giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

REGIONAL PROJECT FOR ECOSYSTEM BASED LAND USE & ECOSYSTEM CONSERVATION IN LOWER AMU DARYA

Expertise report for the project:

«Mapping natural resources along the Amu Darya's banks in Uzbekistan and Turkmenistan »

To carry out the survey of GPS points and the description of their vegetal cover in the LABR (Lower Amudarya Biosphere Reserve), With the Uzbeks partners of the LABR, the State Committee of forestry and the NGO Krass

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Régis Peltier (Forestry Engineer -CIRAD),
With participation of:
Natalya Marmazinskaya (expert ecologist), Elena K'an (Environmentalist)
Nimat Khudiyarov (Forest Service Representative),
Nicolas Fauvet (cartographer & geographer)

Field mission from: 04 to 20 November 2018

cirad AGRICULTURAL RESEARCH FOR DEVELOPMENT

13-03-2019

Summary

1. Abstract

It was the first mission of Cirad in Uzbekistan as part of the project “Mapping natural resources along the Amu Darya's banks in Uzbekistan and Turkmenistan” on behalf of GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit, GmbH). The aim was to get in touch with the local partners of the GIZ and the NGO KRASS (Khozerm Rural Advisory Service Support) by representing our colleagues CIRAD, UMR-Selmet and in particular Jean-Daniel Cesaro, project manager . The second objective was to take field measurements in the two zones of the LABR (Lower Amudarya Biosphere Reserve), located on the banks of the Amu-Darya River, in order to establish a database that can be used to carry out the classifications of images acquired recently by GeoSud-Theïa, *via* Audrey Jolivot (CIRAD-UMR-Tetis). We teamed up with Natalya Marmazinskaya (Zoologist) and Nimat Khudiyarov (Forest Service Representative). Oybek Matkarimou, director of LABR (Lower Amudarya Biosphere Reserve) received us and put at our disposal inspectors-rangers for each field day following our movements in the sectors concerned. We had free choice of our movements and our investigations

We were able to collect 272 measuring points and walk 88km in autumn conditions (morning temperatures ranging from -5 to 2 ° C). Each measurement point contains 4 photos (oriented North, East, South and West), a quantitative description of the habitat (canopy height, average diameter of trees, crown area, height and density of understory vegetation, soil quality, list of species on an area of 20m in diameter) and geographical coordinates obtained by GPS. The forest is characterized by a Euphrates poplar forest structure whose density decreases as it moves away from the river to a pseudo-steppe at the edge of the valley. In addition, some forest areas have been converted into coppice due to accidental fires or logging. The complication of the mapping will lie in the distinction of the structure and the density of trees and understory that constitutes the food of deer. These two factors seem to us to be decisive for obtaining a map of the habitats of the LABR. The cartographic knowledge of these two habitats is essential to feed the file that GIZ wishes to present to UNESCO in order to obtain the Biosphere Reserve label. The LABR is home to one of the last populations of Bukhara Deer (*Cervus elaphus Bactrianus*), which is on the IUCN Red List. However during our field investigations, we were given the regular opportunity to observe these animals as well as the damage they cause to vegetation, especially to forest regeneration, in the southeastern zone of the LABR.

On the occasion of this first mission, we were able to make the following recommendations:

- To limit the overgrazing of the Southeast area of the LABR by deer that threatens the sustainability of the ecosystem, study in short terms the possibility of transferring part of the deer population in the North-West area. In the medium term, the extension of the LABR to ensure continuity between the two zones can be studied;
- Partition of the LABR Core-Zones by strips of 100m wide (50m on either side of a track), classified as Buffer-Zone, so as to let visitors on these tracks and create firebreaks on which the undergrowth would be cleaned;
- Maintain and enhance these firebreaks by allowing domestic livestock to graze and harvesting firewood (undergrowth and dead trees), under contract with the neighboring population;
- Study the possibility of installing a metal or electrified fence on the boundary between the Transition Zone and the Core / Buffer Zone, west of the village of Tallyq, to limit deer intrusions and conflicts with local populations;
- Study the possibility of including part of the Karatau ills and the riparian zone located at its feet, in the Core Zone or in the Buffer Zone of the LABR;
- Initiate negotiations to extend the LABR on the south shore of Amu Darya, in Turkmenistan; on this occasion, see the need and the possibility of reintroducing deer;

- Include the area of the citadels Jampik Kala and Kyzyl Kala, in the buffer Zone of the LABR;
- Establish collaboration agreement between LABR and research organizations (national or foreign) in terms of dynamics and restoration of vegetation and wildlife, as well as in the field of soil salinization, history, relations with local populations, economic impact of the LABR, etc. If the project deems it useful, an expert from CIRAD (D. Cornelis) will be able to count the deer, by doing an overflight, for example in a small plane of 4 places. He could also train local partners.
- Check the limits of the LABR by a GPS survey campaign with the rangers. This work could be an opportunity to review the boundaries between areas (Core, Buffer and Transition) and to include certain areas, to ensure better ecological continuity between the two major parts of the LABR.

It now remains to draw up a cartographic model with the help of our Cirad colleagues. Another mission is scheduled for April-June 2019.

2. Context

Natural resources along the Amu Darya's banks

The diversion of the course of Amu Darya and Syr Darya has not only lowered the level of the waters in the Aral Sea; it resulted in the disappearance of deltas and smaller lakes that were dependent on these two rivers, as well as shoreline habitats such as tugaï forests and reed beds. The Amu Darya delta fed some 2,600 lakes in the 1960s, only 400 in 1985**. Tugaï and reedbed forests once covered more than 500,000 ha, of which only about 10% remains today**; these ecosystems have been replaced by irrigated farmland or have disappeared due to a lack of water. Many lakes and reservoirs have been built to restore the ecology of the surrounding deltas. Wetlands have grown in size and many migratory birds have found refuge there. Diversity remains low, but some species of waterfowl have expanded their breeding grounds along the Amu Darya and Syr Darya valleys. A conservation project completed in 2011 has created the first biosphere reserve in Uzbekistan (not yet recognized by UNESCO), which forms a protected area of 68,718 ha in Karakalpakstan. It will promote the protection and sustainable use of biodiversity resources, including Tugaï forests.

