Bujagali Project: Monitoring & Evaluation Plan for Critical Habitat-qualifying biodiversity

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1 Introduction

This report provides the Monitoring and Evaluation Plan (M&E Plan) for Critical Habitat-qualifying biodiversity of the Bujagali Hydropower Project (HPP) ('the Project').

The Project is located on the Upper Victoria Nile, Uganda, a stretch of the River Nile that connects Lakes Victoria and Kyoga, approximately 8 km north west of the town of Jinja. The 250 MW run-of-river Project has been operational since 2012. The Project's Operational Area of Influence (OAoI) extends upstream to the tailrace areas of the Nalubaale and Kiira hydropower facilities at Jinja (8 km upstream of the Project dam) and downstream to the top of the reservoir of Isimba HPP[1] (c. 17.5km downstream of the Project dam) (Figure 1).

The Project has undertaken a number of aquatic surveys prior to construction, during construction and post construction[2]. The Project's Environmental Mitigation and Monitoring Plan (EMMP, Bujagali Energy Limited 2007) has formed a basis for bi-annual aquatic monitoring since it was written in 2010. Monitoring activities related to aquatic biodiversity are undertaken by the National Fisheries Resource Research Institute (NaFIRRI) and a brief summary can be found in Appendix 1. The EMMP was developed to fulfil the monitoring requirements of the Social and Environmental Assessment (SEA, Burnside International Ltd 2006) and associated documentation. At the time of the SEA, the Project was not considered to be operating in an area of Critical Habitat (SEA, Burnside International Ltd 2006).

As part of Project re-financing in 2018, a Critical Habitat Assessment (CHA) was undertaken according to the updated Performance Standard 6 (PS6; IFC 2012a) and associated Guidance Note (GN6; IFC 2012b) that focus on the protection and conservation of biodiversity and ecosystem services. Applying the revised PS6 criteria, it was concluded that the Project is operating within Critical Habitat (TBC 2018a). In total, forty Critical Habitat-qualifying species were identified; many of these species are from the group of fishes known as haplochromines. To align with PS6, the Project is required to demonstrate that operational activities will not lead to measurable adverse impacts on Critical Habitat-qualifying biodiversity or to a net reduction of Critically Endangered (CR) and/or Endangered (EN) species. A Biodiversity Action Plan (BAP) summarises existing mitigation measures and Additional Conservation Actions (ACAs) within Project control that will contribute towards Net Gain for Critical Habitat-qualifying biodiversity (TBC 2018b).

This M&E Plan sets out the framework, indicators and approaches the Project will use to track changes to Critical Habitat-qualifying biodiversity and evaluate whether the requirements of the ESAP and PS6 have been fulfilled (TBC 2018b).

[1] The top of the Isimba reservoir is not yet known as the HPP is not yet operational, so the Isimba OAoI has been estimated based on information provided by BEL and NaFIRRI.

[2] Specifically, two baseline surveys before construction, 8 monitoring surveys during construction (between 2006 and 2012), and a bi-annual monitoring surveys following the EMMP since 2012 to present.

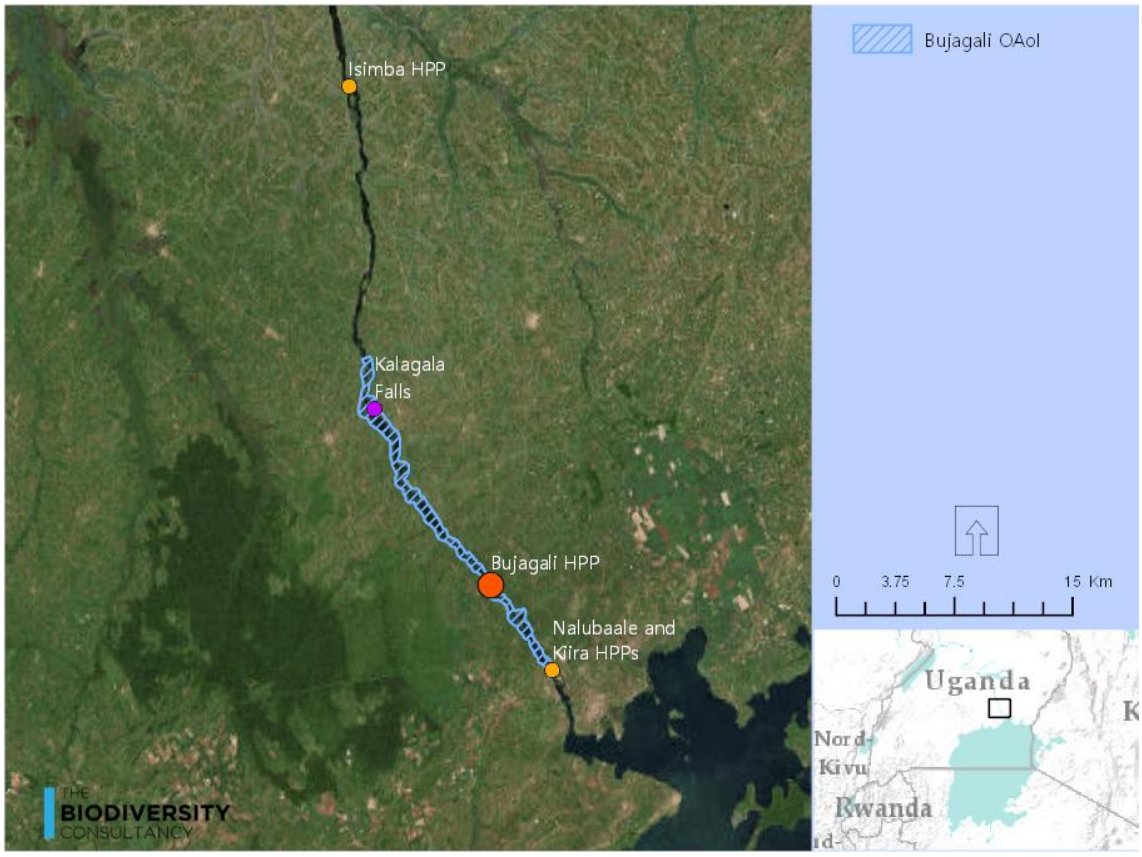

Figure 1: Operational Area of Influence (OAoI) of the Bujagali Project

2 Objectives

This M&E Plan focuses on Critical Habitat-qualifying biodiversity and does not modify the existing EMMP (Bujagali Energy Limited 2007). It provides an overarching framework to track changes to key parameters of aquatic habitat that may affect Critical Habitat-qualifying species and defines additional indicators and methods to target and evaluate changes to Critical Habitat-qualifying species.

This M&E Plan has the following objectives:

- Define an appropriate monitoring framework to enable the Project to track any changes from the on-going operational phase of the Project[3] to Critical Habitat-qualifying biodiversity that would result in a decline in habitat quality and/or loss of populations and adaptively manage its mitigation actions;
- Ensure the fish monitoring methods appropriately sample Critical Habitat-qualifying species;

[3] As agreed with the IFC, all past impacts were assessed through the original Environmental and Social Impact Assessment (ESIA) and are considered to have been addressed by the management actions implemented by the Project (see the Environmental and Social Review Summary (ESRS) on the IFC website: https://disclosures.ifc.org/#/projectDetail/ESRS/24408). The focus of the M&E Plan is therefore potential changes occurring due to the on-going operational phase.

- Ensure appropriate indicators and methods are in place to track changes in the distribution and presence of Critical Habitat-qualifying species and key threats to aquatic habitat;
- Define thresholds for key indicators to determine when adaptive management of mitigation actions is appropriate/necessary (or establish the activities required to define the thresholds).

The data collected through the M&E program will enable a better understanding of the presence, distribution and ecology of all Critical Habitat-qualifying species, and in particular the 25 species that are currently undescribed. The fish specimens (and fin clips) collected will be used in the description of the currently undescribed species if enough information and samples are collected to enable this process (See Additional Conservation Action 1 (ACA1) in the TBC 2018b).

2.1 Scope

2.1.1 Species and habitat

The CHA (TBC 2018a) was based on data gathered by NaFIRRI along the Upper Victoria Nile River during surveys undertaken between 2000 and 2017. The CHA identified a total of forty (40) species that qualify for Critical Habitat (TBC 2018a), most of these species (35) are haplochromine fish (see Section 3). All Critical Habitat-qualifying species are within the scope of this M&E Plan. The National Fisheries Resources Research Institute (NaFIRRI) identified that species such as *Mormyrus kannume*, *Enteromius paludinosus* and *Labeobarbus altianalis* are declining in the OAoI and elsewhere as well. Although these species do not qualify for Critical Habitat they are also captured by this M&E Plan (and by the EMMP).

The CHA also identified sections of the river that are Natural Habitat and sections of the river that are Modified Habitat (see Figure 2 and TBC 2018a for further detail). NaFIRRI monitoring has recorded Critical Habitat-qualifying species in both Natural Habitat sections and Modified Habitat sections of the river. This means that all sections of the river in the OAoI, whether Natural Habitat or Modified Habitat, are Critical Habitat and therefore within the scope of this monitoring plan, and are simply referred to as 'aquatic habitat'. The geographic scope of Critical Habitat for the M&E Plan is defined in Section 2.1.3 below.

