Ministère des Travaux Publics,
Transports et Communications

IMPACT OF ENNERY-PLAISANCE ROAD REHABILITATION ON PLAISANCE KEY BIODIVERSITY AREA

IDB – REPUBLIC OF HAITI
SECTOR SUPPORT ROAD III (HA-L1079)

AUGUST 2013

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EXECUTIVE SUMMARY

The purpose of the study was to obtain sufficient information regarding the direct and indirect impacts of the proposed rehabilitation of the Ennery-Plaisance road (IDB Sector Support Road III (HA-L1079) on the native biodiversity. The study identifies the threatened species and their habitats of a 23.9 km road section between Ennery – Plaisance. Mitigation measures are recommended to minimize the adverse impact of road rehabilitation on the biodiversity residing within the Plaisance Key Biodiversity Area (KBA) based on Timyan (2011).

The IDB road project is taking into consideration the KBA concept in order to satisfy its Safeguard Directive B.5 (*Environment Assessment Requirements*) and B.9 (*Natural Habitats and Cultural Sites*) (IDB, 2007). A previous road project assessing the environmental and social impact of the Gonaives-Ennery road served as an important precedent by considering threatened species and their habitats found in the area (Lavalin-SNC & LGL, 2012).

Fifteen threatened species listed by the IUCN Red List occur within the area of the road. These are represented by birds (4), reptiles (2), amphibians (4), crustaceans (1) and trees (4). Several of these were observed during the field surveys including the White-necked Crow, Scaly-naped Pigeon, Hispaniolan Freshwater Crab, Spanish Cedar and Lignum Vitae. Additionally, point counts were conducted between Ennery-Plaisance to quantify the bird diversity. A total of 264 birds were observed representing 27 species. These included 6 island endemics and 2 threatened breeding residents.

None of the habitats in the road area occur in their natural state. The habitats are in various degrees of disturbance from total deforestation, as evidenced by denuded slopes, to densely shaded agroforestry systems. These extremes are interspersed with secondary scrub and grassy herb-dominated areas. Weedy cosmopolitan species dominate a large proportion of the road edge. Many of these are considered invasive species and have changed the ecological conditions required by native species. In some cases, the invasive species have displaced the native species and caused population declines.

Potential impacts of the road rehabilitation project were assessed for each major taxonomic group (e.g., plants, birds) found in the area. These were broadly divided between direct and indirect impacts and included seasonal considerations due to migrating species into the area. Recommendations to minimize and mitigate the risk of biodiversity loss were broadly divided among timing of road construction activities, setbacks, slope stabilization, drainage and sedimentation control, invasive species and partnerships to enhance biodiversity conservation.

The biological survey team met with key stakeholders and members of the communities of Ennery and Plaisance and communities in between. These included members of local government and key non-governmental institutions in the impact area (Annex 1). Meetings were set up with the mayors of Plaisance and Ennery in order to explain the mission, objectives, methodology and anticipated results of the biological surveys and to move forward with a number of challenging environmental issues in the area.

ACKNOWLEDGEMENTS

This document was prepared by Joel Timyan, a resource ecologist with over 30 years experience in Haiti. He was assisted by Anderson Jean, Maxon Fildor and Beauduy Orilien with the biological field studies. Logistical, planning and administrative support was provided by IDB staff members in Washington DC and Port-au-Prince, including Nicolas Kotschoubey, Reinaldo Fioravanti, Michel Vallée and Stefanie Brackmann. The UCE staff –Garry Jean, Jacques Nels Antoine and Frantz Désormes - at the Ministère des Travaux Publics, Transports et Communications was very helpful in providing contacts and making arrangements with local community leaders in the Ennery and Plaisance areas. Technical assistance was provided by SNC-Lavalin/LGL staff – Christian Laliberté and Philippe Larouche.

ACRONYMS & ABBREVIATIONS

ABC	Agents Brigades Communales
ESIA	Environmental and Social Impact Assessment
GBIF	Global Biodiversity Information Facility
IDB	Inter-American Development Bank
IUCN	International Union for the Conservation of Nature
KBA	Key Biodiversity Area
MTPTC	Ministère des Travaux Publics, Transports et Communications
UCE	Unité Coordination Exécutif (MTPTC)
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
WCMC	World Conservation Monitoring Centre

STUDY AREA

This study is conducted in parallel to the Environmental and Social Impact Assessment (ESIA) to satisfy BID requirements for the rehabilitation of the Ennery-Plaisance road section (Road Sector Support Project in Haiti, HA-L1079). This section of road passes through a Key Biodiversity Area (KBA) identified in Timyan (2011) that is habitat for a number of threatened floral and faunal species found in this area of Haiti (Figure 1).[1]

Figure 1. Map showing location of study area in northern Haiti (left) and Ennery-Plaisance road passing through Plaisance KBA (right).