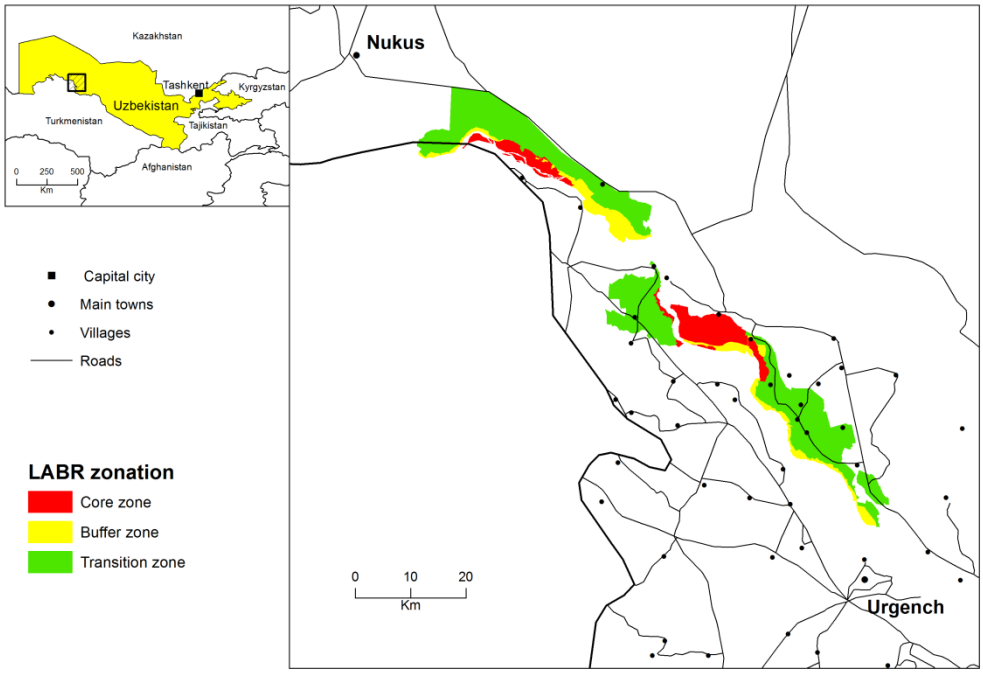
Tugay, also spelt **tugai or tugaï**, is a form of riparian forest or woodland associated with fluvial and floodplain areas in arid climates. These wetlands are subject to periodic inundation, and largely dependent on floods and groundwater rather than directly from rainfall. Tugay habitats occur in semi-arid and desert climates in central Asia. Because Tugay habitat is usually linear, following the courses of rivers in arid landscapes, Tugay communities often function as wildlife corridors. They have disappeared or become fragmented over much of their former range.

Close to rivers and where groundwater levels are shallow, the vegetation is usually dominated by poplars (especially *Populus pruinosa*) and willows such as *Salix songarica*. Where the forest has been disturbed, other species such as *Tamarix sp.*, *Elaeagnus*

turcomanica, Halostachys caspica and *Halimodendron halodendron* will grow. Grass tugai vegetation is dominated by *Phragmites australis and Calamagrostis dubia.* The principle causes for the loss of tugai vegetation include dam construction, tree cutting, grazing, and agriculture.

Objectives of the project "Mapping natural resources along the Amu Darya's banks in Uzbekistan and Turkmenistan"

- Support the NGO KRASS (https://www.krass.uz/) to put in place:
  - Land cover records
  - Inventory protocols for fauna and flora related to ecosystem mapping
- Provide 1: 100,000 ecosystem mapping in the Lower Amudarya State Biosphere Reserve (not recognized by UNESCO) https://whc.unesco.org/en/tentativelists/5436/
  - Landsat + Sentinel 2A (seasonal + long terms)
  - Spot 6/7 Mapping (high precision)
  - Drone mapping (testing on field)
  - Discuss possible adjustment of the boundaries of the State Biosphere Reserve for an international proposal



Map 1: LABR (N. Fauvet, 23/08/2018; According to the Succow foundation's data, Daniel Waible, 2013)

3. Achievement of the November2018 mission

3.1 General Objectives of the Mission

During this mission we were able to contact national services and local partners, in order to properly frame and plan the respective interventions. A field trip was organized to visit the study areas. Two meetings were organized between CIRAD and the partners. The first, at the beginning of the mission, made it possible to present and discuss the objectives of the mission and to organize the logistics. The second, at the end of the mission, made it possible to finalize the chart of the rendering of the maps and the reports. The field trip made possible to make 272 field surveys for the preparation of the satellite image processing (GPS points, description of the vegetation and surface conditions, four cardinal photographs: North, East, South, Western and various observations) in a variety of surface states.

3.2 People who participated in the mission

3.2.1 Cirad France

- Cirad : Valery Gond and Régis Peltier

3.2.2 Uzbekistan and GIZ

First name	Family name	Organization	Function	Mail
Julian	Schlubach	Regional Project for Ecosystem Based Land Use & Ecosystem Conservation in Lower Amu Darya	Project Manager	julian.schlubach@giz.de
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Oybek	Matkarimou	LABR	Director	m.oybek78@mail.ru

3.3 Program of activities

Date (November)	Activity	Accommodation
4, Sunday	Arrival to Tashkent	Tashkent
5, Monday	Meeting with GIZ and with representatives of Forestry Committee - International relations department, - SIG department, - Scientific department, - Department of natural reserves	Tashkent
6, Tuesday	Early flight to Urgentsh Meeting - Director of LABR - KRASS Field work and accommodation arrangement	Urgentsh
7- 9 , Wednesday-Friday	LABR South from Mangit, north from Urgentsh (visit of different biomes taking GPS points and GPS field perimeters)	Urgentsh
10, Saturday	Morning: end of inventory in south zone of LABR Evening: Visit of an ecotourism farm North of Khiva	Urgentsh and Khiva
11, Sunday	Day off (sightseeing Khiva)	Khiva
12-15, Monday-Thursday	LABR North from Mangit, (visit of different	Urgentsh

	biomes taking GPS points and GPS field perimeters)	
16, Friday	Early flight Urgentsh-Tashkent	Tashkent
17-18, Saturday and Sunday	Days off (sightseeing)	
19, Monday	Meeting with GIZ, return and accommodation arrangement	Tashkent
20, Tuesday	Travel from Uzbekistan to France	

3.4 Methods

We collect 272 measuring points and walk 88km in autumn conditions (morning temperatures ranging from -5 to 2 ° C). Each measurement point contains 4 photos (oriented North, East, South and West), a quantitative description of the habitat (canopy height, average diameter of trees, crown area, height and density of understory vegetation, soil quality, list of species on an area of 20m in diameter) and geographical coordinates obtained by GPS.

Based on the field observations, we have created a typology of the main types of land occupations in the LABR (Core and Buffer Zones); this typology is given in Chapter 6, Annex 1. We then assigned each of the 272 GPS points in a given type (see database attached to the report). This classification made it possible to interpret satellite images of the area. To make a first provisional map, we used free European images (Sentinel 2). More precise mapping will be done later, using Spot 6/7 images acquired by the project.
This mapping, reported on a GIS, allows us to calculate the surface area of the different types of land use, in Core and Buffer zones.

It should be noted that, regarding the boundaries of the LABR, and in particular the Core Zone, we used the data provided by the Succow Foundation (see Map 1, page 5). However, for some reason we do not know, these limits seem imprecise and imperfectly follow the natural limits observed on satellite images. These limits should therefore be checked by a GPS survey campaign with the rangers of the LABR.

The difficulty of the mapping lies in the distinction of the structure and the density of trees and understory that constitutes the food of deer. These two factors seem to us to be decisive for obtaining a map of the habitats of the LABR. The cartographic knowledge of these two habitats is essential to feed the file that GIZ wishes to present to UNESCO in order to obtain the Biosphere Reserve label.

3.5 First field observations

The forest is characterized by a Euphrates poplar forest structure whose density decreases as it moves away from the river to a pseudo-steppe at the edge of the valley. In addition, some forest areas have been converted into coppice due to accidental fires or logging.