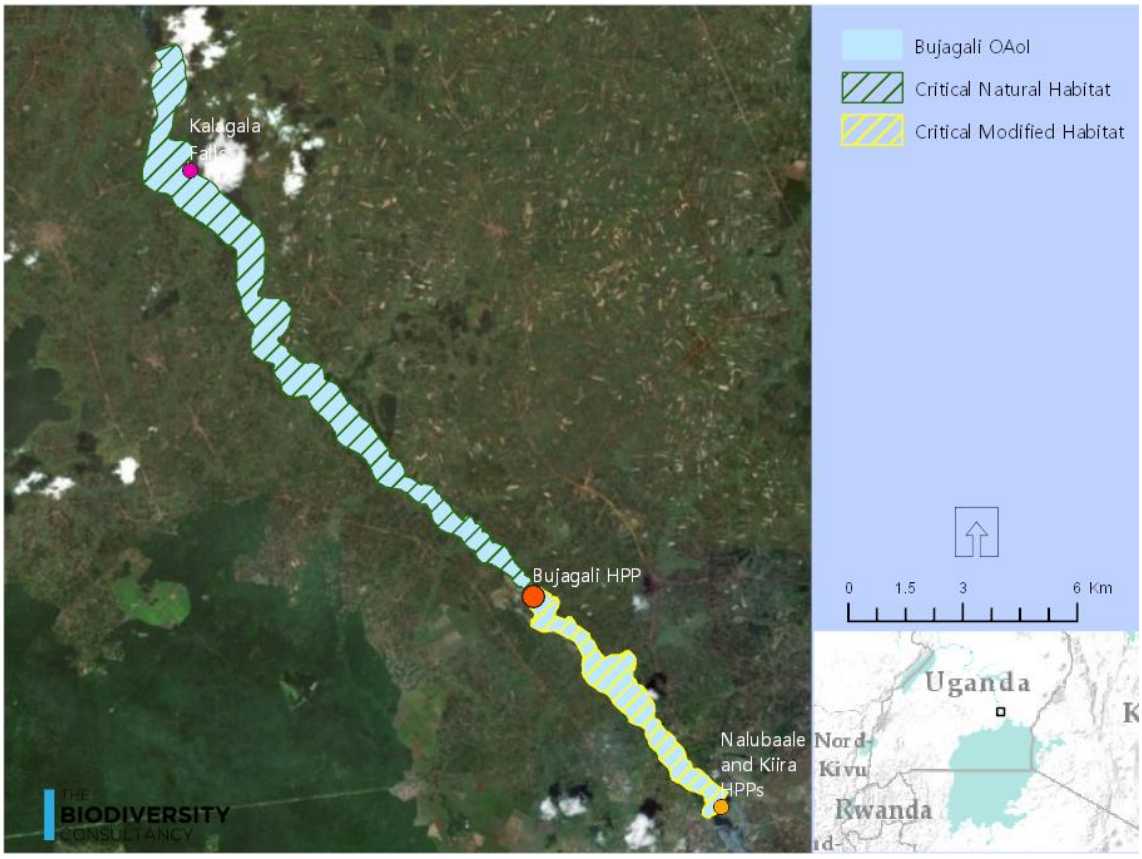

Figure 2: Critical Natural Habitat and Critical Modified Habitat identified in the CHA

2.1.2 Monitoring timeline

M&E activities should be undertaken for the operational life of the Project[4]. The frequency of monitoring events may change over the operational life, but should be informed by periodic evaluation of the data collected (see Section 5). The first monitoring events using this updated M&E Plan (i.e., the next 2 years: 2019-2020) are considered to be the 'pilot phase' for this M&E Plan and will provide the baseline against which future monitoring events will be compared. After the pilot phase, indicators and methods will be reviewed and evaluated and where appropriate adapted.

2.1.3 Geographic scope

The M&E Plan is designed to support an understanding of change in aquatic habitat quality and Critical Habitat-qualifying species within the OAoI of the Project. The OAoI is defined as the section of the river over which the Project exerts some level of control over water flow[5].

Within the OAoI, monitoring activities will be undertaken at key locations that represent important habitats for Critical Habitat-qualifying species. Details are provided in Appendix 3.

[4] Monitoring would also be required during the decommissioning phase of an HPP Project but the scope of this M&E Plan is just the operational phase

[5] Further justification for the OAoI is provided in the Project's Biodiversity Action Plan (TBC 2018b)

2.2 M&E Plan roles and responsibilities

- The General Manager of Bujagali Energy Limited (BEL) has overall responsibility and oversight of the implementation of this M&E Plan.
- Day-to-day management of the Plan is the responsibility of BEL's Environmental and Social (E&S) Consultant.
- BEL will subcontract a third party (NaFIRRI) to undertake the monitoring work as per the requirements of the M&E Plan. BEL will update NaFIRRI's scope of work to include the indicators identified in the M&E Plan and to adjust NaFIRRI's reporting requirements to fulfil the requirements of the M&E Plan.

2.3 Integration with other monitoring work

This M&E Plan does not change the monitoring currently undertaken by NaFIRRI; it adds to it by detailing additional monitoring for Critical Habitat-qualifying species and bringing together the information gathered by NaFIRRI into a comprehensive reporting and evaluation plan. The overlaps with ongoing monitoring are highlighted (see Appendix 3). However, the Project may decide in the future to review the EMMP to assess whether: 1. The full scope of indicators remain relevant to monitor, and 2. Six-monthly monitoring provides significant additional data or whether annual monitoring is appropriate.

3 Priority biodiversity

As mentioned, the CHA (TBC 2018a) concluded that 40 species qualify for Critical Habitat, and most of these species (35) are haplochromine cichlid fishes. Of these 35 species, 25 are currently undescribed. Amongst the forty Critical Habitat-qualifying species there is variability in terms of ecology, threat level and level of scientific understanding. This means the Project response for management and monitoring of risk for these species is also variable.

A prioritisation process was undertaken based on the sensitivity of each species to HPP impacts and the potential consequence of any HPP impact to that species (TBC 2018c). The results are summarised in Table 1. The species classed as highest priority for monitoring and management (Action Category 1) are riverine species[6] that are only likely to be present in the Upper Victoria Nile. Some of these species are known to still be present in the OAoI, others have not been recorded recently. Lack of recent records does not necessarily mean the species is absent, it may also be due to the fact that the species is rare, and as the EMMP monitoring approach did not focus on haplochromine species. Details on when the species was last recorded by NaFIRRI can be found in the species prioritisation report (TBC 2018b). The M&E sampling design includes sections of the river with a variety of micro-habitat types likely to ensure that all habitat types that are likely to support Critical Habitat-qualifying species are included. Specifically, the M&E Plan targets fast-flowing sections of the river as fast-flowing sections are likely to be the

[6] Species that are only found in a river habitat and are not found in lakes

preferred habitat for Action Category 1 species. Fast-flowing sections of the river have not been a focus for EMMP monitoring.

Table 1: Results of the species prioritisation exercise; the references in the Mitigation and monitoring approach column are all found in the Projects BAP (TBC 2018b)

Priority level and monitoring action	Definition	Species list	Mitigation and monitoring approach
1. Endemic to the Upper Victoria Nile: targeted monitoring and management	**Riverine species** only likely to be present in the Upper Victoria Nile	**Recently recorded (8 species)**: 1. *Haplochromis simotes,* 2. *Astatotilapia* "flameback", 3. *Astatotilapia* "blue", 4. *Haplochromis* "silver arrow", 5. *Neochromis* "yellow rufocaudalis", 6. *Neochromis* sp. Labeo new, 7. *Paralabidochromis* sp. "red breast new", 8. *Pundamilia* "scarlet anal" **Not recently recorded (3 species)**: 1. *Haplochromis niloticus,* 2. *Neochromis* "red simotes", 3. *Haplochromis* "cylindrical"	• Continue to implement operational mitigation measures (Section 4.1) • Implement targeted Additional Conservation Actions (Section 4.2: ACA1, ACA2) • Implemented targeted monitoring in fast flowing sections of the river with (TBC2018b)
2. Poorly known species: monitor to understand risk	**Riverine species** recorded in the Project area but maybe present in lakes – surveys required to understand risk **Predominantly lacustrine species** recorded in the Project area and believed to be at risk elsewhere in their range or have may have a narrow range – verification of distribution required to understand risk	**Riverine species (7 species):** 1. *Astatotilapia* "red tail", *2. Astatotilapia* "scarlet anal", 3. *Haplochromis* sp. cf. "red back scraper", 4. *Paralabidochromis* sp 1, 5. *Paralabidochromis* sp "Nile", 6. *Pundamilia* sp. "blue lip", 7. *Neochromis* "lemon britti" **Lacustrine species (13 species):** 1. *Haplochromis aelocephalus,* 2. *Haplochromis brownae,* 3. *Haplochromis crassilabris,* 4. *Haplochromis guiarti,* 5. *Haplochromis microdon,* 6. *Haplochromis parvidens,* 7. *Astatotilapia* "elongate", 8. *Haplochromis* sp. "thick skin like", 9. *Lithochromis* sp, 10. *Neochromis* "elongate", 11. *Paralabidochromis* "scarlet anal", 12. *Paralabidochromis* "yellow", 13. *Ceratophallus concavus* (Gastropod)	• Continue to implement operational mitigation measures (Section 4.1) • Implement targeted Additional Conservation Actions (Section 4.2: ACA1, ACA2) • Continue EMMP monitoring and implement additional targeted monitoring (TBC 2018b)
3. Lacustrine species but river maybe an important refuge: monitor for ongoing presence	**Predominantly lacustrine species** not recently recorded in the Project area but known from multiple other lake and river locations	**Lacustrine species (4 species):** 1. *Labeo victorianus,* 2. *Brycinus jacksonii,* 3. *Mbipia* "blue", 4. *Xystichromis* "earthquake"	• Continue EMMP monitoring; report findings on presence and distribution of these species
4. Lacustrine species with widespread distribution: monitor for ongoing presence	**Predominantly lacustrine species** recorded in the Project area and known from multiple other lake locations	**Lacustrine species (5 species):** 1. *Oreochromis variabilis,* 2. *Xystichromis* sp. nov. "Kyoga flameback", 3. *Haplochromis orthostoma,* 4. *Haplochromis* sp. "flameback", 5. *Sphaerium regularis* (Bivalve)	• Continue EMMP monitoring; report findings on presence and distribution of these species

3.1 Monitoring framework

Standard monitoring practice (e.g., OECD 2003) is to use a "Pressure - State – Response" framework (Figure 3) to assess the effectiveness of biodiversity management actions. The framework is composed of indicators, which are measures that enable the Project to track progress towards the biodiversity goals, i.e. the achievement of Net Gain for Critical Habitat and No Net Loss for Natural Habitat.

The three indicator types used are:

1. **State** - state indicators refer to the *population* and *distribution* of species, such as the presence/absence of a haplochromine species in the monitoring locations. State indicators are the most fundamental as they are most closely linked to the Project biodiversity goals. However, significant impacts on biodiversity can take a long time to become measurable and are subject to external influences beyond the control of the Project (e.g. climate). It is thus also important to assess pressure and response indicators since they can usually be assessed more easily.
2. **Pressure** - pressure indicators identify and track the major *threats* to biodiversity that the Project may or not affect; for example, water quality, water flow rates or fishing rates. Pressure indicators are particularly important as they are simpler to measure and often respond more rapidly than state indicators when the responses are adapted. Monitoring pressure can often be done more precisely and can, therefore, provide more timely information to inform the adaptive management.
3. **Response** - response indicators identify and track management *actions*: for example, the development and implementation of Conservation Agreements to limit the size of fishing gear used. Response indicators are usually the easiest to measure, as they track the management actions undertaken by the Project. However, their success is not always linked to the achievement of the objectives.

An effective monitoring programme is, therefore, a pragmatic mix of response, pressure and state indicators. Response indicators to track whether mitigation actions ('responses') have been implemented, pressure indicators to give a timely indication of whether mitigation actions are having an effect, and state indicators to track the condition of priority biodiversity, which requires the highest level of assurance that mitigation actions are having the intended outcomes.