OBJECTIVES

The objectives of this study are to obtain sufficient information on the conservation status of threatened species in the area in order to assess the impact of the road project and to identify feasible mitigation measures to minimize the risk of biodiversity loss as a result of direct, indirect and cumulative impacts. These objectives are framed by Policy Directives B.5 (*Environment Assessment Requirements*) and B.9 (*Natural Habitats and Cultural Sites*) of IDB (2007). Specific objectives include supporting the ESIA with regard to 1) analysis of road design to direct, indirect, regional or cumulative environmental impacts; 2) preparation of measures to avoid, minimize, compensate or mitigate such impacts; and 3) disclosure of such measures to the public.

LITERATURE REVIEW

A thorough review of technical and scientific documents was conducted. Key technical references included IDB (2007, 2012); SNC-Lavalin and LGL (2012, 2013); and the Government of Haiti (2005, 2011, 2012). Scientific references included several online and meta databases (Avibase, FishBase, FishNet2, GBIF, HerpNet, VertNet), the IUCN Red List (2013) and selected documents supporting the conservation status of threatened species known to occur in this region of Haiti: BirdLife International (2008), Cizuzza et al. (2007), Crouse (2000-2002), Hedges (2013a, 2013b), Hedges & Conn (2012), Henderson and Powell (2009), Howard (1973), Latta et al. (2006), Lewis et al. (2010), Liogier (1983), McPherson & Graham (1993), Missouri Botanical Garden (2013), Keith et al. (2003), Rivera (2007), Rodríguez-Durán & Kunz (2001), Timyan (2011), UNEP-WCMC (2013), USAID (1986), Vlaminck (1990), Watson (2008), Wilig et al. (2010) and Zanoni (1984).

[1] KBAs are essential to the preservation of endangered species since they contain a globally significant portion of a species' population or specific habitats found nowhere else in the world. These habitats are often restricted to small areas within the KBA.

SPECIES CHECK LIST

Table 1 summarizes the list of IUCN Red List species contained in the Plaisance KBA or along the road to Ennery. This list is somewhat modified from Timyan (2011) since it includes the southern aspect of the Chaine du Nord mountain range along the road toward Ennery as well as additional information resulting from interviews with local stakeholders and scientists currently collecting in Haiti. Furthermore, since many of the species occur in restricted areas of the KBA not directly impacted by the road, the likelihood of their being relevant to the study was analyzed. The results, in terms of being considered if suitable habitats occurred along the road, are shown below.

Annex 2 contains other vertebrate species that are not listed on the IUCN Red List that are known to occur in the area. Many of these species are considered "special concern" by experts due the restricted nature of their natural distribution, continuing population declines due to habitat destruction and degradation. Annex 2 also shows the results of the 44 point counts and opportunistic surveys conducted for birds along the Ennery – Plaisance road.

Table 1. IUCN Red List species known to occur in the Plaisance KBA and their likelihood of occurring near the road. CR = Critically Endangered, EN = Endangered, VU = Vulnerable.