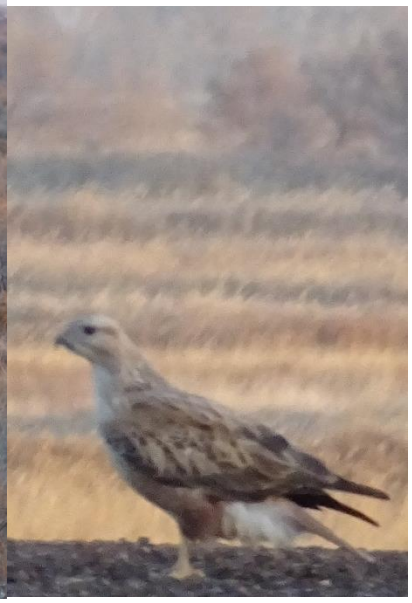
LABR is home to one of the last populations of Bukhara Deer (*Cervus elaphus Bactrianus*), which is on the IUCN Red List. During our field investigations, in the Southeast zone, north from Urgentsh, we

were given the regular opportunity to observe these animals as well as the damage they cause to vegetation, especially to forest regeneration.

We did not make any numerical observations on the number of poplars rubbed and dehorned by deer. However, the proportion of trees that are severely affected, dead or dying at 10% (Photos left & center) and the proportion of trees affected but with a good chance of survival at 15% (Photo right) can be roughly estimated.

Regarding the regeneration of young poplars, in all this southern part, it is rare or non-existent. Most of the seedlings or suckers have been eaten, most likely by the deer.

Regarding wild animals, still in this South-East part of the LABR (Core Zone), apart from more than a hundred deer, we could observe 3 golden jackals, a dozen pheasants, 3 eagles, many corvids, and many traces of badgers.

In the north-west, north of Mangit, outside the birds, we could not observe mammals; however, we have seen many traces of wild boars, rabbits, badgers, jackals and domestic livestock. The very few rubbed trees observed had been so by the horses of the rangers, and the regeneration of the poplars was everywhere abundant.



Regarding the actions of the NGO Krass, we were able to visit plantations of hedgerows, bordering Buffer zone. However, the survival rates of trees planted by farmers were low and as a result, hedgerows could not be effective in preventing deer or livestock from crossing them.
Regarding eco-tourism, we visited the achievements of a particularly dynamic peasant, north of Khiva. He has already built several fish ponds and a restaurant. Tourists can fish or consume fish products. This restaurant seems in full expansion and is very well organized. The farmer has planted some “Black Saxaoul” (*Haloxylon aphyllon*); he now builds a large fenced park in the dunes of the northern edge of the Karakum Desert, near his farm. This area will include small parks for different wild ungulates (sort of zoo) and a much larger park where it will be possible to walk in camels or motorized vehicles. Rooms, offices and laboratories for scientists are under construction, as well as a small leisure park for children .If this model of tourism can work, on the edge of the tourist town of Khiva, it is not reproducible as it is on the edge of the LABR, where tourism that is more respectful of nature and traditional habitat is more desirable. However, we will retain the fact that there are dynamic investors in the region capable of responding to tourist demand.



4. First recommendations expressed by the experts, following this first mission

4.1 Preliminaries

These recommendations are based on a very partial knowledge of the environment, so they are fully subject to discussion and must be validated or invalidated during the project.

4.2 Overgrazing by deer in the Southeast Zone

We found that in the Southeast area, almost all tree regeneration, especially poplars, whether young seedlings or stump sprouts, is regularly browsed by deer. In addition, quite a large number of mature trees are also dehorned by deer.
In the North-West zone, where there seems to be no deer (we only observed traces of wild boars, jackals, badgers, rabbits and pheasants), despite the obvious signs of presence of cattle (tracks and dung), we do not observe this damage on the regeneration, nor on the trunks.
We believe that the number of deer in the Southeast Zone is too large, probably higher than the figure of 800 individuals, on an area of less than 10,000 ha (about 1 deer per 10 ha).
It would be useful to set up a mechanism for monitoring the deer population and damages with indicators. This can be addressed during the next CIRAD mission. If the project deems it useful, an expert from CIRAD (D. Cornelis) will be able to count the deer, by doing an overflight, for example in a small plane of 4 places. He could also train local partners. It would also be very interesting to set up a deer tracking mechanism, in conjunction with a university or research center, throughout a year, to determine which environments they value, at each season of the year.

But it is already almost certain that the tree stands are being degraded and that the main cause is the overpopulation of deer. The species being protected, we cannot consider regulation by hunting, which would be the easiest and most economically interesting solution. In addition, since the area is surrounded by cultivated, semi-desert or industrial areas, deer cannot be expected to migrate to another area. The only predators are golden

jackals which, although quite numerous, should only attack young individuals or sick animals. Badgers and wild boars are probably playing a role of scavenger.

It thus appears that one of the only short-term options for regulating the deer population would be to capture enough of them to repopulate other reserves. In this case, we think that priority could be given to the restocking of the northwestern part of the LABR. Subsequently, restocking of other reserves could be considered in the country or in Turkestan as part of a transboundary reserve. Natalya Marmanzinskaya, a specialist in cervids, believes that the LABR agents do not have the technology to make this partial transfer safely. In addition, she pointed out that the authorization that had been requested by WWF, a few years ago, has not yet been granted. We note that CIRAD has a partner (Didier Roques-Rogery) who specializes in the capture and transport of deer; if necessary, it can be mobilized to carry out tests, while forming the ranger of the LABR. But before that, the transfer authorization must be obtained from the competent authorities. In the medium term, the extension of the LABR to ensure ecological continuity between the two zones can be studied.

4.3 Pasture by cattle in the LABR

It is certain that many cattle occasionally graze on the LABR.
However, traces of cattle are much more numerous in the north-west, without this seems to threaten the tree population (presence of many young trees and stumps). On the contrary, in some areas, probably in the Buffer Zone, the villagers cleared the undergrowth, which favored the growth of grasses. We have visited a trees stand without undergrowth which is a very good firewall. However, the fire risks are great in the LABR (see next chapter), and we have seen the damage of large fires in the past (700 ha in 2005). We therefore think that it would be perfectly compatible with the sustainable management of the LABR, to partition it by firebreaks made up of areas thus cleared and grazed, especially along tracks. Small fire-wood and dead trees could be used.
This would involve a classification of these zones into "buffer zones" and a negotiation with the populations, to obtain a discipline compatible with the objectives of protection of the LABR.
Finally, it is hoped that these agreements would defuse conflicts between rangers and the local population and reduce the risk of fires and illegal logging.

4.4 Fires in the LABR

During field reconnaissance, we recorded about 10 points in areas that had been burned down in previous decades. It was possible to see the old tree stumps (especially poplars) with traces of charcoal, which had coppiced. In addition, the rangers had the memory of these fires. We will see if it is possible to map these fires, by studying the old satellite images. In any case, it must alert LABR managers to the dangers of burning these Tugai forests. This is particularly the case in the northern part of the LABR. This important frequency can be explained by the fact that the undergrowth is denser because of the

absence of deer. It also may be possible to suspect a greater number of conflicts with the local population, although nothing during our visits would confirm this hypothesis.

Be that as it may, we recommend enclosing and partitioning the different parts of the rLABR by strips of a hundred meters wide, on which the undergrowth would be cut and removed. It should be noted that in some cases this cleaning work could be done by neighboring herders, who would graze their livestock. Indeed, we could see plots managed in this way, which had a very good appearance (see photos).

