program had to be slightly modified to match with the logistical and meteorological constraints. The class was delivered with MS Powerpoint® presentations and videos; a hard copy of the didactical material has been provided on the first day. The sessions were kept dynamic through free exchanges and questions: they also allow continuous monitoring of the understanding. Every day, thematic exercises were organized for the participants to try and practice. See Appendix for details.

Theme 1 – Biology & Zootechnics
Ostriches anatomical and physiological particularities and consequences on interventions.
Introduction to the requirement for infrastructure features and cleaning.
Farm auditing: application to the example of Kellé (ranch visit, historic, records and identification of strengths and weaknesses)

Theme 2 – Reproduction
Physiological basics: behaviours, nesting and laying eggs, parental cares
Egg management: collection, cleaning, incubation, hatching
Issues during incubation
Chicks' hand-rearing
Sex determination



Theme 3 – Nutrition
Biological basics: physiological needs, foraging behaviour
Recommendations for chicks, fattening and breeding
Mains risks: impaction, nutritional unbalances

Theme 4 – Pathology
Identification of the first symptoms and practice basic cares
Practice a post-mortem and useful sample collection

Theme 5 – Strategies and farming objectives
Captive breeding for conservation purposes: behavioural and ecological components important for the release of individuals
Commercial farming: Information on the ostrich industry, Public health requirements

The training course reached its objectives toward the students. The satisfaction survey testifies of the participants' satisfactions.

Figure 10 : Staff of Kellé breeding site – from left to right, Ms. Maimounatou Mamadou Ibrahim, Mr. Zacharia Idi, and Mr. Harouna Moussa

The daily sessions were organised with the Centre staff. Lectures on ostrich capture and contention were given, as well as on egg examination and chick hand rearing.

The discussions and experience sharing with the site manager were very productive. The methodology on data collection and reporting has been revised and the needs for capacity improvement analysed. The material and drugs available on site have been checked (see inventory in appendix): it appeared that none of the drug can be used anymore; there is some suture, bandage and sampling material but basic instruments are missing (surgical instruments for suture or post mortem, insufflations bags,...) as well as disinfectants.

A reference manual in Aviary pathology, in French, has been offered to the site manager

Conclusion

This mission was very productive. Firstly, it highlighted the excellent site management: Ms. Maimounatou Ibrahim demonstrated to know a lot about ostrich's behaviour and care, and to be able to build on her knowledge and experience to face most of the unexpected situations.

The site has also a great potential of development, with good quality and well maintained infrastructure as well as a good pool of breeders.

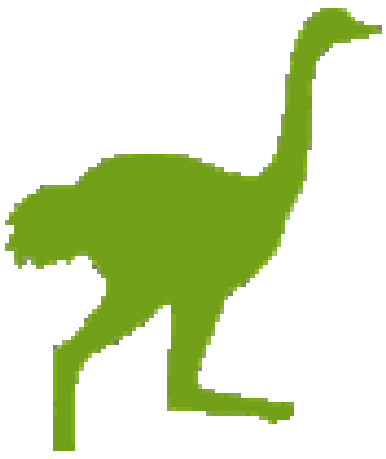
The recommendations made in this report are mainly the fruit of discussions and brainstorming sessions and this emphasizes the need of developing a platform of exchanges between field biologists and zoo people.

We can report that there is room for improvement, particularly in basic veterinary nursing (someone on site should know how to treat a wound, give injections, take samples, intubate...) and in data compilation (there is a great amount of scientific data that are not made usable yet).

This could be achieved through further visits and possibly, academic supervision of the site manager to place her work into a more scientific framework.
In the near future, the lack of veterinary capacity on site may be an issue in the routine work with the chicks' artificial incubation: the basics can be learnt by the staff, but it could also be an option to explore the possibility of working with local veterinary trainees.

Finally, there is a need to anticipate the future of the birds produced: there is currently enough room to house the young chicks but it might become too small very quickly, particularly if the objective is to release them. There seems to be enough space on the site to create large paddocks, for flock acclimation. Infrastructure and skills will have to be developed for ostrich capture and transport.