CLASS	SPECIES	STATUS	LIKELIHOOD NEAR ROAD
BIRDS	*Amazona ventralis* Müller, 1776	**VU**	Yes. Seasonal migration during fall maize harvests known to occur near the road. Also McPherson & Graham (1993), Crouse (2000-2002), Latta et al. (2006), Keith et al. (2003).
	Aratinga chloroptera Souancé, 1856	**VU**	Yes. Seasonal migration during fall maize harvests known to occur near the road. Also McPherson & Graham (1993), Crouse (2000-2002), Latta et al. (2006), Keith et al. (2003).
	Corvus leucognaphalus Daudin, 1800	**VU**	Yes. Observed along road in Ennery.
	Patagioenas inorta Vigors, 1827	**VU**	Yes. Not observed, but Watson (2008) noted presence along Plaisance road toward Limbé.
REPTILES	*Celestus warreni* Schwartz, 1970	**CR**	Yes. Not observed, but collected previously near Plaisance in mesic[2] habitat (HerpNet, 2013). Rare.
	Spondylurus lineolatus Noble & Hassler, 1933	**CR**	No. Likely extirpated due to presence of mongoose and loss of habitat (Hedges & Conn, 2012).
AMPHIBIANS	*Eleutherodactylus sommeri* Schwartz, 1977	**EN**	Possible. Collected 15 km east of Puilboreau in coffee plantations and remnant broad-leaved forests. Not observed during this study (HerpNet, 2013).
	Hypsiboas heilprini Noble, 1923	**VU**	Yes. Collected recently in 2009 in 3rd ravine along road north of Puilboreau intersection (HerpNet, 2013).
	Osteopilus pulchrilineatus Cope, 1869	**EN**	Not likely, has not been collected recently and likely extirpated from the area due unsuitable forested habitat.
	Osteopilus vastus Cope, 1871	**EN**	Yes. Not observed in this study, but known to occur in mesic forested habitats along streams near Plaisance.
CRUSTACEANS	*Epilobocera haytensis* Rathbun, 1893	**VU**	Yes. Observed during this study in Trois Rivières and its tributaries near Plaisance.
TREES	*Cedrela odorata* L.	**VU**	Yes. Observed alongside road near Plaisance.
	Cinnamomum triplinerve (Ruiz & Pav.) Kosterm.	**VU**	Possible. However, threatened status remains uncertain due to recent taxonomic study indicating the listed species is *Phoebe amplifolia* Mez & Donn. Sm., a taxon distributed throughout Central and South America (MBG, 2013).
	Guaiacum officinale L.	**EN**	Yes. Observed in the Ennery area.
	Guaiacum sanctum L.	**EN**	Possible. Occurs in same habitat as *G. officinale.*
	Magnolia domingensis Urb.	**EN**	No. Occurs in wetter higher elevation forests nearer to coast (Cizuzza et al., 2007; Zanoni, 1984). Rare.

[2] Type of habitat with a moderate or well-balanced supply of moisture

FIELD SURVEY

Field inventory of the flora and fauna was conducted July 2-4, 2013. A team of biologists consisting of a resource ecologist (Joel Timyan), an ornithologist (Anderson Jean) and two technical assistants (Maxon Fildor, Beauduy Orielien) developed a methodology to rapidly survey the road section. A total of 43 points were surveyed between Ennery and Plaisance (Figure 2). Alternating 1-km road sections were surveyed at intervals of 200 meters. At each sample point, a 5-minute point count was made for birds within 50 m, greater than 50 m, overhead or opportunistically (between sample points). The dominant vegetation types of habitat were recorded for each survey point.

Figure 2. Survey points (white circles) between Puilboreau-Plaisance (left) and Puilboreau-Ennery (right). Road (red line) and KBA (light green polygon) are shown.

VEGETATION COVER

The natural areas of the drier Ennery - Puilboreau section are comprised of several life zones that correlate with elevation (Holdridge, 1971). The lowest elevation life zone at Ennery is Sub-tropical Moist Forest (*Forêt humide de la zone Sous-Tropicale*). This transitions to Sub-tropical Humid Forest (*Forêt très humide de la zone Sous-Tropicale*) and then to Lower Elevation Mountain Rain Forest (*Forêt très humide de Montagne de basse altitude*) at Puilboreau. The transition of the life zones are in reverse order from Puilboreau to Plaisance, though Plaisance is wetter due its position on the windward side of the mountain range and Ennery being on the leeward side of the mountain range.

In general, the natural areas that were not obviously being cultivated or converted to home gardens and courtyards were either dominated by a grass-herbaceous flora or in early stages of a secondary scrub forest. No primary forests occur in the vicinity of the road. Species that dominate the secondary scrub forest in the moist forest include *Busera simarouba, Acacia macracantha, Plumeria* spp., *Citharexylum fruticosum, Bunchosia* spp., *Swietenia mahogani, Catalpa longissima* and a mix of forbs and grasses. Common invasive grasses and forbs include *Themelda quadrivalvis, Panicum maximum, Urochloa mosambicensis, Melochia pyramidata, Melinas repens, Andropogon bicornis, Stachytarpheta jamaicensis* and *Sphagneticola trilobata.* In the higher elevation of Puilboreau, the invasive *Casuarina glauca* occurs. It was introduced to Haiti in the 1970s by FAO as part of a Ministry of Agriculture scheme to use fast-growing hardwood species for reforestation purposes. It propagates by root suckers and tends to form disclimax monocultural stands where it becomes established.