In other countries, for example in Kenya, it has been noted that the cohabitation of domestic cattle and wild ungulates ensures optimal use of herbaceous plants and shrubs. In addition, the "cantonment" of grazing in these bands, would more easily make it possible to make accept to the local populations, the prohibition of grazing in Core-Zone. On the other hand, this implies that these areas where grazing cattle would be allowed are classified as Buffer Zone, which may involve reclassifications. Note that these Buffer-Zones could also be travelled by tourists, accompanied by rangers.

4.5 Harvest of wood in the LABR

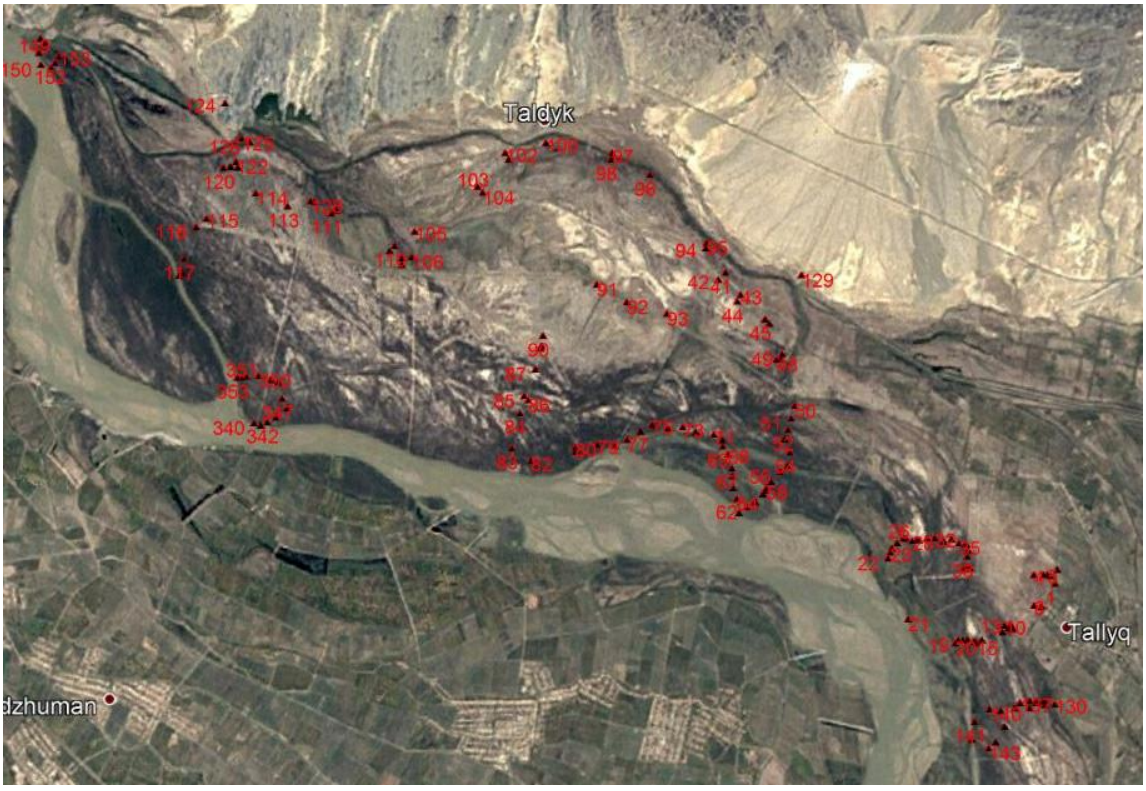
The LABR is home to a considerable biomass of wood energy, in a region where wood is scarce and where all the biomass of agricultural waste is harvested (cotton stalks, etc.), especially for cooking food (bread oven, etc.). During the inventories, we saw many traces of logging and tree stumps, some of which were marked by the forest service (usually following litigation).

It is clear that it is not legal to exploit trees in the Core Zone. However, in the case where partitions would be made in this Core Zone and lead to the creation of strips of land classified as Buffer Zone, we would find it interesting to carry out forest works. This could include forest restoration work (thinning old trees to regenerate, possibly protected against deer by a wire fence for a few years), cleaning the undergrowth and thinning coppice to obtain high forest. In any case, this work would make it possible to obtain wood that would

be interesting to exchange with the neighboring populations, against their participation in forestry work.
This type of collaboration between rangers and the neighboring population would improve social relations. For the population, the LABR would not only be a source of problems (game damage in cultivated fields, etc.) but would become a source of additional income.
In the future other income for the local population could be envisaged, such as the reception of tourists at the inhabitant (housing, catering, horse rental, etc.).

4.6 Deer damage in neighboring crops and possibility of fencing

During visits, we observed very frequent deer intrusions in crops, particularly cotton. These are particularly evident in the Transition-Zone located west of the village of Tallyq (e.g. GPS points 1, 6 & 7). Cotton plants have been so often grazed that they grow plagiotropically, which greatly reduces seed and fiber production.



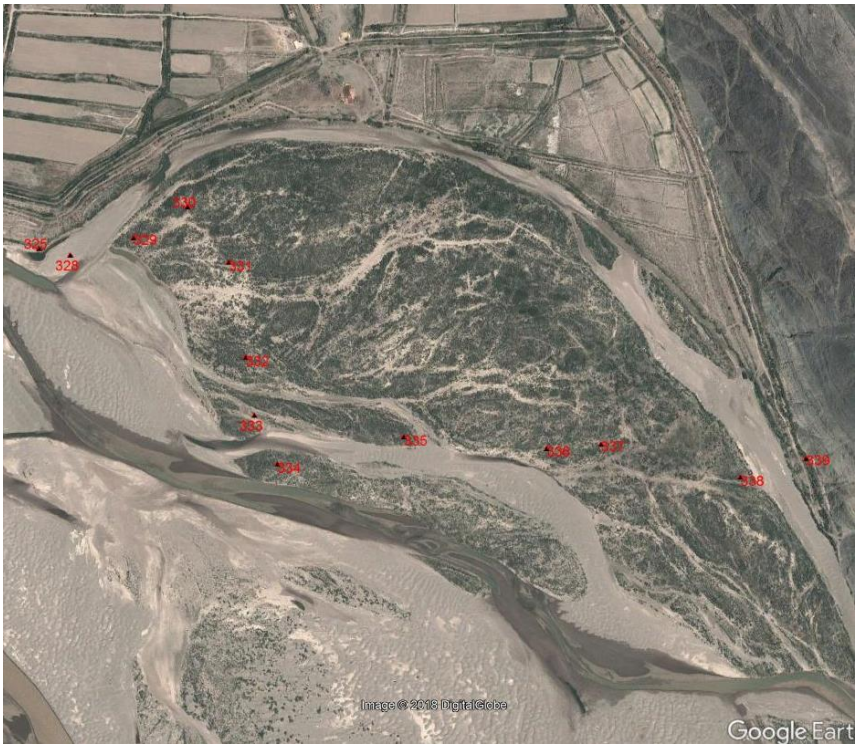
In addition, we could see recent traces of deer penetrating inside a residential courtyard, piercing the fence into stalks of shrubs, to eat the reserve of fodder (stalks of corn).
Live hedges, whose planting has been encouraged by the NGO KRASS, cannot in any case prevent these hardy animals from entering the fields.
Moving the LABR limit would only move the problem. From our point of view, there are only two solutions, either to reduce the number of deer in these areas close to the fields, or to install a really effective fence. It may be a wire fence, similar to the fence where deer are kept, or an electrified fence, such as the one along the Tashkent to Bukhara high speed train

line. This fence would be approximately 10 km long, along the eastern and southern boundary of the most southeastern Core-Zone.