Appendices



Training course contents

Theme	Lecture	Contents	Exercise	Questions of preliminary test (D1)	Questions of the daily oral test (quizz)
Biology & Zootechnics	TH01-01 _ Ostrich's anatomical and physiological particularities and consequences on interventions	Anatomy and mechanics		Anatomic drawing to complete	**1. Anatomic drawing** 2. What is the adult/chick weight? 3. How to make the difference between male and female? 4. What is the physical restrain technique for ostrich? 5. What are the benefits of cement floor? 6. What are the inconvenient with outdoor farming? 7. How to organize incubation and hatching rooms? 8. What are the main parameters to monitor for the chicks? 9. What could be the consequences of farm management weaknesses? **10. What are the different units in a farm?**
		Adult ostrich restrain	Too many participant for capture		
		Chick restrain Vent sexing			
	TH01-02 _ Introduction to the requirement for infrastructures features and cleaning. Farm auditing	The different farm types Flock management	Site visit: application to the example of Kellé (ranch visit, historic, records and identification of strengths and weaknesses)	What are the different units in a farm?	
		Ostrich housing and feeding			
		Chick housing and feeding			
Reproduction	TH02-01 _ Biology & physiology of ostrich reproduction	behaviours, nesting and laying eggs, parental cares		What is the brooding period duration?	1. Describe the laying 2. Describe the brooding behaviour 3. What are the endocrine response to stress and territorial defence? 4. What is the duration of the incubation and what does influence it? 5. What are the egg natural protections? 6. What are the stages of embryotic development? 7. How to clean the eggs? 8. How to store the eggs? 9. What are the incubation parameter and how to monitor them? 10. What are the hatching parameters?
		Egg management: collect, cleaning, incubation, hatching	Egg candling	What precaution to take whilst collecting eggs?	
		Issues during incubation			
		Chicks' hand-rearing			
Nutrition	TH03-01 _ Ostrich nutrition requirements	Biological basics: physiological needs, foraging behaviour		What is the ostrich's diet?	1. How do you feed the bird in an extensive farming system? 2. When do you start feeding the chicks? 3. Describe the anatomy of the digestive system. 4. What are the digestion mechanisms of the Ostrich? 5. What are the differences between the feeding behaviour in a farm and in the wild? 6. What are the physiological adaptations to arid habitats? 7. What are the specific requirements for the hens? 8. What is the ostrich's Energetic Need? What does the ration in Kellé is made of? 9. When and how feed the ostriches? Why? 10. What would you do if a 2-week-old chick has a diarrhoea?
		Recommendations for chicks, fattening and breeding			
		Mains risks: impaction, nutritional unbalances			
Pathology	TH04-01 _ Clinical examination and post-mortem	Identification of the first symptoms and practice basic cares		Why some ostriches do not have feathers on their back?	1. What are the post-mortem procedure steps? 2. How and what to sample? 3. What is the macroscopic difference of a new-born liver? 4. How do you assess the body condition and hydration? 5. How to examine the gastro-intestinal tract? 6. On the photo, show the kidneys? What are the possible noticeable aspects? 7. What is this organ? Does it look normal? 8. What is this organ? Does it look normal? 9. What is this organ? Does it look normal? 10. How to write post-mortem conclusions.
		post-mortem and useful sample collection	Chicken post mortem		
Strategies and farming strategies	TH05-01 _ Captive breeding for conservation purposes	behavioural and ecological components important for the release of individuals	Site visit: audit of Tchilalla pre-release site		
	TH05-02 _ Commercial farming	Information on the ostrich industry, Public health requirements			

Training course evaluation

The course has been evaluated at different levels:

- ✓ Improvement of knowledge: the same short-answer test, marked out of 10, was written individually by each student on the first and the last day of the course;
- ✓ Knowledge gain : a written test requiring short answers (marked out of 10) and essay answers (marked out of 10) was taken on the last day;
- ✓ Assimilation level: before starting a new education theme, an oral quiz, marked out of 50 (5 marks per question), was taken in group to evaluate the assimilation of class completed; this allowed to re-adjust the teaching methodology and go back over the points that may need it;
- ✓ Analysis skills : a group homework on zootechnics audit was due to be completed over the week, the essay was marked out of 20;
- ✓ Practical: theories and procedures learned were applied to the actual doing and technical skills of the participant were assessed.