The agroforestry gardens – tree-dominated shade gardens – are almost entirely cultivated with the exception of a few native tree species, valued for their timber, that are allowed to regenerate from wildings (e.g., *Catalpa longissima, Simarouba glauca, Colubrina arborescens*). Their companion fruit trees are a mix of native and

introduced species – *Mangifera indica, Annona muricata, A. squamosa, Persera americana, Citrus aurantium, C. aurantifolia, C. maxima.* These are cropped in association with *Musa* sp. and *Coffea arabica* var. *typica* (perennial gardens) and *Zea mays, Phaseolus vulgaris, Manihot esculenta, Curcubita moschata, Sorghum bicolor, Dioscorea* spp. and *Cajanus cajan* (annual gardens). Common live fence species include *Comocladium* spp., *Euphorbia* spp., *Yucca aloifolia* and *Bromelia pinguin.*

Figure 3. Threatened *Corvus leucognaphalus* perching in *Colubrina arborescens* near Ennery.

THREATENED HABITATS AND SPECIES

Plants. The IUCN Red List is the basis for biological importance of the Plaisance KBA. While the vertebrate species that include birds, amphibians, reptiles and mammals are relatively well represented, the plants and invertebrates are not. In the case of Haiti, only 29 plant species are listed on an island that contains as many as 6000 species of which approximately 34% are endemic (Mejia, 2006). The Orchidaceae family is not represented on the IUCN Red List, yet it contains the most species of any plant family with a disproportionate share of species endemic to Haiti.

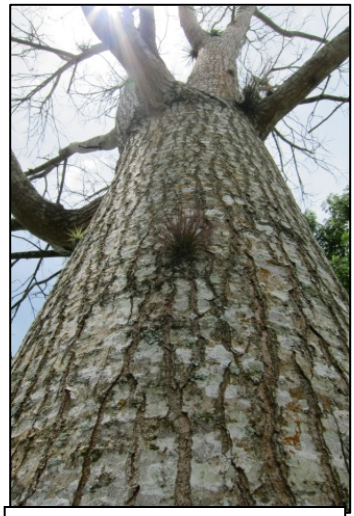

Figure 4. Threatened *Cedrela odorata* near Plaisance.

The Plaisance KBA contains five threatened plant species – all trees. Two of these species, *Cedrela odorata* and *Guaiacum officinale*, were observed in the vicinity of the Ennery-Plaisance road (Figure 3). Both species have been over-exploited due the commercial value of their wood and their natural habitats have either disappeared or degraded to the extent that the population declines are a concern. The other species are much less common and not likely to be present in the area of the road. *Magnolia domingensis* only occurs in the much wetter, higher elevation areas near the northern coast. *Cinnamomum triplinerve* is likely a taxon that is considered synonymous with *Phoebe amplifolia* with a much wider distribution throughout Central and South America (MBG, 2013). *Guaiacum sanctum* occurs in similar habitats as *G. officinale* and it is likely that its smaller stature and rarity was the reason it was not found during this study.

Birds. The results of the bird inventory are shown in Annex 2. Twenty-seven species were identified represented by 264 individuals. This diversity is less than was expected and is due to several factors: 1) Roadside surveys typically underestimate species diversity and total individuals due the noise factor of motor vehicles; 2) Under sampling along the road near Plaisance (due to time factor) and 3) Seasonal nature of bird migrations in this area. Local residents report the migration of several threatened species[3] from higher elevations to the areas around Plaisance and Ennery during October-November period when corn and millet are ripe. This is confirmed by the observations of Crouse (2000-2002).

Most of the species observed in July are common species found throughout Haiti, especially in disturbed and urban areas. Notable species included the threatened White-necked Crow (*Corvus leucognaphalus*), considered Vulnerable (IUCN, 2013) and the threatened Scaly-naped Pigeon (*Patagioenas squamosa*). The former is endemic to Hispaniola and its population is declining as a result of being hunted for its excellent meat, but also because of habitat alteration (Figure 4). The four individuals sited near Ennery were less than expected since the species tends to occur in larger colonies. The presence of the Scaly-naped Pigeon at over a dozen sites was encouraging given many reports indicating population declines throughout the island (Latta et al., 2006). It inhabits mostly mesic broadleaf forests and appears to be adapted to the tree-dominated shade gardens common along the road. An additional threatened species, Plain Pigeon (*Patagioenas inornata*) was not observed, but Watson (2008) noted its presence along the road near Plaisance.