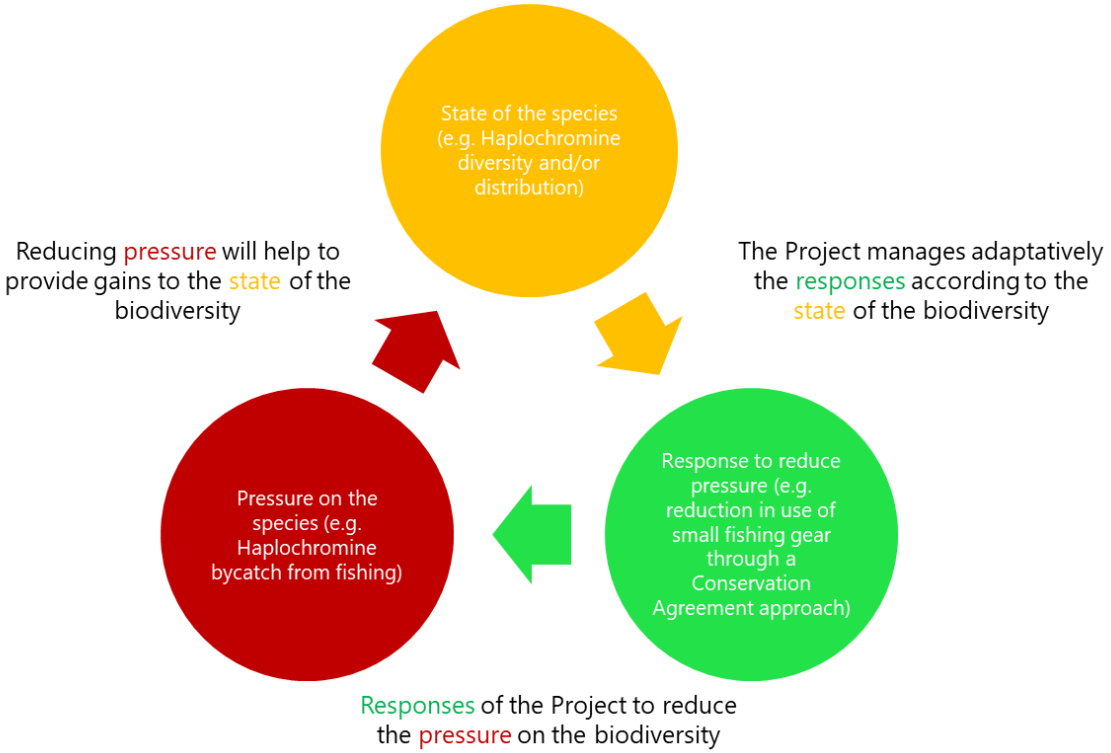

Figure 3: Concept of the State-Pressure-Response Framework

3.2 Thresholds and adaptive management

Monitoring requires *thresholds* for pressure and state indicators. Thresholds are agreed values of indicators designed to signal to the Project that progress towards biodiversity goals may be deviating from expected levels (Figure 4).

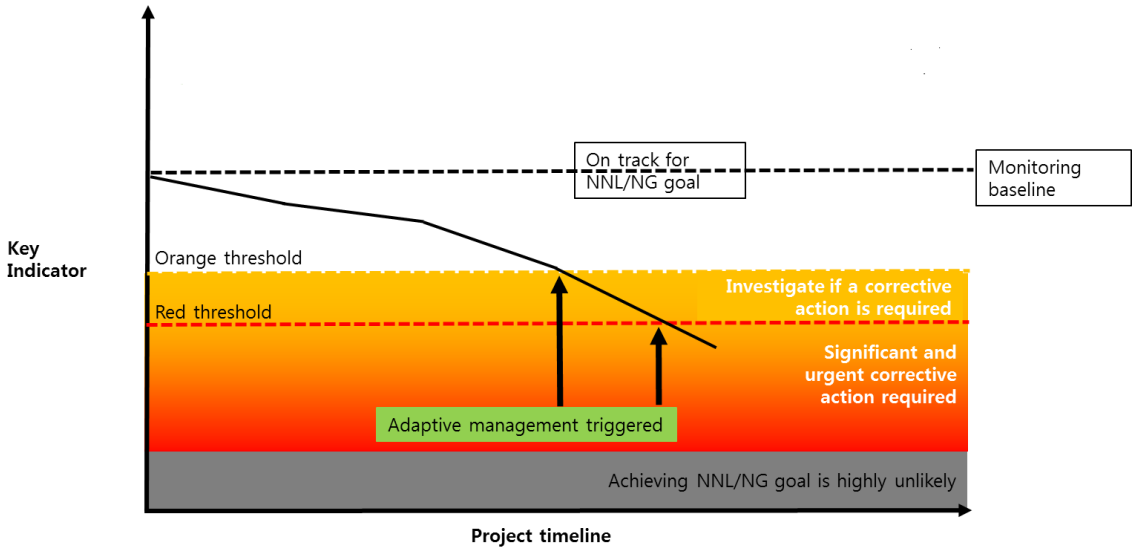

Figure 4: Concept of Indicator thresholds and adaptive management

Adaptive management actions are triggered when a threshold is crossed, enabling the Project to quickly respond to negative changes and implement solutions. Two threshold levels are ideally required: orange and red.

- Breaching the ***orange threshold*** is a warning to the Project that mitigation activities may not be working. Triggering the orange threshold should lead to a review of mitigation and monitoring efforts to understand the nature of the problem, and if necessary research or adapt the type or intensity of mitigation actions.
- Triggering the ***red threshold*** is an urgent warning to the Project that efforts to achieve biodiversity goals may be significantly awry. Remedial and/or different mitigation actions are likely to be immediately required.

The identification of threshold values can be difficult as it requires a high level of understanding of the degree of natural variation in the features being monitored. Hence, the development of thresholds is an iterative process that will be refined over time based on monitoring results.

3.3 Criteria used to select the indicators, the measures and the methods

Robust M&E indicators have the following characteristics – they are:

- Measurable – feasibly measurable to an appropriate degree of precision within a time period relevant for management;
- Precisely defined – understood in the same way by different people;
- Sensitive – changing in a known manner in response to actual changes in the condition or extent/population of the feature being measured;
- Consistent - not changing over time so that measurements are comparable.

In reality, there is frequently a trade-off between these characteristics, especially the feasible degree of precision that can be obtained and the sensitivity or consistency of the indicator.

4 Monitoring plan

4.1 Sampling locations

During the pilot phase of the implementation of this plan, state indicators will be sampled at the locations outlined in Table 2 and shown in Figure 5. At each location, several stations will be selected to conduct the sampling to cover the different types of micro-habitat that are present and important for priority haplochromine species. After the pilot phase, the number of locations should be reviewed based on the data collected to assess whether all are required, particularly whether the 'mid'-reservoir location and Kalange location yield significantly different diversity of Critical Habitat-qualifying species, given their similar locations within slower moving waters of the reservoir.

Table 2: Sampling locations (from the top of the reservoir to below the Project dam)

Location name	Location with respect to Project	Key characteristics	Notes
Lower Nava	Top of the Bujagali reservoir	Rocky habitat and faster-flowing water	Only sample sections of the river where species requiring fast-flowing water might be recorded
Kalange	Within the reservoir	Various substrates are found here (sandy, muddy, rocky) in slow-moving water	One of NaFiRRI's bi-annual monitoring locations
'Mid'-reservoir	Within the reservoir	Various substrates are found here (sandy, muddy, rocky) in slow-moving water	One of NaFiRRI's bi-annual monitoring locations
Buyala	c. 1.5 km downstream of the dam	Various substrates are found here (sandy, muddy, rocky) and different rates of water flow	One of NaFiRRI's bi-annual monitoring locations
Busowoko	c. 7.5 km downstream of the dam	Rocky habitat and faster-flowing water	Located within the newly defined Kalagala Offset Area (KOA)[7]. Only sample sections of the river where species requiring fast-flowing water might be recorded

[7] It is anticipated that information gathered at this sampling location can be shared with the authorities to support the management of the area (TBC 2018b).

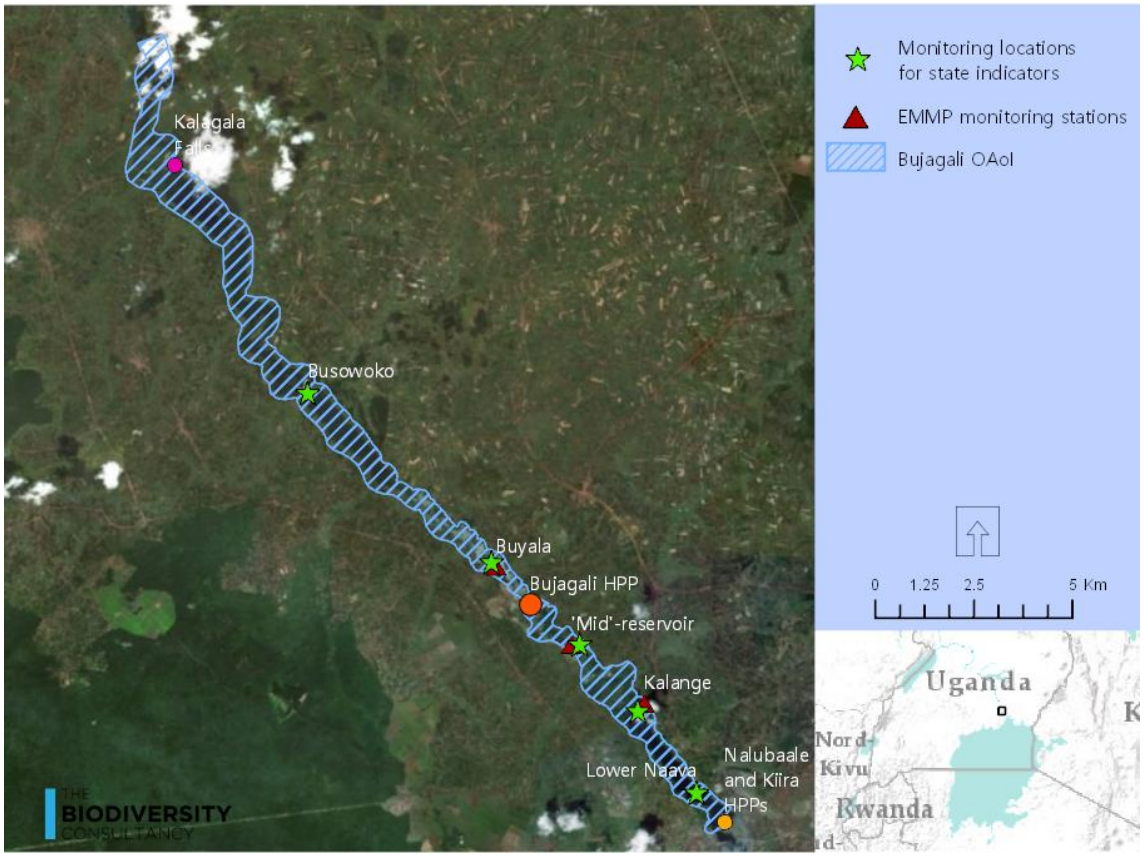

Figure 5: Monitoring locations for state indicators during the pilot phase and EMMP monitoring locations

4.2 Indicators

The indicators and their attributes were selected through discussions (including a workshop) between NaFIRRI, BEL, and TBC.