4.7 Extension of the South-East Zone to the Karatau Massif

On proposal of Mrs. Natalya Marmanzinskaya, we raised the points GPS 325 to 339, in a zone of alluvium of the river, covered by a regeneration of poplars, located in unprotected zone, in the South the northwestern part of the LABR. In fact, the episodic presence of a deer herd of up to forty individuals had been reported by a ranger. In addition, he considers that a small population of mountain wild sheep (mouflon) lives on the small rocky massif of Karatau, located in the East of point 339, this massif also sheltering eagles. Without having seen traces of these ungulates, we found the presence of traces many rabbits or hares and large canids.

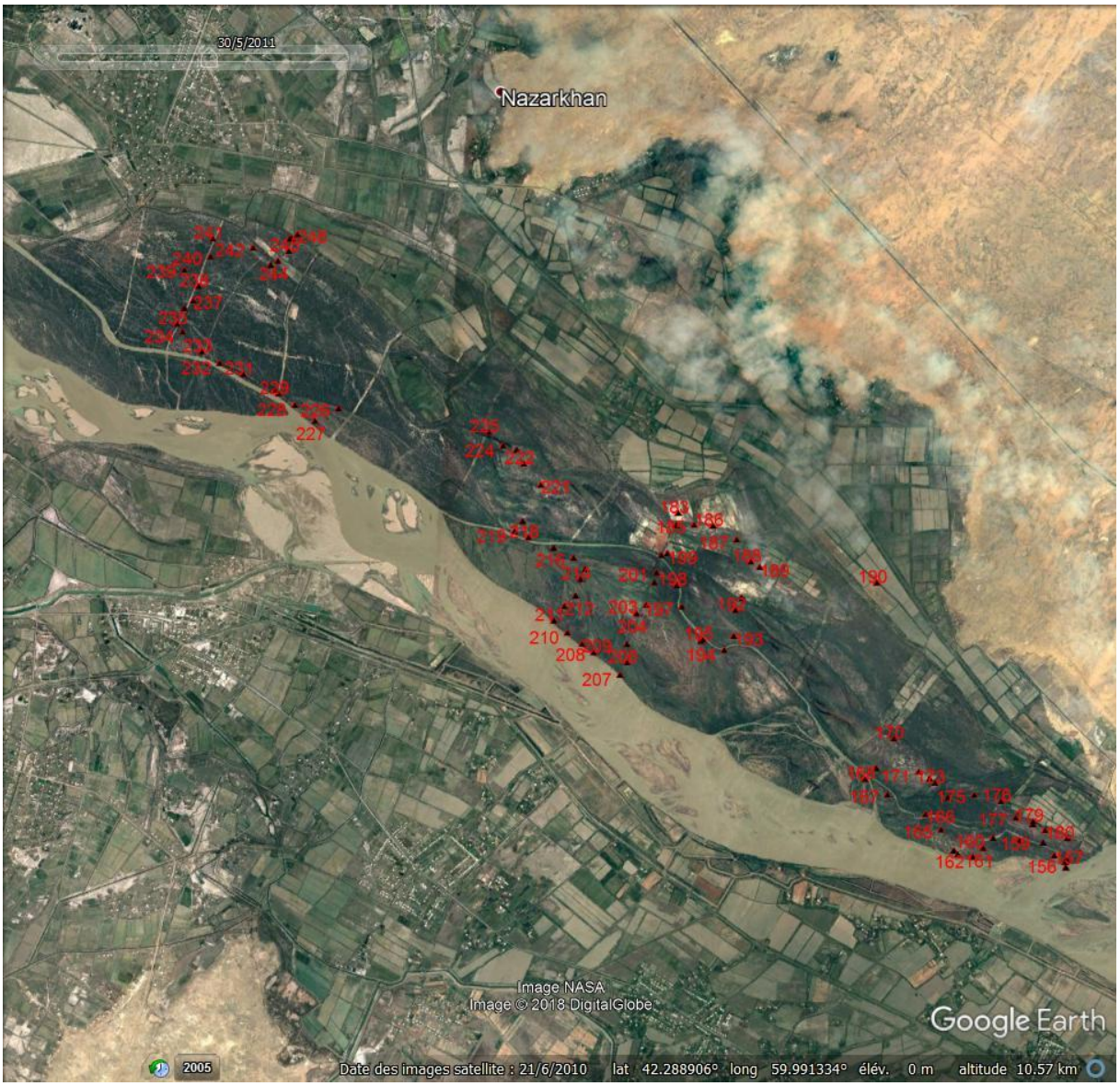
We think it would be interesting to study the possibility of including this riparian zone and part of the rock mass in the Core Zone or in the Buffer Zone (if we want to tolerate the grazing rights of local residents). Adding a few dozen ha located on either side of the river or on its islands would improve the possibility of ecological continuity between the South-East and North-West parts, without however having a real corridor for deer's which could be considered in the more distant future. In addition, the range of endangered species protected by the LABR would be expanded. For mouflon and canids, monitoring with "camera traps" should be considered, to avoid any risk of confusion with domestic animals returned to the wild (sheep and dogs).



4.8 Creation of a reserve on the Turkmen side of the river

Southwest of the most northwestern part of the LABR, south of the river, is a Tugai forest in Turkmen territory.

A very basic mapping was made, based on satellite images and without field surveys. As part of the project, it will be interesting to carry out a mission in Turkmenistan; to discuss it with the authorities of this country and to raise points, if that is possible. On this occasion, it will be useful to check if this area is populated by wild animals and to determine which ones, before considering any re-introduction.



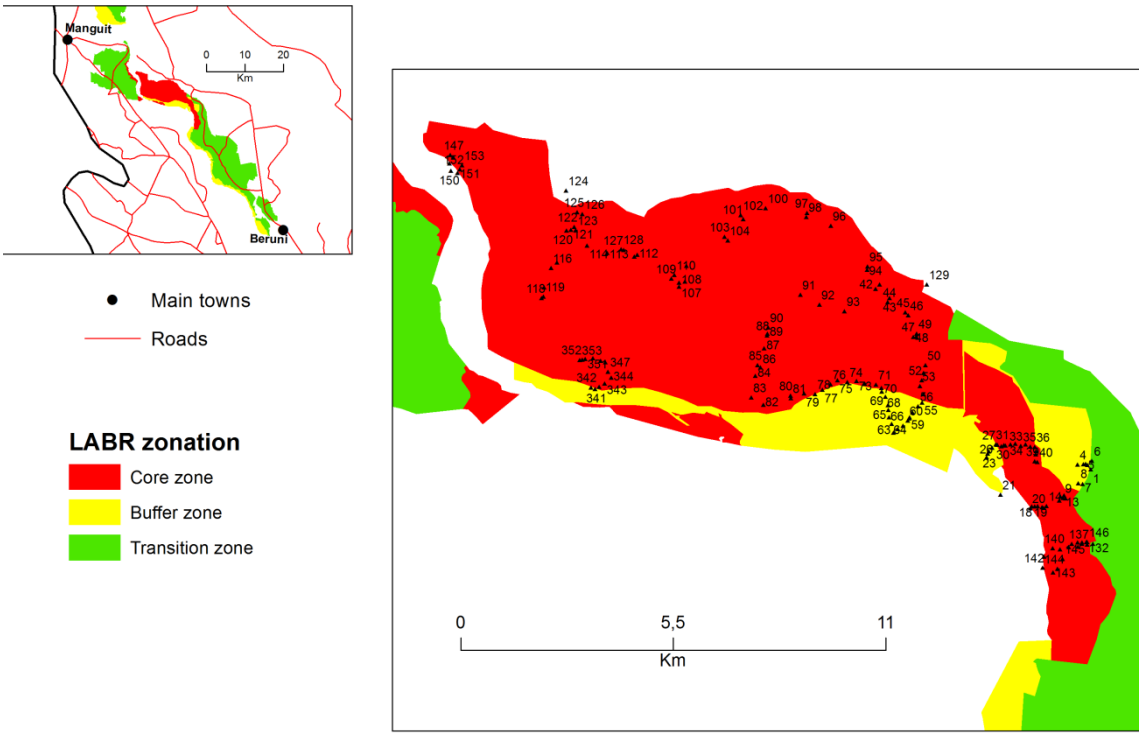
4.9 Modification of Core Zones to allow access for tourists