The benefit for the guards was assessed independently of the other students as the methodology and the objectives of the training were different.

Ms. Maimounatou Ibrahim, site manager at Kellé, was not evaluated in a formal mode as she demonstrates a level of knowledge higher than the other participants. Private discussions were scheduled to discuss most of the aspects of ostrich farming for conservation purposes.

Guards' evaluation

The two guards of Kellé and the one of Maïné do not speak any French: Maimounatou Ibrahim acted as interpret.

At the end of the week, they were individually asked four (4) questions, marked out of 5. The results (Table 3) were excellent and encourage continuing training them.

Table 3 : Results of the final oral exam for the sites guards (18/7/17, 17h15 to 18h45)

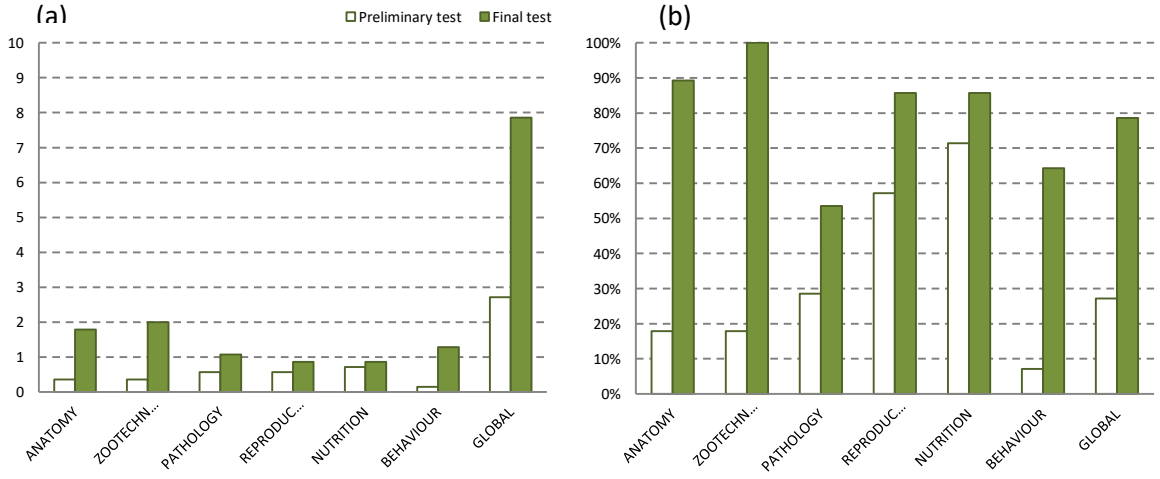
	Harouna Moussa (Kellé)	Zacharia Idi (Kellé)	Maoudé Abdoulaye (Maïné)
How would you catch an ostrich?	5 / 5	5 / 5	4 / 5
How can you check if an egg is fertile?	5 / 5	4 / 5	3 / 5
Can you change the breeding pairs from time to time?	5 / 5	5 / 5	5 / 5
How would you feed a chick after hatching?	5 / 5	5 / 5	3 / 5
TOTAL	**20 / 20**	**19 /20**	**15 / 20**

Improvement of knowledge

Six (6) written questions, marked out of 10, were submitted to the participants on the evening of their arrival. The same test has been re-submitted as part of the final evaluation. The results (Figure 11a) obtained were quite low, with an average mark of 2.75/10 (from 1/10 to 4/10). Their interpretation shows a lack of knowledge in anatomy, behaviour and basic farming principles (Figure 11b).