Table 3 presents a summary of the indicators that were selected (based on see Figure 8 in Appendix 2). The Project will focus on implementing management actions to address priority threats over which the Project can exert some degree of control. Threats that are outside Project ability to affect any change will only be monitored to detect background change and will not be addressed through Project actions.

State indicators were identified as the presence/absence and the abundance of Critical Habitat-qualifying species at each monitoring location, and the length of Natural Habitat within the OAoI.

Pressure indicators were identified as the key characteristics of the Upper Victoria Nile River system affecting aquatic habitat and haplochromine species (Figure 8 in Appendix 2).

Response indicators were identified as the actions the Project undertakes to reduce key pressures on haplochromine species.

The detailed method (protocols), and responsible parties for each indicator outlined in Table 4 can be found in Appendix 3.

Table 3: State-Pressure-Response indicator framework

<table>
<tr><th colspan="2">State</th><th colspan="2">Pressure</th><th colspan="2">Response</th></tr>
<tr><th>Indicator</th><th>Measure</th><th>Indicator</th><th>Measure</th><th>Indicator</th><th>Measure</th></tr>
<tr><td rowspan="3">1. Diversity of Critical Habitat-qualifying species (species richness and abundance)</td><td rowspan="3">1. Critical Habitat-qualifying species recorded at each sampling location[8]

2. Number of Critical Habitat-qualifying individuals recorded at each sampling location (irrespective of species) per unit effort (CPUE)</td><td>3. Bycatch during fishing</td><td>Proportion of haplochromines in landed catch (per total biomass of fish catch and fishing effort)</td><td rowspan="4">8. Establishment of voluntary mechanisms (ACA2, TBC 2018b)

9. Implementation of voluntary mechanisms (ACA2, TBC 2018b)</td><td>No. of Conservation Agreements in place with Beach Management Authorities in the reservoir and immediately downstream of the HPP</td></tr>
<tr><td>4. Fishing for bait</td><td>Proportion of haplochromines in live catch (per total biomass of live catch and fishing effort)</td></tr>
<tr><td>5. Predation by Nile Perch</td><td>1. Abundance of Nile Perch in each sampling location
2. Proportion of haplochromines in Nile perch diet</td><td>1. Frequency of prohibited[9] fishing tackle encountered during control checks</td></tr>
<tr><td rowspan="2">2. Extent of Natural Habitat</td><td rowspan="2">Number of rapids in the OAoI</td><td>6. Water quality</td><td>Suspended solids water transparency, P, N, pH, dissolved O_2, phytoplankton, zooplankton, and macro-invertebrate abundance</td><td rowspan="2">2. % of fishermen involved in Conservation Agreements reporting no change or positive livelihood outcome</td></tr>
<tr><td>7. Water release</td><td>Discharge rate (m^3/second) and frequency</td></tr>
</table>

[8] This measure should reflect the change in presence or absence of each Critical Habitat-qualifying species in each location compared to previous years and the baseline. It is not the overall number of Critical Habitat-qualifying species that is important as this does not reflect changes in diversity.

[9] Note: See BAP (TBC 2018b) for information on how the type and size of fishing gear that will be 'prohibited' will be determined.

Table 4: Indicator overview. Where mentioned in the threshold column, the baseline for threshold comparison will be based on 2019-2020 data

Indicator type	Indicator	Measure	Method	Threshold		Role/ responsibilities	Frequency	
				Alert (orange threshold)	Critical (red threshold)		Data collection	Evaluation
State	1. Diversity of Critical Habitat-qualifying species	1. Critical Habitat-qualifying species recorded at each sampling location	Fish collection using complementary techniques across sampling locations	Absence in two consecutive surveys	Absence in four consecutive surveys	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
		2. No. of Critical Habitat-qualifying individuals recorded in each station (irrespective of species) per unit effort (CPUE)	Fish collection using complementary techniques sampling locations	Decline by 20% from the baseline	Decline by 50% from the baseline	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
State	2. Extent of Natural Habitat	Number of rapids in the OAoI (Grades 1 to 5). (Rapids are used as a proxy for Natural Habitat)	Tracking of activities in the OAoI that will affect the number of rapids e.g. HPP developments, industry	Degradation of 1 rapid	Loss of 1 rapid	BEL and NaFIRRI	Ongoing	After each monitoring event

Indicator type	Indicator	Measure	Method	Threshold		Role/ responsibilities	Frequency	
				Alert (orange threshold)	Critical (red threshold)		Data collection	Evaluation
Pressure	3. Bycatch during fishing	Proportion of haplochromines in landed catch (per total biomass of fish catch and fishing effort)	Observation of fish catch at landing sites (Buyala, 'mid'-reservoir, Kalange only)	Presence of bycatch in fish landings	Bycatch higher than target species	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
Pressure	4. Fishing for bait	Proportion of haplochromines in live catch (per total biomass of live catch and fishing effort)	Observation of fish catch at landing sites (Buyala, 'mid'-reservoir, Kalange only)	10% of landed catches being live haplochromines	30% of landed catches being live haplochromines	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
Pressure	5. Predation by Nile Perch	1. Abundance of Nile Perch in sampling location	Nile perch collection in nets	<50% of catch in experimental nets composed of Nile perch	>90% of catch from experimental nets composed of Nile perch	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
		2. Proportion of haplochromines in Nile perch diet	Stomach content analysis	20% of Nile perch diet comprised of haplochromines	>90% of Nile perch diet comprised of haplochromines	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event

Indicator type	Indicator	Measure	Method	Threshold		Role/ responsibilities	Frequency	
				Alert (orange threshold)	Critical (red threshold)		Data collection	Evaluation
Pressure	6. Water quality	Suspended solids water transparency, P, N, pH, dissolved O_2, phytoplankton, zooplankton, and macro-invertebrate abundance	Water and sediment sampling	Parameters fluctuate with 50% of critical limits	DO <3 mg/L, PH<6 &>8, Temp<20°C&>35°C, TSS>100 mg/l, NH_4-N>10000 μg/L, NO_2-N>20,000 μg/L, TN>10,000, SRP>5000 µg/L; TP>10,000 µg/L	NaFIRRI to undertake the M&E	Every 6 months for the first 2 years, then evaluate	After each monitoring event
Pressure	7. Water release	Discharge rate (m^3/second) and frequency / Number of 'surge' events	BEL records			BEL to provide data to NaFIRRI for evaluation	Continuous	Every 6 months for the first 2 years then evaluate
Response	8. Establishment of voluntary mechanisms (ACA2, TBC 2018b)	No. of Conservation Agreements in place with Beach Management Authorities in the reservoir and immediately downstream of the HPP	BEL records	No progress towards Conservation Agreements by 2020		BEL to undertake the evaluation	Yearly	N/A

Indicator type	Indicator	Measure	Method	Threshold		Role/ responsibilities	Frequency	
				Alert (orange threshold)	Critical (red threshold)		Data collection	Evaluation
Response	9. Implementation of voluntary mechanisms	1. Frequency of prohibited fishing tackle encountered during control checks	NaFIRRI records	Increase recorded compared to baseline		BEL to undertake the evaluation	Yearly	After each monitoring event
		2. % of fishermen involved in Conservation Agreements reporting no change or positive livelihood outcome	BEL records			BEL to undertake the evaluation	Yearly	After each monitoring event

4.3 Data management

Monitoring data should be compiled into a comprehensive excel spreadsheet which one staff member within NaFIRRI is assigned responsibility to maintain and coordinate input, analysis and evaluation. A quality control and checking process should be put in place to ensure data is correctly entered. The spreadsheet should enable NaFIRRI to track results of each indicator and its evaluation against thresholds (i.e., interpretation of the results) over time.

Raw data, analysis and the report that evaluates the monitoring findings should be provided by NaFIRRI to BEL after each monitoring event (see 'Frequency' in Table 4). Both institutions will store the data as records and for the purpose of further evaluations. BEL is the owner of the data. NaFIRRI should seek consent from BEL prior to using the data for national reporting and for publications.

5 Evaluation and adaptive management

Evaluation of data is required after each monitoring event to assess change compared to the baseline[10] and to assess whether thresholds have been breached. If thresholds have been breached this may indicate that the Project may not be able to achieve the objectives of the Additional Conservation Actions (i.e. contribute towards achieving Net Gain for Critical Habitat-qualifying species). Specifically:

1. As part of the analysis of each monitoring event, NaFIRRI should compare the monitoring findings with baseline data and thresholds (where applicable) to assess if there has been a significant positive or negative change in the data.

2. If a threshold is triggered, BEL will assign an appropriate person (from NaFIRRI, BEL, or an external partner) to review the data and assess the cause of the problem. If a problem is defined and is within BEL's control, adaptive measures should be taken (e.g. additional reasonable mitigation measures). If the nature of the problem is beyond Project control, the issue may need to be shared and discussed with third parties and stakeholders (see the BAP, TBC 2018b) such as NEMA or other relevant authorities to evaluate an appropriate response.

Every five years, a periodic review and evaluation of the indicators and the related methods of the M&E plan should be undertaken to assess if they are still appropriate for the purpose of the monitoring. This review could either be undertaken by NaFIRRI or by an appropriate external partner.

6 Reporting of M&E results

A report should be provided after each monitoring event that summarises the results and evaluation of the data collection (see template in Appendix 4) with any recommendation for adaptive management if relevant.

Reports will be prepared by NaFIRRI and sent to BEL. BEL will then share the information as requested with NEMA, Project lenders, and at its discretion, any other relevant institutions (see BAP ACA5, TBC 2018b).

[10] The baseline for this M&E Plan will be created by the first 2 years of data collection during the pilot phase (Section 7)

7 Next steps

The next 2 years (2019 and 2020) are considered to be the 'pilot phase' for this M&E Plan, after which the plan, indicators and methods will be reviewed and evaluated and where appropriate adapted.

During the pilot phase, specific actions should be undertaken to support finalisation of the Plan (see Table 5 for details). During the pilot phase, data collection will be conducted twice a year, with the exception of pressure indicators related to water flow/release, which will be monitored continuously by BEL.