To fulfill its educational and touristic interest, the LABR must be able to welcome visitors in good conditions and allow them access to beautiful views, to admire the fauna, flora and landscapes.

However, currently, we cannot access the views of the river (e.g. GPS points 22, 62, 83 and 340) without crossing a red zone. Similarly, the East-West dike track that passes through GPS

points 115, 106, 91 and 50 and is an excellent observatory for deer grazing in the samphire steppe, is also in Core-Zone. Finally, it seems practically impossible to access the historic Jampik Kala Castle (point 124), from the LABR office (point 129) without going into the Core Zone (at point 100, etc.).

Thus, every visitor is in violation of the law which prohibits any penetration in Core-Zone. We propose that these tracks and a band of 50 m on each side (to allow actions of cleaning, opening of firewall, walking on foot or on horseback), are reclassified in Buffer-Zone.



4.10 Inclusion of two historic citadels in Buffer Zones

In addition to their own historical and aesthetic interest, the citadels of Jampik Kala (point 124) and Kyzyl Kala (point 154) provide a superb view of both parts of the LABR. They are an integral part of the history of these ecosystems and the forest has certainly been able to develop and re-colonize the area, after their abandonment. In addition, their materials include herbaceous, woody and soil, most likely from the reserve. Finally, a number of birds nest there and traces of deer are visible inside the Jampik Kala. The surroundings of this last citadel could be used for the creation of a camp of yurts or other traditional habitat to welcome the tourists.

For all these reasons, we think it would be useful to classify the area of these citadels as LABR Buffer Zone, while respecting the integrity of the places and traditional practices (Kyzyl Kala). We also propose, if possible, to study the materials that made it possible to build the Jampik Kala to improve the knowledge of the history of the LABR. For example, it would be possible to take some samples on the logs that are included in the walls, so as to determine the tree species and date of cut. If necessary, CIRAD could participate in this work.

4.11 Establishment of collaboration agreement with research organizations

Throughout the paragraphs above, we have pointed out some points that deserve scientific studies to accompany the protection and management of the LABR. This type of action had been considered in the past, since a reception camp had been created, but it is now degraded by time and lack of maintenance.

It is not our responsibility to list all possible research, in terms of dynamics and restoration of vegetation and wildlife, as well as in the field of soil salinization, history, relations with local populations, the economic impact of the LABR, etc.

However, it seems important to stress that this reserve, located in a very original ecological environment, highly impacted by the global changes, must, in our opinion, be a privileged field of research for Uzbek universities and their foreign partners.

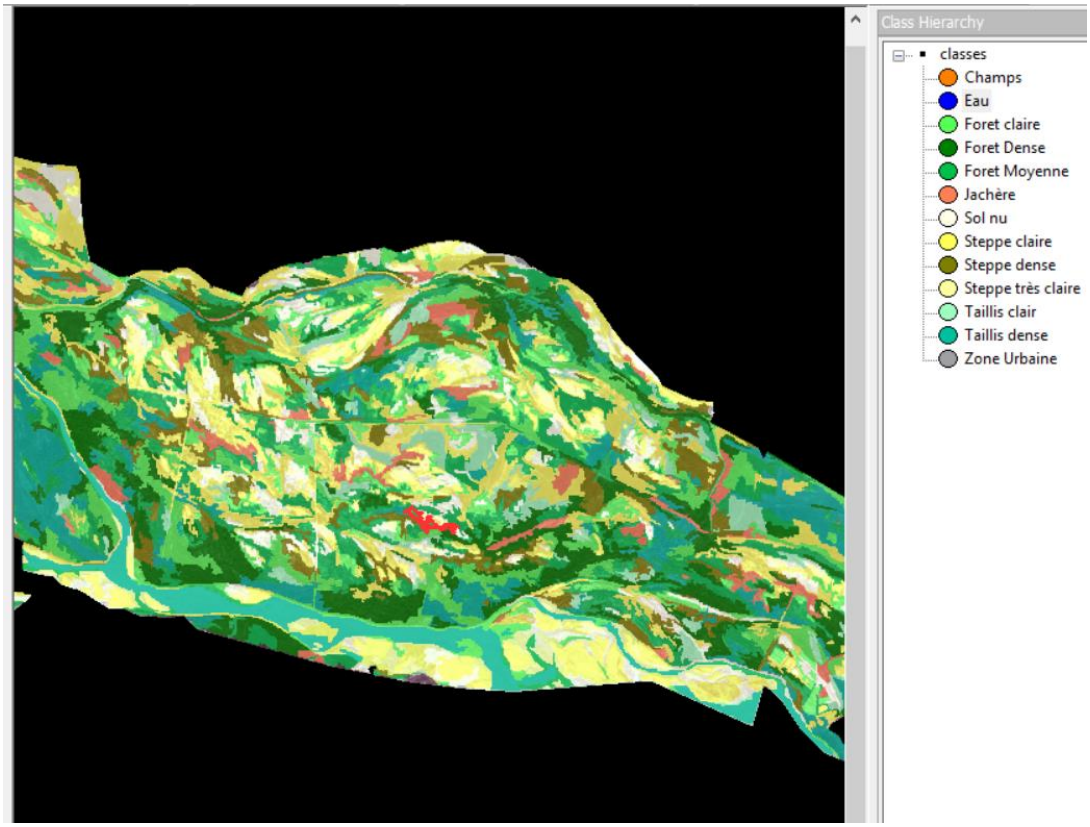
4.12 GPS survey campaign to check the limits of the LABR

Regarding the boundaries of the LABR, and in particular the Core Zone, we used the data provided by the Succow Foundation (see Map 1, page 5). However, for some reason we do not know, these limits seem imprecise and imperfectly follow the natural limits observed on satellite images. These limits should therefore be checked by a GPS survey campaign with the rangers of the LABR. This work could be an opportunity to review the boundaries between areas (Core, Buffer and Transition) and to include certain areas, to ensure better ecological continuity between the two major parts of the LABR.

4. Mapping performed

A provisional map (Draft-map) has been created based on the processing of Sentinel 2 European free images at 10m spatial resolution, with 13 types of land occupation (See Tab. and Map 1 below, and Annex 1).