The non-threatened island endemics include the Lizard Cuckoo (*Coccyzus longirostris*), Palmchat (*Dulus dominicensis*), Hispaniolan Woodpecker (*Melanerpes striatus*), Black-crowned Palm Tanager (*Phaenicophilus plamarum*) and Broad-billed Tody (*Todus subulatus*). The Palmchat is the sole member of its genus and family and claims the distinction of being the only bird family endemic to Hispaniola.

It was not possible to confirm the presence of winter migratory species. However, based on recent sightings at similar elevations and habitat conditions in northern Hispaniola, it is possible that threatened species such as Bicknell's Thrush (*Catharus bicknelli*) and Swainson's Warbler (*Limnothlypis swainsonii*) may occur in remnant patches between Puilboreau and Plaisance (Keith et al., 2003; Latta et al., 2006).

Amphibians. Haiti has the highest number of threatened frog species in the world (Hedges & Diaz, 2011). There are possibly 8 frog species present in the road area and half of these are threatened – *Eleutherodactylus sommeri, Hypsiboas heilprini, Osteopilus pulchrilineatus* and *O. vastus* (Figure 5). None of these species were observed during the biological survey.[4]

[3] *Amazona ventralis, Aratinga chloroptera, Patagioenas inornatus, P. leucocephala.*

[4] Weather conditions were not optimal for collection and even the most common species (e.g., *E. abbotti*) were heard but not seen. Only *Osteopilus domincensis* and *Bufo marinus*, an introduced species, were collected during this study.

Figure 5. Threatened *Osteopilus vastus.* Photo: Robin Moore / iLCP.

Due to deteriorated habitat conditions, *O. pulchrilineatus* and *E. sommeri* may no longer occur in the area of the road. Recorded collection sites for these 2 species occur at some distance from the road and were collected decades ago (Figure 6). Conversely, *H. heilprini* and *O. vastus* are much more likely to be present near the road, especially among the shade-coffee and banana groves in the Plaisance area and along the upper tributaries of Trois Rivières. *H. heilprini* has been recently collected along the road just south of Plaisance (HerpNet, 2013).

Figure 6. Collection sites of threatened frog species near Plaisance – *Eleutherodactylus sommeri, Hypsiboas heilprini, Osteopilus pulchrilineatus* and *O. vastus.*

Figure 7. Endemic *Leiocephalus schreibersii* near Ennery road.

Reptiles. The diversity of reptile species that occur in this area is high, particularly in the lower and drier elevations around Ennery. Thirty-one species of lizards, snakes and amphisbaenas have been collected or believe to still occur in the area. Most of these are island endemics and several species appear to be restricted to small geographic areas. One of two critically endangered species, the Hispaniolan Ten-lined Skink (*Spondylurus lineolatus*), is most likely extirpated from the area due the long-time presence of the mongoose (*Herpestes auropunctatus*) (Hedges & Conn, 2012). Whether the same fate has occurred for the other threatened species – *Celestus warreni* – is also a concern since mongoose have shown to have significant impacts on reptiles wherever they have been introduced on islands in the Caribbean (Lewis, 2010). Additional hunting pressure by local residents, particularly for *C. warreni*, has also been reported (Henderson & Powell, 2009).

Several of the common lizards were found in gardens and scrub habitats near the road (e.g., *Ameiva chrysolaema, Anolis chlorocyanus, A. cybotes, A. distichus, Leiocephalus schreibersii*). All these species are endemic to Hispaniola (Figure 7).

The diversity of snakes could not be confirmed during the survey. However, a local resident in the Gimeau (Jimo) area described at least 6 species that match the habits for *Epicrates gracilis, Hypsirhynchus ferox, H. parvifrons, Ialstris dorsalis,Uromacer catesbyi* and *U. oxyrhynchus* (Choute Tavius, pers. comm.). An additional reptile described by the same informant is likely the Haitian Giant Anole (*Anolis ricordii*).

Fish. The Puilboreau – Ennery section of the road feeds the upper tributaries of Trois Rivières. No recent ichthyological work in this area could be found. However, past collections in similar habitats in northern Haiti and downstream areas of Trois Rivières suggest that at least 2 island endemics occur –*L. tridens* (Figure 8) and *Poecilia hispaniolana* – and possibly a third, *Limia pauciradiata* (FishNet2, 2013). None of these species have been assessed by the IUCN and their conservation status remains unknown.[5]

[5] The only freshwater species listed by IUCN is *Gambusia dominicensis* that occurs in the lakes of southern Hispaniola.