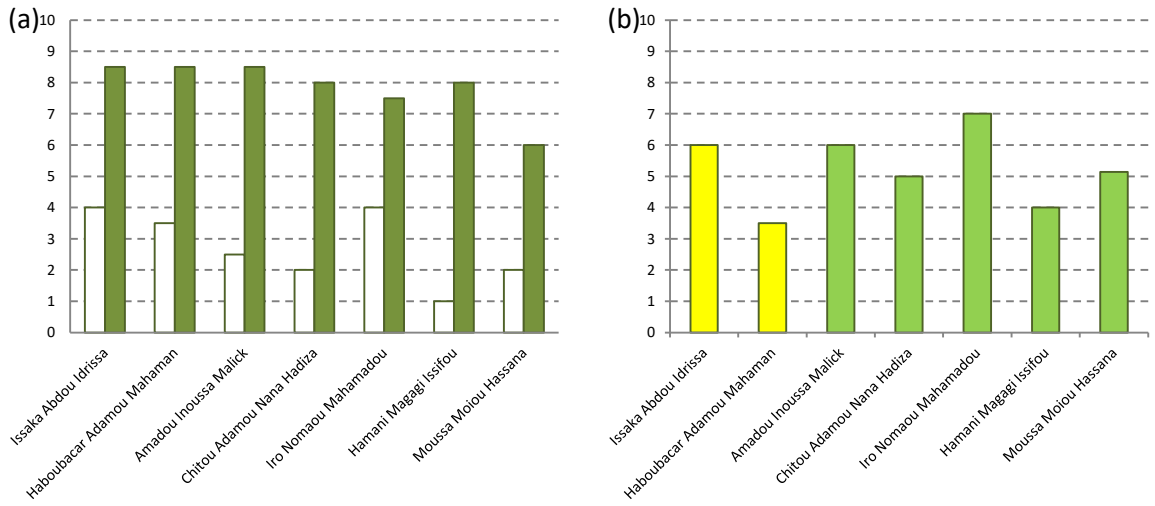
The participants were not aware that the same questions will be re-asked at the end of the course. The average mark obtained during the final test increased to 7.86/10 (from 6 to 8.5/10): a significant improvement can be observed in the species biology and behaviour, and their applications to captivity and farming (Figure 11). The general understanding level of the most specialized themes such as pathology, artificial incubation and applied behaviour science however remained average: this observation led to revise the educational objectives in order to make sure that at least the basics will be properly gained. This underlines the need for further training sessions for those who aim at being involved in ostrich farming.

Figure 11 : (a) average marks per question (N=8); (b) average success rate per question – comparison between initial (white) and final (green) results



The monitoring of individual progresses is satisfying as well, with a homogenization of the level of all students but one (Figure 12a). The delta of progress of this student however appears to be commendable (+5 marks) and the course benefits (Figure 12b).

Figure 12 : (a) progresses: initial and final marks (/10); (b) Deltas of progress: difference between initial and final marks



Knowledge gain

The level of knowledge gained was evaluated by ten (10) written question, marked out of 20, including the six (6) short-answer questions submitted during the preliminary test (10 marks) and four (4) questions in essay form (10 marks).

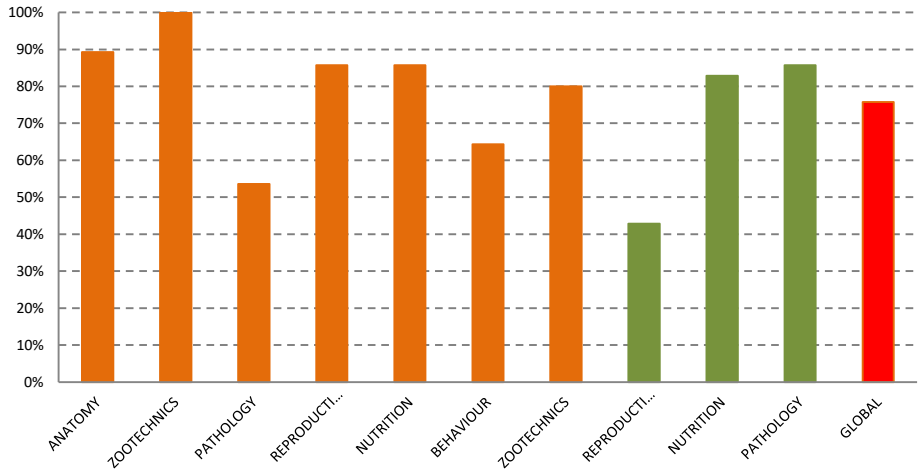
The Table 4 highlights the comparison between the students and the professionals already involved in wildlife conservation. Two (2) students were thus marked out with Grade B (mark >16/20), two (2) with Grade C (mark >14/20); the fifth obtained a Grade E (mark >10/20) even if was the last one to hand in her paper.