Table 5: Specific actions to implement during the pilot phase

Period	Activities
Q4 2018/Q1 2019	• Update NaFIRRI Scope of work and MoU to fulfil M&E Plan requirements • Agree on Role and Responsibilities for each indicator

2019	• Specific actions to finalize M&E approaches before the first round of data collection:
	  ◦ Check effectiveness of NaFIRRI equipment for sediment analysis[11]
	  ◦ Conduct gear selectivity analyses for different fish species that are consumed and/or commercialized using data collected from previous monitoring surveys to determine appropriate gear sizes that correspond to size at maturity for different fishes, so as to determine minimum mesh sizes that can be incorporated into Conservation Agreements with Beach Management Units to reduce fishing immature fishes (see BAP ACA2, TBC 2018b)
	  ◦ Identify if bycatch from Mukene fishing has a significant impact on haplochromines and should specifically be monitored and addressed in Conservation Agreements[12]
	• Undertake monitoring in April and September and prepare report
	• Perform a complete evaluation of all NaFIRRI monitoring events to date under the EMMP program of work to assess any significant changes through the last ten years and to identify if all recorded indicators are still relevant for the Project. This should be based on a statistical assessment of whether sampling effort is sufficient, conducted by a competent external independent statistician.
	• Specific actions to undertaken after 2019 monitoring events:
	  ◦ Check the preliminary indicator thresholds against data collected to ensure they are appropriate, adapt as necessary
	  ◦ Document data analysis protocols (statistical tests to use, etc.)

2020	• Undertake monitoring in April and September and prepare report • Specific actions to undertaken after 2020 monitoring events:

[11] During the workshop, it was noted that the sedimentation levels (based on data collected by NaFIRRI) are substantially smaller than NEMA thresholds. This might be due to a mistake in the units while reporting or a problem with NaFIRRI equipment for sediment analysis. This should be tested by taking a sample and conducting the analysis in a NaFIRRI laboratory as well as in an independent laboratory.

[12] Mukene fishing is undertaken with Lampala nets (5-10 mm, predominantly 5mm) and therefore has the potential to be a significant driver of haplochromine bycatch. The significance of haplochromine bycatch from Mukene fishing requires verification through investigation in beach areas and deep water where Mukene fishing is carried out. If significant haplochromine bycatch is detected this should be addressed in the Conservation Agreements and monitored by NaFIRRI.

	• Undertake a review of this M&E Plan and the data collected during the pilot phase to evaluate if the indicators and approaches are appropriate for informing adaptive management and the status of Critical Habitat-qualifying biodiversity. This should be based on a statistical assessment of whether sampling effort is sufficient. It should also include an assessment of whether bi-annual monitoring is required or if annual monitoring collects sufficient data to inform the monitoring objectives. Update indicators, methods and thresholds as appropriate following the review.

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Appendices

Appendix 1. NaFIRRI bi-annual monitoring under the EMMP; approach and data trends

NaFIRRI has been undertaking monitoring on behalf of the Project during pre-construction, construction and operational phases of the Project (Table 6, Figure 6). The monitoring was designed to collect data on the fish presence and abundance, fish catch and stock, water quality, sanitation and disease vectors and macro-invertebrates[13], following the requirements of the EMMP.

Table 6: Period and location of NaFIRRI monitoring

	Period	Sites
Pre-construction	2000 and 2006	4 sites (Kalange, Buyala, Kirindi, and Namasagali)
During construction	September 2007, September 2008, April and September 2009, April and September 2010, April and September 2011	2 sites (Kalange and Buyala)
Post-construction	Bi-annual (April and September)	3 sites (Kalange, 'mid'-reservoir, and Buyala)

[13] Findings on the 2 last points are not detailed in the report since there are not relevant for the purpose of the M&E plan

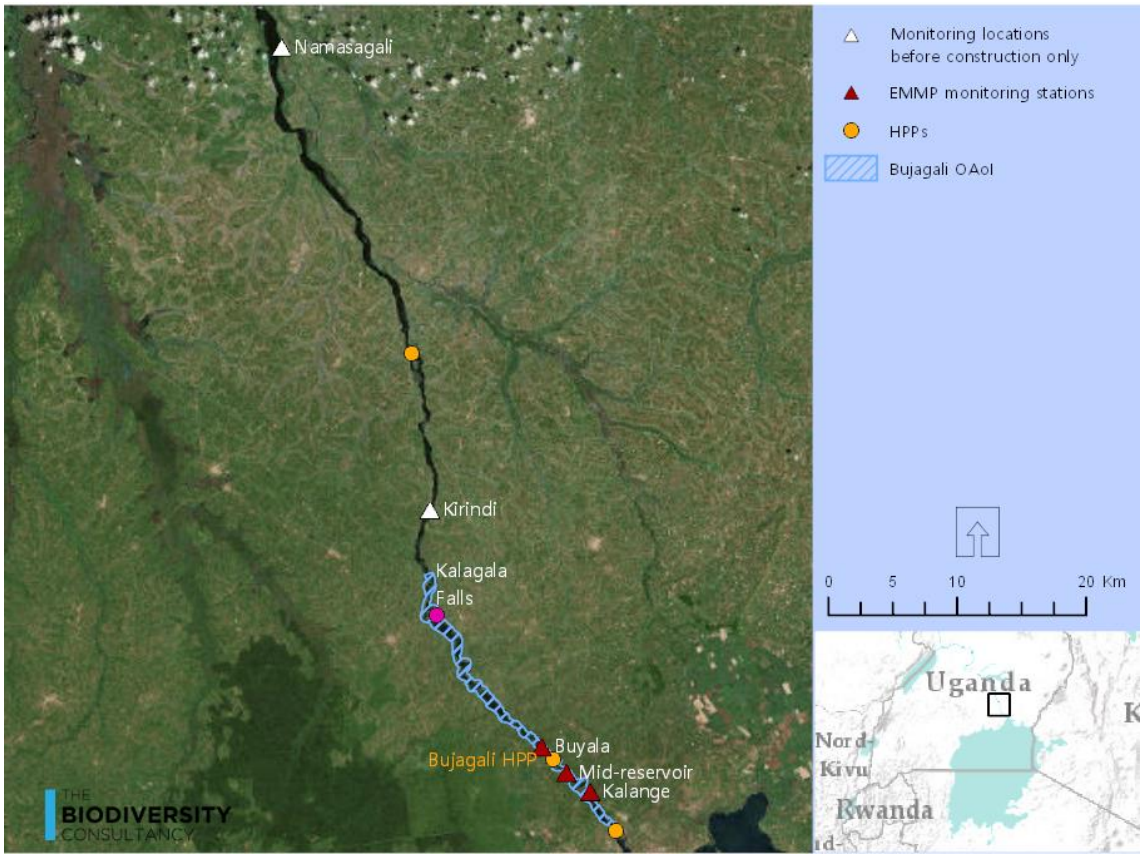

Figure 6: Monitoring locations before construction and to date[14]

1. Fish monitoring

Methods

Multifilament gillnets of incrementing size (from 1" to 8", by 1/2") are set up at each site for the night. The next morning, nets are retrieved and fish species are identified and their abundance recorded within each net. Fish size is measured and, when possible, data on biology and ecology (e.g. maturity status) are collected too. Stomach contents are analysed for a subset of specimens. Net setting is repeated twice at each site. Catch rates are analysed.

Major findings and trends

Non-haplochromine fish: The number of species and their abundance have decreased through time and some species such as *Mormyrus kannume* or *Barbus* species are rarely recorded. A general decrease in the size at which fish reach sexual maturity is also detectable in the data and prey species for fish are less abundant than 10 years ago. Within the reservoir, changes in water flow as a result of the Project has opened up hunting grounds for Nile Perch predation and also more areas for fishing by local people. Immediately downstream of the Project (Buyala), changes in water flow over 24-hour periods due to the operation of the HPP result in fluctuations in water level which also affect biota.

[14] Note: the location called 'mid-reservoir' is immediately upstream of the HPP and the site called Kalange is in the middle section of the reservoir

Haplochromine fish: There was no requirement in the EMMP to focus on haplochromine fish and therefore whilst the methods used have caught haplochromines, there is scope, as outlined in the M&E Plan to further target this tribe of fish. The smallest size of gillnets (1-2.5") caught haplochromines in the slower moving waters where they were placed (See Figure 6 and Table 6) and catch rates from 2006 to present, indicate a general decline in species diversity at the monitored locations.[15].

2. Fish catch

Methods

Information is collected through direct observation of landed catch by fishermen and interviews with fishermen at landing sites (in Kalange, Buyala and the 'mid'-reservoir) in the morning. Fish species, the size of the gear, the number of vessels and the fishing tackle are recorded. Interviews are conducted over 2 consecutive days.

Major findings and trends

NaFIRRI monitoring indicates that the number of fished species and overall catch have decreased over time. At the same time a decline in the number of fishing vessels has been recorded and the use of smaller sized mesh is now recorded. However, fishermen also move between fishing grounds and so the decline in the number of fishing vessels may only be an artefact of the collection methods. Overall, although the catch success has decreased, the economic value of daily catch has increased over time.

3. Water quality

Methods

At each fish sampling location, water quality variables, namely, temperature, pH, water conductivity, and dissolved oxygen are measured *in situ*, at approximately 0.5m below water surface, using calibrated standard portable meters. The water samples are also analysed for nutrients and suspended solids (TSS) using standard methods for freshwaters, as well as algae and invertebrates, which are used as biological indicators of water quality.

Major findings and trends through time

A minor decrease in water clarity is noted, owing to accumulated total suspended solids (sedimentation) in Kalange (within the reservoir). Other trends in water quality variables are not clear.

[15] Whilst the smallest size of gillnet catches haplochromines, the species identification of haplochromines is more challenging after the fish has spent a night in a net (or even several hours) as they lose their colours after death Other features can be used to support identification (e.g. teeth, shape of jaw etc) but due to the similarities between species, colour is also required to make a complete identification. The approaches outlined in the M&E Plan 1. Ensure regular checking of gillnets where they are used in the slow flowing sampling locations,2. Ensure small meshed gillnets are not left out overnight resulting in accidental mortality of haplochromines, and 3.. Select additional sampling locations in fast flowing rocky sections of the river, using appropriate fishing gear to capture species that prefer this habitat (i.e. the Action Category 1 species).

Appendix 2: State of knowledge of priority biodiversity

Haplochromine cichlid fishes

Haplochromine cichlids are one of the most abundant and diverse tribe of freshwater fish in the world. For instance, the genus *Haplochromis*, with 473 described species (Froese & Pauly 2018), is the most species-rich fish genus on the African continent. The majority of haplochromine cichlids are found in the East African Great Lakes, which have a total of ca. 2,000 haplochromine species, most of them endemic to specific water bodies (Danley *et al.* 2012). Among the most species-rich lakes, Lake Tanganyika has ca. 250 endemic haplochromine species (Coulter 1991), Lake Victoria ca. 500 species (Witte *et al.* 2007), and Lake Malawi >800 endemic haplochromines (Fryer & Iles 1972). The diversity and endemism of haplochromines are due to the availability of various unique habitats, such as rocky areas, marginal wetlands, sandy and muddy bottoms, to which individual species adapted spatially, morphologically, nutritionally and behaviourally to evolve into numerous species endemic to these lakes and the adjacent rivers. Species are also found in a variety of water depths and water flows. They can feed on insects, algae, zooplankton, macroinvertebrates, small fish, eggs or fish larvae.