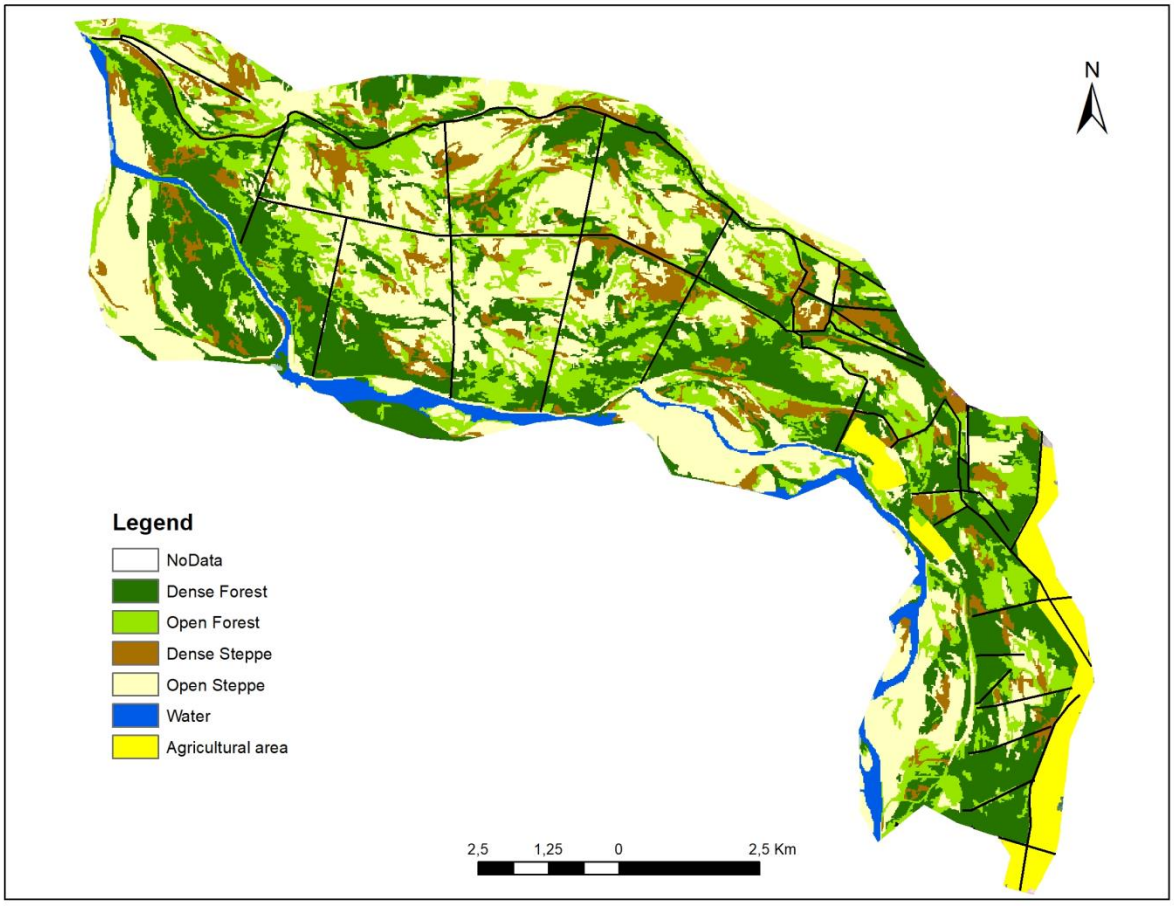
Codes of land occupation	Types of land occupation
DF	Dense forest
FF	Forest
OF	Open forest
DC	Dense coppice
OC	Open coppice
DS	Dense steppe
OS	Open steppe
VS	Very open steppe
FA	Fallow
AG	Agriculture
BS	Bare soil
RO	Rock
WA	Water



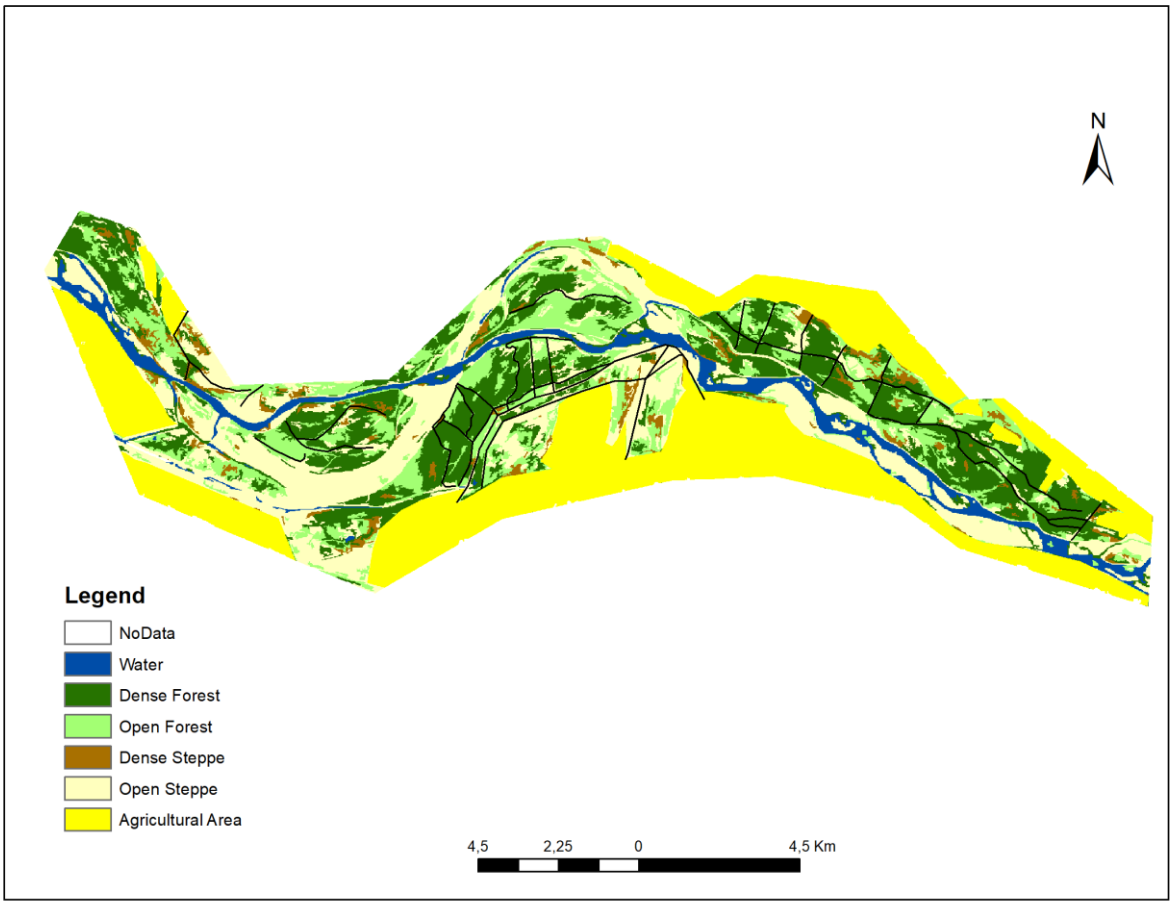
Map 2: First draft map of LABR Southeast area, produced by interpretation of Sentinel 2 European free images at 10m spatial resolution, with 13 types of land occupation (J. Betbeder, 16/11/2018).