Table 4 : Results of the final exam (18/7/17, 17h15 to 18h45)

	Short-answer question	Essay question	**total (/20)**
Issaka Abdou Idrissa	*8,5*	*8,5*	***17***
Haboubacar Adamou Mahaman	*8,5*	*7*	***15,5***
Amadou Inoussa Malick	8,5	8	**16,5**
Chitou Adamou Nana Hadiza	8	8	**16**
Iro Nomaou Mahamadou	7,5	8	**15,5**
Hamani Magagi Issifou	8	6	**14**
Moussa Moiou Hassana	6	5,5	**11,5**

The gain level for the whole group is thought satisfying as an average of 76% of correct answers was provided (Figure 13). In details, the basics on sanitary rules and breeding management remain vague (average rate of correct answers below 50%) but it was unlikely to reach a very high score in the time span dedicated.

Figure 13: average rate of correct answers per question (orange= short answers; green= essay; red= global)



Daily assimilation level

A methodology of oral test (« quiz »), marked out of 50 (5 marks per questions), was organized before starting a new theme. It allowed evaluating the level of assimilation of the previous theme and consequently revising the teaching approach or come back on specific points if needed.

These questions aimed at evaluating three (3) learning components:

- ✓ Knowledge : immediate memory of theoretical information
- ✓ Understanding : ability to justify and explain mechanisms
- ✓ Analysis : ability to extrapolate a solution from data provided

Table 5 summarizes the number of question per component and per theme.

Table 5 : Number of questions of each learning component per thematic quiz

	ZOOTECHNICS	REPRODUCTION	NUTRITION	PATHOLOGY
Knowledge	3	4	5	4
Understanding	5	3	3	5
Analysis	2	3	2	1
TOTAL	**10**	**10**	**10**	**10**

The interpretation of the answers shows a good level of immediate assimilation, what reveals a very satisfying level of attention and an efficient teaching methodology (Table 6).

Looking into details, it appears that some themes were better assimilated than other but this pattern is not foung again in the final test. Thus, the average mark for the individual written test for the « Reproduction » theme was only 2/3,5 (i.e. 57%) whereas it was 5/5 (100%) during the oral quiz; on the contrary, notion in « Nutrition » and « Zootechnics » remained vague for the majority of the participants during the

oral test (average mark below 4/10, i.e. 40%) but significantly increased in the final exam (respectively 3/3,5=86% and 4/4,5=89%).

It is possible that the random differences between the questions explain the mismatch, but it is more likely that the participants put more energy to revise these themes before the final exam, in reaction to the lower score obtained during the quiz (lecturer's personal observation).

Table 6 : average mark (/5) obtained per component and per thematic quiz

	GLOBAL	ZOOTECHNICS	REPRODUCTION	NUTRITION	PATHOLOGY
Knowledge	4,25	5	5	2,8	4,75
Understanding	4,375	4	5	4,7	4,2
Analysis	3,625	2	5	3,5	3
TOTAL	**4,175**	**3,9**	**5**	**3,5**	**4,3**

Analysis skills

Following the identified weakness in zootechnics (Table 6) and its major importance for candidate/worker in an ostrich farm, it has been asked to the group to proceed to an audit of Kellé, applying the theoretical notions taught. This written homework was marked out of 20.

Thus, during their visit to the breeding site, they were invited to collect the data and talk to the staff in order to gather the needed information.

They obtained a mark of 34/50 (Table 7), what was passable but the overall goal was to emulate opinion, experience and expertise sharing between people with very different skills.