An estimated 200 species of haplochromines in Lake Victoria (40% of haplochromine diversity of the Lake) have disappeared or are listed as threatened on the IUCN Red List (Witte *et al.* 2007) due to environmental degradation, predation from the introduced Nile Perch, and climatic variation. The Upper Victoria Nile, which flows over diverse habitats including rocky areas, falls and rapids from an altitude of 1,134 metres above sea level (m.a.s.l.) on Lake Victoria to 615 m.a.s.l. on Lake Albert, provides suitable habitats (or refugia) for species that might be under threat in Lake Victoria. In the river, species are threatened by Nile Perch predation (in slow-flowing water), changes in water flows due to the development of HPP projects and fishing (NaFIRRI 2017). Haplochromines are caught as bycatch when fishermen use small-mesh nets while targeting other species such as Nile Perch, or targeted as bait for Nile Perch Industry using lines and hooks and small-sized monofilament nets (V. Natugonza *pers. comm*.). As many haplochromines are mouthbrooders (i.e. females typically produce few eggs, keep the fertilized eggs in their mouths until they hatch, and carry larvae for some time even after hatching) (tkint *et al.* 2012), fishing can have a direct negative impact on recruitment, either by depleting the spawning stock or exposing the "naïve" larvae to predation (e.g. Marten 1979).

Characteristics of the Upper Victoria Nile river system and threats to the system that may affect Critical Habitat-qualifying biodiversity

The habitat specialisation shown by many haplochromines means they are sensitive to changes in the environment; to changes in aquatic habitat quality and water flow.

The characteristics of the Upper Victoria Nile River system that affect aquatic habitat and Critical Habitat-qualifying species were identified during a workshop between NaFIRRI, the Project and The Biodiversity Consultancy (TBC), in August 2018 (Figure 7). The M&E Plan identifies indicators for the key characteristics (or threats) to this system to enable the Project to track changes in aquatic habitat that may affect the Critical Habitat-qualifying biodiversity (Figure 8). Threats that were not selected for monitoring were not considered to pose as significant a risk for Critical Habitat-qualifying biodiversity e.g. water flows in the majority of the OAoI are fast enough to avoid significant accumulations of the invasive species, water hyacinth. It was therefore not

considered to be a key threat. The Project also monitors the amount of water hyacinth removed from the HPP as part of the Invasive Species Management Plan (see BAP action MA7).

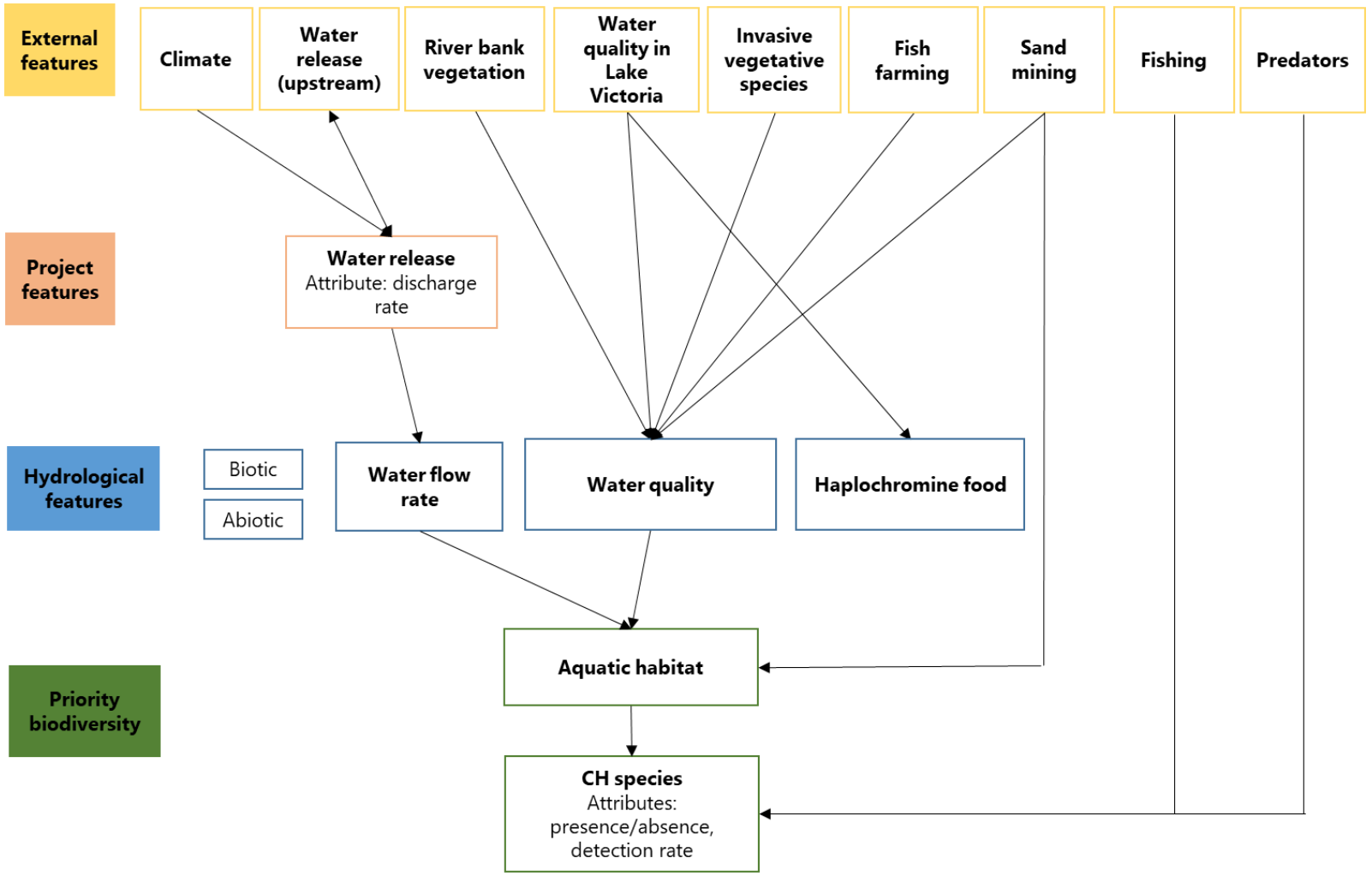

Figure 7: Characteristics of the Upper Victoria Nile river system

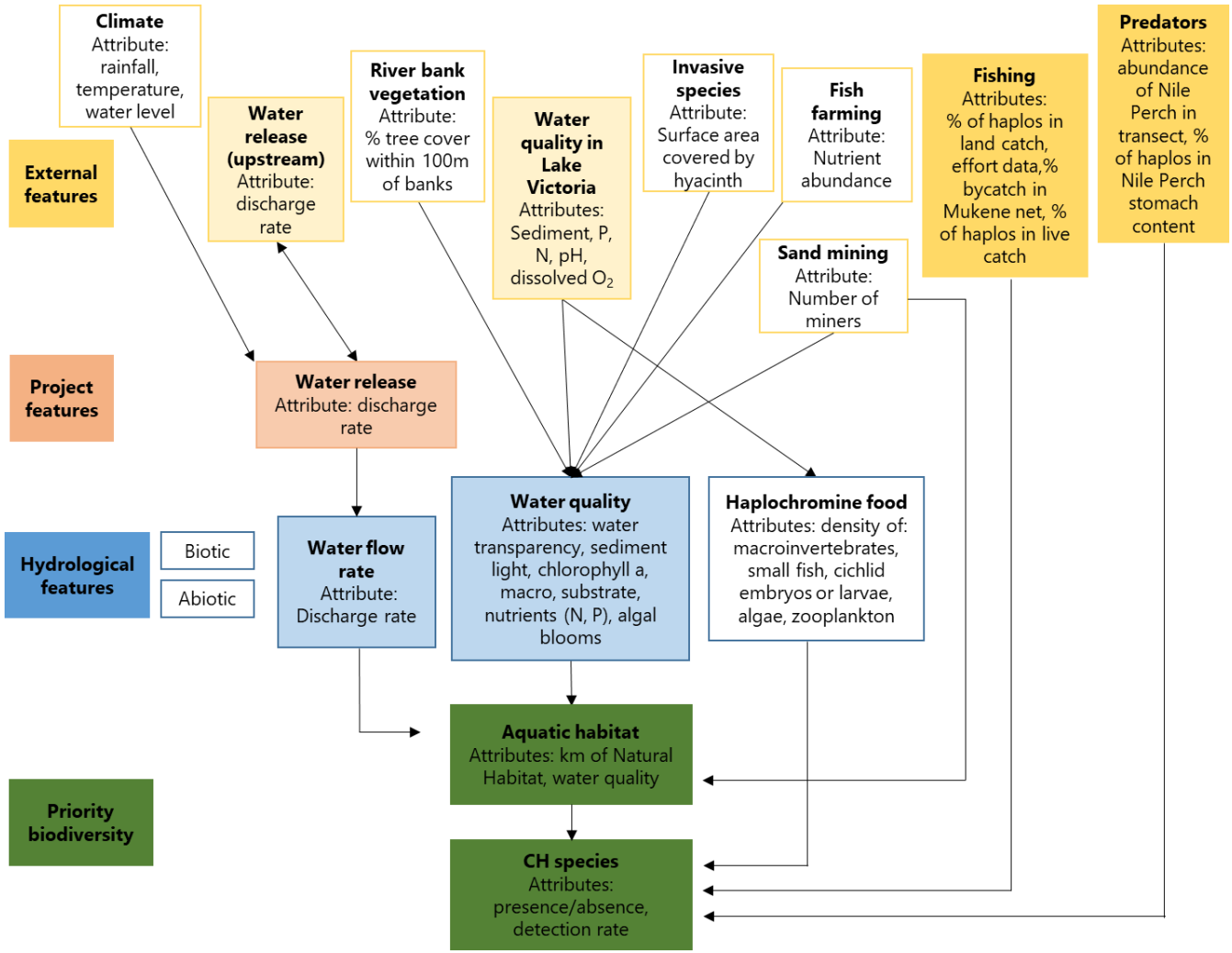

Figure 8: Key characteristics of the Upper Nile of the Upper Nile River system that are included in the scope of the M&E Plan are highlighted in colour