Figure 8. *Limia tridens.* © FishBase, 2013.

FishBase (2013) lists 39 freshwater species confirmed for Haiti, while Vlaminck (1990) estimates 48 species as cited in SNC-Lavalin & LGL S. A. (2012). However, how many of these actually occur in the upper watersheds relevant to this project remains uncertain.

Given the high endemicity found among the Poeciliidae (*Gambusia, Limia, Poecilia*) on the island and their vulnerability to more aggressive introduced cichlids, such as *Oreochromis* spp., these species should remain of special concern. Their ecological role in the control of mosquito populations and the incidence of mosquito-borne diseases (malaria, dengue fever) in Haiti is largely unknown but should not be ignored as an important health benefit.

Invertebrates. The diversity of invertebrates is largely unknown for this region of Haiti, though biologists estimate that as many as 15,000 insect species occur on the island (Hedges, 2013b). The IUCN Red List lists 2 insect species, 2 crustaceans and 10 coral species thus confirming the paucity of scientific data and lack of assessment by IUCN.

The only threatened invertebrate in this area is the Hispaniolan endemic freshwater crab, *Epilobocera haytensis* (Figure 9). Healthy populations were found in both the main river channel near the road south of Plaisance as well as small freshwater streams that empty into the river along the road to Pilate. This crab is hunted for its meat and its conservation should remain a concern especially with regard to any alteration of its riverine habitat.

Figure 9. Adult *Epilobocera haytensis* near Plaisance.

Mammals. The only native mammal diversity found in this area is the bat fauna.[6] Most checklists account for 18 species (Rodríguez-Durán & Kunz, 2001). A single threatened bat species occurs in Haiti - *Lasiurus minor.*[7] It is

[6] There are two native quadrupeds in Haiti (*Plagiodontia aedium, Solenodon paradoxus*), but neither occur in the study area (Last Survivors, 2013).

endemic to the Bahamas and Hispaniola, appearing less frequent on Hispaniola than the Bahamas. The only collection on record in Haiti is the type locality near Trouin (Massif de la Selle) where it was collected in the 1930s (GBIF, 2013). It is uncertain to what extent this species occurs in the Plaisance-Ennery area, but being a tree-dwelling insectivore it is quite possible that *L. minor* populations are present. This would be true for the other tree-dwelling and generalists.[8] Though no caves were observed along this entire stretch of road, it is possible that several of the cave-dwelling species occur in the small caves reported in the Puilboreau and Plaisance areas (e.g., Yacouba cave near Plaisance), especially the more common species such as *Monophyllus redmani* (Klingener et al., 1978).[9] About a dozen bat species occur in the area given the assumption that all the tree-dwelling and generalists are present and the more common cave-dwelling species also occur.

[7] Many authors consider *L. minor* to be a subspecies of *L. borealis* whose distribution extends to parts of North America, Central America and South America (Wilig et al., 2010).

[8] Other tree-dwelling and generalists (in terms of roosting behavior) include *Noctilis leporinus, Molossus molossus, Nyctinomops macrotis, Macrotus waterhousii, Artibeus jamaicensis, Phyllops falcatus* and *Eptisicus fuseus* (Rodríguez-Durán & Kunz, 2001).

[9] Cave-dwelling species include *Tadarida brasiliensis, Mormops blainvillii, Pteronotus parnellii, P. quadridens, Brachyphylla nana, Phyllonycteris poeyi, Monophyllus redmani, Chilonatalus micropus, Erophylla sezekorni* subsp. *bombifrons* and *Natalus stramineus* (Rodríguez-Durán & Kunz, 2001).

CONSULTATION WITH STAKEHOLDERS

Meetings were held at the beginning of the consultation with personnel from IDB and MTPTC in Port-au-Prince (June 12-13). These meetings were organized to clarify the terms of reference relating to this biological study and to begin the process of divulging necessary information in order to meet the requisite policy measures set forth by IDB.