Table 7 : marking of the farm auditing homework completed by the group of participants

	Scale	**Mark**	**Comments**
Logical thread	18	12	Lack of consistency between recommendations and content
Analysis	18	12	Insufficient recommendations (lack of solution analysis); Many statements are not justified or partially analysed
Data collection	10	8	Some inaccuracies, acceptable as they do not interfere with the work logic
Spelling	4	2	Writing perfectible and to perfect
TOTAL	**50**	**34**	**Generally good**

Practicals

Practicals allow the participants to face a real question and to assess their skills. They have been designed according to the themes developed and depending on the resources available.

The theoretical lecture on ostrich capture and handling could not be applied as there were too many participants and this was too stressful for the animals. It has been replaced by a fun chicken capture exercise.

Figure 14 : chicken capture at Kellé

Therefore, the participants got practicals on:

- ✓ Post-mortem (chickens)
- ✓ Egg candling (on unfertile ostrich eggs)
- ✓ Site assessment (at the future release site of Tchilalla)

Figure 15 : future release site of Tchilalla (left) and the manager of Iferouane taking note on habitat suitability (right)

The evaluation of these activities was immediate, at the lecturer's appraisal, correcting the participants when needed.

Conclusion

The training course reached its objectives toward the students. The satisfaction survey (Figure 16) testifies of the participants' satisfactions.

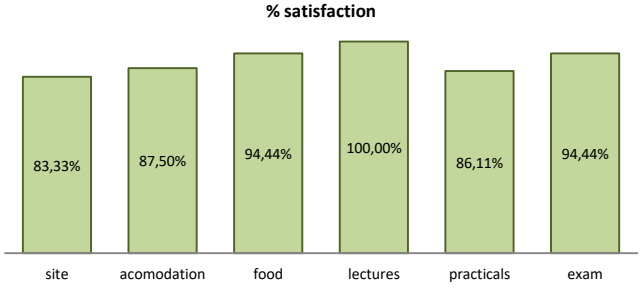


Figure 16 : satisfaction survey results

Pharmacy inventory – 18.7.17

The veterinary material available on site has been checked. All the drugs were obsolete and could not be used anymore. There is some material for suture, bandage and sampling (Table 8) but surgical instruments are missing.

Table 8 : list of the pharmacy at Kellé breeding centre

category		size	Nb	Expiration date
Non-absorbable	Prolene	dec. 3	23	2013
		dec. 3,5	3	2006
Absorbable	Vicryl (circle)	dec. 2	20	2008
		dec. 3	2	2005
		dec. 3,5	9	2010
		dec. 4,0	1	2013
	Monocryl (circle)	dec. 3,5	15	2010
	Monocryl (triangle)	dec. 0,7	2	2011
		dec. 3	1	2006
	PDS II (triangle)	dec. 1	3	2007
		dec. 1,5	2	2006
		dec. 2	4	2007
		dec. 3	2	2014
		dec. 4,0	2	2012
	PDS II (circle)	dec. 2	11	2007
		dec. 3	12	2014
Pipette	non sterile	1mL	8	
syringes	Mounted	6mL	19	
		20mL	35	
		12mL	12	
sampling tubes	microtubes sealed	2mL	88	
	Cryotube	3,6mL	13	
	CORVAC serum	6mL	25	2009
	monoject blue	7mL	14	2010
	CAT red	6mL	27	
	Z red	5mL	12	
	Red	2,5mL	9	2008
	green heparin	4mL	13	2002
	dry non steriles	1mL	30	
Swab	non sterile		160	
plastic bag	Sealed	small	27	
parafilm		1 m	1	
gloves	surgical sterile	6 to 9	32	
mask	non sterile		12	
gaze	non steriles	100 units	2	
bandage	V-trap	8cm	6	
		12cm	2	
	Plaster	10cm	6	
	Band-Aid	various	17	
tubes	tracheal tubes	4.0	2	
		4.5	2	
		5.0	3	
		5.5	3	
		6.0	1	
		6.5	1	
	Feeding tube		15	
	Foley catheter		4	
mircroship			7	

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