Appendix 3: Technical protocols for data collection

1. State indicators

Table 7: Indicator #1, Measure #1

Indicator #1	Diversity of Critical Habitat-qualifying species (species richness)
Measure #1	Critical Habitat-qualifying species recorded at each sampling location
Method	Fish collection using techniques that target Critical Habitat-qualifying species across locations and stations
Detailed protocol for data collection	***Objective of the indicator***: Record the number of Critical Habitat-qualifying species present within the OAoI (Note: this data will be used to track changes in numbers and species composition at each location over time). ***Sampling strategy***: The sampling techniques have been selected to specifically target Critical Habitat-qualifying species and track their presence/absence at each location and station. Four locations within the OAoI are identified to target Critical Habitat-qualifying species. At each location multiple stations will be sampled that cover a variety of micro-habitat types that Critical Habitat-qualifying species prefer (muddy, sandy or rocky substrates) with varying water flow rates. Basic information on the water quality at each station at the time monitoring should also be collected (see Indicator #6). During the first two years of data collection sampling effort should be carefully controlled (see Additional remarks below). ***Sampling locations***: Lower Naava, Kalange, 'mid'-reservoir, Buyala and Busowoko. Collecting stations within each of the new locations will be selected to represent different habitat characteristics i.e. rocky, muddy, vegetated, sandy, and degraded shoreline/banks. The GPS coordinates of each location and each sampling station will be recorded during the first monitoring event to enable the same stations to be re-visited and sampled during subsequent monitoring events. ***Sampling techniques***: Monofilament gillnets of stretched mesh sizes 1 to 6 inches in increments of 0.5 inches will be used, and sampling will be undertaken during the day. Soaking will last for one hour, but multiple soakings will be used at each station (the number of soakings will be defined during the pilot phase, see below). In habitats where gillnets cannot be used, especially rocky areas, hooks of sizes number 18 and 20 will be used (number will be defined during the pilot phase). In sandy substrates, a beach seine will be used. ***Sampling effort***: Sampling effort will be varied during the 2-year pilot phase, including large effort to enable assessment and the 'optimal' effort to be defined for post-pilot phase monitoring (see Additional remarks below). **For hook fishing**: Hook fishing will be performed from boats and from rocks in calmer sections of water within and immediately downstream of fast flowing water. Fishermen will be spaced at least 5m apart. The level of effort will be varied in order to assess the species accumulation curve and define the 'optimal' effort for post-pilot phase implementation (see Additional remarks below). **Monofilament fishing**: One fleet of gillnets, 90 m long and 26 meshes deep, will be set by two fishermen while on boat. Nets will be set parallel to the river bank at a distance that will be determined by local habitat conditions. The nets will remain

	in water (uninterrupted) for approximately one hour. The number of soakings will be determined during the pilot phase, but the soaking time will remain standard. Nets will not be left for longer than 1 hour (or over-night) to ensure accidental mortality of haplochromines is avoided. Current EMMP monitoring approaches will also be updated to ensure small sized gillnets are not left for longer than 1 hour (or over-night). After retrieval from water, fish will be identified to the species level immediately, and photos of live fish taken in standard cuvette. Confirmation of fish identification can be completed in the lab from the live photos taken. For fish that are considered threatened, they will be immediately released back into the water once their images are captured. However, for rare fishes without DNA information, fin clip samples will be collected using standard protocols and preserved in ethanol[16]. For undescribed species, some specimens will be preserved in formalin for further processing in the lab. ***Data collection***: • Identification of species collected with hooks and nets, • The size of the fish, • Photos of each fish, • Time of fishing, habitat, sampling gear and gear size, river characteristics (including flow speed at the time of sampling, water depth), presence of fishermen and any other issues of note, • Total time spent using each method.
Data analysis and interpretation	Data should be recorded in an excel sheet, with one row per species record and one column for each related characteristic (date of collection, location, station, fishing technique, gear net size when relevant, collector, fish size, etc.). A listing of all survey events, effort and whether or not fish were caught should also be provided. Data should be compiled to report on the presence/absence of each Critical Habitat-qualifying species in each location. Presence/absence will be compared with the baseline data (2019-2020) and evaluated against the thresholds. The significance of any change will be discussed; any significant change should be clearly stated in the report.
Additional remarks	A pilot phase effort should be undertaken during the 2 first years of monitoring in order to assess the appropriate effort to collect presence/absence of Critical Habitat-qualifying species. Monitoring should vary and include a large sampling effort (in terms of time, number of nets and hooks) to statistically assess, during the complete review of the monitoring after 2 years, the final sampling effort. This is usually done by calculating the number of additional species recorded by additional effort unit (time and/or number of fish tackle). The adequate sampling effort is reached when the number of recorded species reaches a plateau (i.e. when the rate of capture slows). This should be conducted for each monitoring station and statistically assessed. NOTE: if data is already available to determine sampling effort then this data should be statistically assessed now to determine effort.

[16] Note: For undescribed species, fin clips must be taken immediately, whilst in the field and preserved in ethanol. Once a specimen has been preserved in formalin genetic analysis is not possible.

Table 8: Indicator #1, Measure #2

Indicator #1	Diversity of Critical Habitat-qualifying species (abundance)
Measure #2	No. of Critical Habitat-qualifying individuals recorded at each sampling location (irrespective of species) per unit effort (CPUE)
Method	Fish collection using complementary techniques across locations
Detailed protocol for data collection	***Objective of the indicator***: Estimate the abundance of Critical Habitat-qualifying species at different strategic locations of the OAoI. ***Sampling strategy***: Same as for Indicator #1, Measure #1. ***Sampling locations***: Same as for Indicator #1, Measure #1. ***Sampling techniques***: Same as for Indicator #1, Measure #1. ***Sampling effort***: Sampling effort must be estimated during the pilot phase effort (see Additional remarks of Indicator #1, Measure #1) and will be the same as for Indicator #1, Measure #1. ***Data collection***: • The number of Critical Habitat-qualifying individuals collected with hooks, • The number of Critical Habitat-qualifying individuals collected in each net, • The time spent using each method, • The number of nets used during the sampling (to keep track of any changes in the effort if a net is lost), • The total number of hooks used in each location and station.
Data analysis and interpretation	Data should be recorded in a excel sheet, with one row per species record and one column for each related characteristic (data of collection, location, station, fishing technique, gear net size when relevant, collector, fish size). Data will further be compiled to report on the total number individuals of Critical Habitat-qualifying species per time unit (CPUE) in each location. Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds). Any significant change should be clearly stated in the report.
Additional remarks	The pilot phase effort (detailed in Indicator #1, Measure #1) should be used to assess the appropriate effort to collect overall abundance of Critical Habitat-qualifying species, based on the same statistical method.

Table 9: Indicator #2

Indicator #2	Extent of Natural Habitat
Measure	Number of rapids in the OAoI (Grades 1 to 5) (Rapids are used as a proxy for Natural Habitat)
Method	Tracking of activities in the OAoI that will affect the number of rapids e.g. HPP developments, industry

Detailed protocol for data collection	***Objective of the indicator***: Estimate the extent of Natural Habitat in the OAoI. The area upstream to the dam has been identified as Modified Habitat. Natural Habitat extends from the dam down to the top of the Isimba reservoir. (The baseline is established in the BAP, TBC 2018b). ***Sampling strategy***: Monitor activities in the OAoI that may affect Natural Habitat, e.g., activities that might significantly affect water flow (e.g., HPP developments or changes in operation of an HPP that results in a change in water flow), activities that might affect water quality (e.g., new industry causing water contamination, sand mining increasing sediment load). If a new activity is identified that may significantly impact Natural Habitat, the threat posed by the activity should be identified and periodically monitored to evaluate if it is a significant threat to Natural Habitat (i.e. whether it removes sections of fast flowing water). ***Sampling locations***: Check for new developments in the OAoI and if detected monitor if fast flowing sections of water are impacted. ***Sampling techniques***: Field observation, feedback from communities, newspaper articles, discussion with local authorities. ***Sampling effort***: Dependent on activity and threat identified. ***Data collection***: • GPS point of activity and/or threat posed by activity; • Dependent on the activity and threat to be monitored.
Data analysis and interpretation	New development activities that may affect Natural Habitat should be reported after each monitoring event. BEL and NaFIRRI should determine in the development may significantly affect Natural Habitat in the OAoI and whether monitoring of the threat posed by the activity is required, if the activity needs to be reported to a relevant authority to be monitored and/or determine an appropriate course of action.

2. Pressure indicators

Table 10: Indicator #3

Indicator #3	Bycatch during fishing
Measure	Proportion of haplochromines in landed catch (per total biomass of fish catch and fishing effort)
Method	Observations of fish catch at landing sites
Detailed protocol for data collection	***Objective of the indicator***: Estimate the significance of bycatch for haplochromine species. ***Sampling strategy***: Landing sites are visited during the busiest period of day, i.e. in the morning, and the bycatch of fishermen is sampled to assess the proportion of haplochromine species in catches. * *This indicator is collected by NaFIRRI at existing monitoring locations.* ***Sampling locations***: Kalange, 'mid'-reservoir, Buyala. ***Sampling techniques***: Records of fish catch at landing sites and direct interviews of fishermen.

	Sampling effort: Two days will be spent at each landing site. Given the small number of landing sites, all catch will be inspected and recorded by one scientist at each landing site, and any associated meta-data will be recorded by interviewing all fishers (individually) at the landing site. ***Data collection***: • List of species recorded in the catch, • Whether the species was targeted or not, • Fishing tackle used that resulted in haplochromine bycatch, • Total biomass of the daily catch, • Total biomass of targeted species and of incidental catch with respect to gear size, • Gear type and number, • Critical Habitat-qualifying species biomass in the daily catch, • Fishing effort of fishermen - type of nets (monofilament vs. multifilament), numbers of nets, length of nets, number and size of hooks, time spent in the water, time spent using this technique to harvest a particular species.
Data analysis and interpretation	Data should be recorded in a excel sheet. Data will further be compiled to report on daily total catch per species, proportion of target species vs. bycatch, and proportion of Critical Habitat-qualifying species in daily catch at each landing site. This information should be analysed and compared with data on fishing effort variables above. Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds). Any significant change should be clearly stated in the report.

Table 11: Indicator #4

Indicator #4	Fishing for bait
Measure	Proportion of haplochromines in live catch (per total biomass of live catch and fishing effort)
Method	Observations of fish catch at landing sites and interviews with fishers and buyers/transporters of live haplochromines
Detailed protocol for data collection	***Objective of the indicator***: assess the significance of capture for live bait for of haplochromine species. ***Sampling strategy***: As per Indicator #3. ***Sampling locations***: Kalange, 'mid'-reservoir, Buyala. ***Sampling techniques***: records of fish catch at landing sites and direct interviews of fishermen. ***Sampling effort***: same as Indicator #3. ***Data collection***: • List of species collected during live bait fishing, • Fishing tackle used for fishing of live bait, • Total biomass of the daily catch of live bait, • Critical Habitat-qualifying species biomass per species in the daily catch of live bait,

	• Fishing effort of fishermen (type of nest, numbers of nets, number and size of hooks, time spent in the water, time spent using this technique to harvest a particular species).
Data analysis and interpretation	Data should be recorded in a excel sheet. Data will be compiled to report on the proportion of live haplochromines in daily total catch at each landing site. Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds. Any significant change should be clearly stated in the report.