During the July 1-4 field surveys, several of the individuals and groups recommended by MTPTC were contacted (Annex 1). The biological survey team met with key stakeholders and members of communities lying between Ennery and Plaisance. Meetings were set up with the mayors of Plaisance and Ennery in order to explain the mission, objectives, methodology and anticipated results of the biological surveys and to move forward with a number of challenging environmental issues in the area. The mayors of Plaisance and Ennery enthusiastically welcomed the biological surveys and expressed interest in supporting conservation strategies and any necessary mitigation activities required to safeguard the natural heritage of this area of Haiti. In particular, the Ennery mayor expressed a need to support the newly founded "Agents Brigades Communales (ABC)" in the area of financial, technical and scientific assistance. ABC is currently assisting the municipality to monitor and enforce local *arrêtés communals* and *arrêtés municipals* designed to control free grazing, tree cutting, burning and house construction in ravines. This road project may serve as a catalyst to support such groups like ABC with measures designed to minimize long term road maintenance costs, maintain investment value and enact practical steps to conserve the biodiversity and natural habitats of the area.

IMPACTS OF ENNERY-PLAISANCE ROAD REHABILITATION

Direct, indirect and cumulative environmental impacts of the road project is both a function to what extent the construction designs disturb the current status of the habitats, the resilience of the respective species to such disturbance and biological factors inherent to each threatened species. The main *potential* impacts that the Ennery-Plaisance road project may have on the ecology and native species' populations are summarized in Table 2.

Table 2. Potential impact of road project on biodiversity of Ennery-Plaisance area (after Rajvanshi et al., 2007).

Project Activities	Ecological Impacts	Flora/Fauna Impacts
Design • Selection of route • Land consumption	• Loss of habitat • Fragmentation	• Population declines • Possible extirpation
Construction • Clearing of vegetation • Rehabilitation of road • Establishment of supporting infrastructure • Resource harvesting • Water extraction • Excavation and filling • Road surfacing and construction of culverts and drainage systems • Restoration of exposed areas, slope stabilization • Transportation of solid waste and dumping.	Changes in Habitat and Ecology • Reduced plant cover • Adverse changes in species diversity • Disruption of animal migrations • Invasion of exotic species • Increased pressure on natural resources • Changes in species' populations Water quality and hydrology • Increased runoff and erosion • Shifts in water balance • Increased sedimentation load and pollutants from runoff Soil and Productivity • Compaction of soil • Loss of productive soil • Decline in soil porosity and permeability to water • Destablilization of slopes and erosion	Habitat Loss, fragmentation • Habitat loss, disruption or fragmentation • Habitat modification • Decline in species sensitive to disturbance and sedimentation • Decline in vigor of flow-dependent ecosystems Barrier Effect • Obstruction of daily or migratory movement • Adverse change in habitat use and resource competition Induced Threats • Increased access to pristine areas • Increased hunting and poaching • Increased invasive species' populations • Increased probability of fire, traffic and other threats to native populations • Increased human-wildlife conflicts • Increase in resource exploitation

Project Activities	Ecological Impacts	Flora/Fauna Impacts
	• Generation of solid waste	
Operation • Traffic, movement of vehicles • Transportation of goods • Road maintenance	• Wildlife population depletion Air Quality • Pollution due emissions of gases (NOx, SOx, CO, HC, PM10) • Pollution due to combustion of fuels, road dust, material transformation Noise Pollution • Movement of traffic • Decreased buffer capacity of vegetation	Safety hazards and health impacts • Increased road mortality • Decline in animal and plant health due pollution • Competition for limited resources Long-term Impacts on biodiversity • Increase in in-breeding and declines in population size • Reduction in genetic diversity • Local extinction • Changes in flora and fauna behavior

Impact on Plants. The direct impacts of the road project are likely to be 1) reduced plant cover in the areas of construction, road excavation and fill and associated working areas, 2) increased populations of exotic and weedy species, often invasive, due to transport of propagules via equipment, increased traffic and site disturbance that favors such species at the expense of sensitive native species, 3) changes in species distribution and diversity due to changes in environmental conditions, particularly changes in hydrology, soil water balances, pollution, soil erosion and soil ecology.

None of the threatened species' populations are expected to show short- or long-term population declines due to direct impacts. This is mostly due to the fact that most of the area along the road section is highly degraded habitat. However, the risk of indirect impacts such as increased development due to increased land values and access to remaining forest patches in terms of resource extraction, hunting and poaching, are likely to increase.