However, this map seemed too complicated to use and with too many errors of interpretation. That's why this work has been improved, to limit confusion. It has been necessary to group together certain types of land occupation that are not distinguishable by remote sensing, at 10m spatial resolution. Dense Forest, Forest and Dense Coppice have been grouped into Dense Forest; Open Forest and Open Coppice have been grouped into Open Forest; Open Steppe, Very Open Steppe, Bare Soil, Rock and Fallow have been grouped into “Open Steppe”, this type also includes the river's major bed, consisting of alluvial beaches, often covered by grasses.

Maps 3 and 4, which represent the two parts of the LABR (Core Zones), are shown below. It should be remembered that the limits of these zones, taken from Map 1, do not seem very precise and include agricultural areas.



Map 3: Draft map of LABR Southeast area, produced by interpretation of Sentinel 2 European free images at 10m spatial resolution, with 6 types of land occupation (J. Betbeder, 28/02/2019).



Map 4: Draft map of LABR Northwest area, produced by interpretation of Sentinel 2 European free images at 10m spatial resolution, with 6 types of land occupation (J. Betbeder, 28/02/2019).

The GIS data processing will make it possible to make an initial assessment of the surfaces of the different types of land occupation.

Land occupation		Southeast zone	Northwest zone	Total
Codes	Types of land occupation			
DF	Dense forest	3124,86	3569,23	6694,09
OF	Open forest	2207,67	2536,89	4744,56
DS	Dense steppe	960,813	520,044	1480,857
OS	Open steppe	3407,29	4002,05	7409,34
WA	Water	344,779	919,432	1264,211
AG	Agriculture	451,164	5220,99	5672,154
	Total area	10496,576	16768,636	27265,212

Table I: Surfaces (in ha) of the different types of land occupation, in the draft maps studied area.

The statistics concerning the classification of types of land use are given in Annex 3. They show that the reliability of this classification is acceptable for a provisional map.

These maps will be improved in close future by the CIRAD team, thanks to the processing of Spot 6/7 images at 1,5m spatial resolution, purchased by the project.

6. Annex 1: Photos of the types of land occupation selected to make the first draft-map of the LABR

a) Poplar Dense Forest, trees cover ≥ 60%, **Code DF**

b) Poplar Forest, 60% ≥ trees cover ≥ 40%, **Code FF**

c) Poplar Open Forest, 40% ≥ trees cover **Code OF**

d) Poplar and some other trees Dense Coppice, trees cover ≥ 50%, **Code DC**

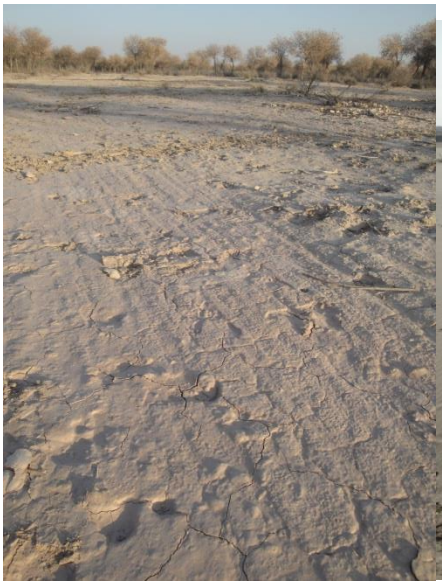
e) Poplar and some other trees Open Coppice, 50% ≥ trees cover, **Code OC**

f) Dense Steppe, trees, shrubs and grass cover ≥ 60%, **Code DS**

g) Open Steppe, 60% ≥ trees, shrubs and grass cover ≥ 30%, **Code OS**

h) Very Open Steppe, 30% ≥ trees, shrubs and grass cover, **Code VS**

i) Bare Soil **Code BS**



j) Agriculture Fields or very young fallow **Code AG**

i) Old Fallow with shrubs and perennial grass **Code FA**

k) Rocks and mountains **Code RO**

l) River and water **Code WA**

7. Annex 2: List of plant species observed on the points during the mission on November 6-16 at LABR (Natalya Marmazinskaya)

a. **Fam. Poaceae**

Erianthus ravennae (herbaceous)

Calamagrostis dubia (herbaceous)

Phragmites australis (herbaceous)

Aeluropus litoralis (herbaceous)

b. Fam. Salicaceae

- Salix wilchelmsiana (tree)
- Salix songarica (tree)
- Populus pruinosa (tree)
- Populus ariana (tree)

c. Fam. Chenopodiaceae

- *Halostachys caspica (synonym Halostachys belangerianum) (shrub)*

d. Fam. Ranunculaceae

- Clematis orientalis *(shrub)*

e. Fam. Fabaceae

- *Halimodendron halodendron (shrub)*
- *Glycyrrhiza glabra (herbaceous)*
- *Alhagi paeudalhagi (herbaceous)*

f. Fam. Zygophyllaceae

- *Peganum harmala (perennial herb)*
- *Zygophyllum oxianum (perennial shrub*

g. Fam Malvaceae

- *Gossypium hirsutum (cotton)*

h. Fam. Tamaricaceae

- *Tamarix pentandra (shrub)*
- *Tamarix hispida (shrub)*

6.8 Fam. Elaeagnaceae

- *Elaeagnus turcomanica (tree)*

6.9 Fam. Apiaceae

- *Ferula assa-foetida*

6.10 Fam. Limoniacaeae

- *Limonium otolepis (shrub)*

6.11 Fam. Apocynaceae

- *Trachomitum scabrum (synonym Apocinum scabrum) (shrub)*

6.12 Fam. Solanaceae

- *Lycium ruthenicum (shrub)*

6.13 Fam. Asteraceae

- *Karelinia caspica (perennial herb)*

A family of wild boars, a doe and a deer in a stand of *Phragmites australis*, are represented in an Assyrian bas-relief from the 8th century BC (British Museum). Such ecosystems, which are very similar to those of LABR, have become very rare in Central Asia and deserve protection.

8. Annex 3: Statistics on the classification of land use types

South-East zone	Classification							
		Dense Forest	**Open Forest**	**Dense Steppe**	**Open Steppe**	**Water**	**TOTAL**	**PRECISION**
Field	**Dense Forest**	20	3	0	0	0	23	0,86956522
	Open Forest	6	4	0	2	0	12	0,33333333
	Dense Steppe	0	1	3	0	0	4	0,75
	Open Steppe	0	2	0	9	0	11	0,81818182
	Water	1	0	0	0	5	6	0,83333333
	TOTAL	27	10	3	11	5	41	
	PRECISION	0,74074074	0,4	1	0,81818182	1		
		Po	0,732142857					
		Pc	0,537775134					
		Overall Accuracy	0,732142857					
		Kappa Index	0,420504688					

North-West zone		Classification						
		Dense Forest	**Open Forest**	**Dense Steppe**	**Open Steppe**	**Water**	**TOTAL**	**PRECISION**
Field	**Dense Forest**	17	4	0	2	0	23	0,73913043
	Open Forest	1	9	2	0	0	12	0,75
	Dense Steppe	1	0	2	2	0	5	0,4
	Open Steppe	1	0	0	7	0	8	0,875
	Water	0	0	0	1	8	9	0,88888889
	TOTAL	20	13	4	12	8	43	
	PRECISION	0,85	0,692307692	0	0,58333333	1		
		Po	0,754385965					
		Pc	0,434829638					
		Overall Accuracy	0,754385965					
		Kappa Index	0,565415932					