Table 12: Indicator #5, Measure #1

Indicator #5	Predation by Nile Perch
Measure #1	Abundance of Nile Perch at each location
Method	Nile Perch collection in nets/commercial catches from fishermen
Detailed protocol for data collection	***Objective of the indicator***: estimate the abundance of Nile Perch as a proxy of Nile Perch predation on haplochromine species. ***Sampling strategy***: Experimental fishing using multifilament gillnets set overnight at all sampling locations to record the recovery rate of Nile perch. * *This indicator is collected by NaFIRRI at existing monitoring locations*. ***Sampling locations***: Lower Naava, Kalange, 'mid'-reservoir, Buyala, Busowoko. ***Sampling techniques***: Multifilament gillnets of stretched mesh sizes 1 to 8 inches in increments of 0.5 inches are to be used, and sampling is to be done by soaking nets in water overnight. ***Sampling effort***: One fleet of gillnets, 90 m long and 26 meshes deep, will be set by two fishermen from a boat. Nets will be set parallel to the river bank at a distance that will be determined by local habitat conditions. Soaking should last for about 12 hours, from 18:00hrs to 06:00hrs. ***Data collection***: • The number of Nile Perch specimens collected, • The number of Nile Perch specimens collected above the size where they are predators for haplochromine species (per class length, see Measure #2), • Total biomass of the daily catch, • Biomass of Nile Perch.
Data analysis and interpretation	Data should be recorded in a excel sheet. Data will further be compiled to report on the abundance of Nile Perch at each location where haplochromine sampling is done, and in addition to calculating abundance of Nile perch, the abundance of haplochromines will be compared in areas of both high and low Nile perch abundance to assess the correlation in abundance of two fish groups. It is expected that the abundance of two fish groups will be inversely proportional in areas where predation is most prevalent. Findings will be compared with the baseline data (2019-2020) and other monitoring events (i.e. evaluation against the thresholds). The sampling effort can be used to interpret and discuss the significance of any change. Any significant change should be clearly stated in the report.

Table 13: Indicator #5, Measure #2

Indicator #5	Predation by Nile Perch
Measure #2	Proportion of haplochromines in Nile Perch diet
Method	Analysis of stomach content
Detailed protocol for data collection	***Objective of the indicator***: estimate the proportion of haplochromines in Nile Perch diet. ***Sampling strategy***: As per Indicator #5, Measure #1. Analysis of stomach content of Nile Perch larger than 15cm (size at which haplochromines are more than 25% of prey types of Nile Perch, Kishe-Machumu *et al.* 2012) will be undertaken. * *This indicator is collected by NaFIRRI at existing monitoring locations*. ***Sampling locations***: Lower Naava, Kalange, 'mid'-reservoir, Buyala, Busowoko. ***Sampling techniques***: fishing technique as per Indicator #5 Measure #1. ***Sampling effort***: Number of Nile Perch for which stomach content will be analysed should be defined during the pilot phase and sampling should represent a range of Nile Perch size (using 5cm length class). ***Data collection***: • Weight and length of Nile Perch, • Proportion of stomach content being haplochromine species.
Data analysis and interpretation	Data should be recorded in a excel sheet. Data will further be compiled to report on Nile Perch diet at each location where haplochromine sampling is done (per class length and overall). The proportion of haplochromines in the Nile Perch stomachs will be used to infer on their importance in the predator's diet. Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds. Any significant change should be clearly stated in the report.

Table 14: Indicator #6

Indicator #6	Water quality parameters
Measure	Suspended solids water transparency, P, N, pH, dissolved O_2, phytoplankton, zooplankton, and macro-invertebrate abundance
Method	Water sampling
Detailed protocol for data collection	***Objective of the indicator***: assess if they are any significant changes in water quality that might affect haplochromine species. ***Sampling strategy***: survey water quality parameters through standard measurements across the sampling locations and identify any changes that might affect Critical Habitat-qualifying species. * *This indicator is collected at NaFIRRI at existing monitoring locations.* ***Sampling locations***: Lower Naava, Kalange, 'mid'-reservoir, Buyala, Busowoko. ***Sampling techniques***: *In situ* measurements of physical and chemical conditions (temperature, pH, water conductivity, and dissolved oxygen) at approximately 0.5m

	below water surface, using calibrated standard portable meters. Collection and analysis of water samples for nutrients, suspended solids, algae and invertebrates using standard protocols. ***Sampling effort***: As per current EMMP approach ***Sample analysis:*** Physical and chemical conditions are measured *in situ* while water is collected to conduct other analysis. ***Data collection***: • Temperature, • pH, • Water conductivity, • Dissolved Oxygen (mg/L), • Nutrients, • Total suspended solids (mg/L), • Algae and invertebrates.
Data analysis and interpretation	Data should be recorded in a excel sheet. Data will further be compiled to report on the water quality at each station (data of collection, location, station, temperature, water conductivity, dissolved oxygen, pH, nutrients, total suspended solids, algae and invertebrates, collector). Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds. Any significant change should be clearly stated in the report.

Table 15: Indicator #7

Indicator #7	Water release
Measure	m^3/second
Method	Compilation and review of BEL daily records
Detailed protocol for data collection	***Objective of the indicator***: Assess the number and frequency of large water release events (BEL to define what is above normal/large) per month if they are any significant changes in water release that might affect Natural Habitat downstream of the Project. ***Sampling strategy***: Daily water release is used as a proxy to assess if there are any significant changes in water flow rates downstream of the project. * *This indicator is already collected by BEL*. ***Sampling locations***: BEL HPP facilities. ***Sampling techniques***: # how is the measure collected # ***Sampling effort***: #frequency of data collection # ***Data collection***: • Total amount of water released per day • Water release per second
Data analysis and interpretation	Data will further be compiled to report on the mean daily water release and assess the distribution of mean daily release over a 6-month period to assess extremes

	and what is considered as a large release event that may sections of Natural Habitat downstream. Findings will be compared with the baseline data (2019-2020) and evaluation made against the thresholds. Any significant change should be clearly stated in the report.

3. Response indicators

Table 16: Indicator #8

Indicator #8	Establishment of voluntary mechanisms (ACA2, TBC 2018b)
Measure	No. of Conservation Agreements in place with Beach Management Authorities in the reservoir and immediately downstream of the HPP
Method	Simple count of signed Conservation Agreements between the Project and the Beach Management Unit engaged. During the establishment process, the number of Conservation Agreements in development should be reported
Detailed protocol for data collection	Not required
Data analysis and interpretation	Not required

Table 17: Indicator #9, Measure #1

Indicator #9	Implementation of voluntary mechanisms
Measure #1	Frequency of prohibited fishing tackle encountered during control checks
Method	This data is collected by NaFIRRI when landing sites are visited as part of data collection for Indicator #3 and Indicator #4 (i.e. no additional data collection is required, only clear reporting against the indicator). Once Conservation Agreements have been agreed with the Beach Management Units (See TBC 2018b, ACA2), it will be clear what size of fishing gear should not be used by fishermen. The number of times per monitoring event that prohibited gear is encountered can then be recorded and the frequency of prohibited fishing tackle encountered can be calculated. The BAP (TBC 2018b) also recommends that the Beach Management Units undertake checks of prohibited fishing gear to ensure that authorities and communities are fully engaged in the implementation of the conservation actions. The BMUs should make the same records as NaFIRRI when checks are undertaken.
Detailed protocol for data collection	***Objective of the indicator***: Assess the frequency of encounter of prohibited sizes of fishing gear to assess whether Conservation Agreements are being effectively implemented ***Sampling strategy***: As per indicator #3 ***Sampling locations***: Landing sites at Buyala, 'mid'-reservoir and Kalange. ***Sampling techniques***: Count of the number of prohibited fishing gear in use by fishermen at the landing sites during the survey period.

	Sampling effort: As per indicator #3. ***Data collection***: • Number and size of gears in use per boat/fisherman.
Data analysis and interpretation	Data will be recorded in a excel sheet and compiled to report against the indicator. Findings will be compared with the baseline data (2019-2020) and evaluated against the thresholds. Any significant change should be clearly stated in the report.

Table 18: Indicator #9, Measure #2

Indicator #9	Implementation of voluntary mechanisms
Measure #2	% of fishermen involved in Conservation Agreements reporting no change or positive livelihood outcome
Method	Conservation Agreements contain 1. A conservation action that fishermen agree to improve conservation outcomes for haplochromine species and 2. A conservation incentive to ensure that there is no negative outcome for fishermen or their families. As part of the development of Conservation Agreements, simple attributes will be selected by the fishermen and the Project to measure outcomes of the agreed actions. For the conservation action, the suggested attribute is the frequency of prohibited gears encountered which is captured in Indicator 9, Measure #1 (above). For the conservation incentive, the suggested attribute is the fishermen's evaluation of livelihood change. Once the conservation incentives are known, this attribute and measure may be changed, if appropriate.
Detailed protocol for data collection	***Objective of the indicator***: Evaluate the livelihood outcome of the Conservation Agreements for fishermen/families ***Sampling strategy***: Simple questionnaire with fishermen. ***Sampling locations***: With the fishermen involved with the Conservation Agreements in Buyala, 'mid'-reservoir and Kalange. ***Sampling techniques***: To be added by the BEL Conservation Agreement coordinator, once the approach is designed. ***Sampling effort***: To be added by the BEL Conservation Agreement coordinator, once the approach is designed. ***Data collection***: • To be added by the BEL Conservation Agreement coordinator, once the approach is designed.
Data analysis and interpretation	Indicator 9 should be used, along with other information collected by the BEL coordinator to assess if the Conservation Agreements are effective.

Appendix 4: Table of contents for monitoring and evaluation reports

1. Executive Summary

- Summary of the major findings (in table format)
- Highlighting if any actions should be undertaken by the project

2. Introduction

1.1 Background

- Why the monitoring is conducted
- How many monitoring have already been conducted
- Main results and general trends on previous monitoring events

2. Methods

- Highlight any variations that have occurred from the M&E Plan (agreed methods)
- Highlight any challenges that have affected the implementation of the methods

3. Findings

- For each indicator, present the following sections:
    - Results of the monitoring
    - Evaluation against the thresholds
    - Interpretation of the results and the evaluation (is there any other result that can help to interpret the changes in an indicator)
    - Recommendations

4. Conclusions

- General trends of this monitoring
- Requirement of adaptive monitoring