The improved road is expected to stimulate economic activity that is likely to have a negative impact on native plant populations if such activity leads to a net increase in people residing in the area coupled with increased rates of urbanization and agricultural expansion. Insofar that one of the main threats to *Cedrela odorata* is a change in environmental conditions that reduce germination and recruitment rates of the species' population, the road cannot have a positive effect. However, the population of *Cedrela odorata* is so low in the area of the road that such effects are not likely to have significant impact on the overall population. If any impact were to occur, it would be in terms of eliminating ones or tens of individuals. The same would be true for the other commercially exploited species – *Guaiacum officinale.*

Impact on Birds. The additional impact of the road project on birds is both direct and indirect. The direct impacts are likely 1) a decrease in certain native species' populations due to an increase in noise pollution, both during construction phase as well as increased traffic flows following the project; 2) increased road mortality in proportion to an increase in vehicle speeds and traffic volume; and 3) decreased availability of nesting and breeding sites as a result of habitat loss in areas cleared for road expansion and affiliated construction activity.

Indirect impacts are associated with a net increase in development activities (urbanization, communication towers, agricultural expansion) that will have long-term effects on habitat quality and cause a decline in populations as a result of destroyed or modified nesting and breeding habitats. The increase in the human population along the road will result in increased predation rates because hunters and populations of rats, dogs, cats and mongoose increase in tandem. The ground-dwelling species and game birds are of particular concern, including *Corvus leucognaphalus* and *Patagioenas squamosa*. In the case of communication towers, it is the lighting that attracts nocturnal birds which are injured or killed when hitting the guy wires or towers. This lighting can be modified to reduce bird mortality to include motion sensors and domed security lighting (so that the lighting is invisible to the birds). Furthermore, single mast towers are recommended.

The disturbance associated with road construction and increased traffic volumes will favor certain bird species, like the common native *Tyrannus dominicensus* and non-native *Passer domesticus*, at the expense of uncommon native populations. While the direct effects are considered to be short-term and have a negligible effect on the threatened species' populations, the overall long-term effect of the road due the indirect impacts is negative. This is also true for the neo-tropical migratory bird species, such as *Catharus bicknelli*, since habitat loss and the lack of necessary food resources during the winter months are expected to be exacerbated by an increase of human populations in the immediate area of the road.

Impact on Amphibians and Reptiles. The main direct impact of the road on the herpetofauna is due the change in habitat conditions as a result of decreased humidity and increased temperatures that alter their behavior and mobility. An increase in traffic volume and speed will result in increased rates of road mortality, especially for the slower moving species and those that favor asphalt to regulate their body temperatures. The modification of hydrology, soil water balances and water quality on habitat favored by amphibians is of particular concern, especially for such species as *Hypsiboas heilpreni* and *Osteopilus vastus* that are associated with fast-flowing streams and mesic habitats in the ravines . As in the case of birds, certain species, such as *Osteopilus domincensis* and *Rhinella marina*, will benefit from altered habitat conditions at the expense of the threatened species.

The indirect impacts of the road associated with an increase in human populations, urbanization, agricultural activity and resource extraction will have a negative impact on most of the threatened herpetofaunal populations. Increased human traffic generally favors an increase in the predators associated with humans – cats, dogs, rats and mongoose and diseases, such as the chytrid fungus (*Batrachochytrium dendrobatidis*), that is causing worldwide declines in amphibian populations and is present in Haiti (C. Martinez, pers. comm.).

Impact on Fish. The road has two bridges that pass over the upper tributaries of the Trois Rivières river and numerous culverts that shed runoff directly into ravines that feed these tributaries. Direct impact of road construction and re-paving activities will result in increased sedimentation and pollution associated with petroleum-based products as well as increased channeling and peak flows during high rainfall events. These factors cause a decline in water quality and stress the aquatic systems, sometimes resulting in habitat loss, particularly for the vulnerable endemic species in the *Limia, Gambusia* and *Poecilia* genera. Indirect impacts of the road relating to uncontrolled development of ravines, streams and river banks will continue to cause a decline of local populations of these genera and possibly an increase in the incident of mosquito-borne diseases such as malaria and dengue. The latter is hypothetical but possible given the role that *Gambusia* play in the control of mosquito populations. The decline of the native fish populations is a result of both an increase in fishing and loss of suitable habitat for reproduction and recruitment of young fry, but also the increased threat of introduced species, particularly *Oreochromis*.

Impact on Invertebrates. The direct impact of the road on invertebrates is largely unknown due the paucity of data regarding the conservation status of the local species diversity and their habitat requirements. Only one species, the endemic freshwater crab (*Epilobocera haytensis*), was considered in this study. While it occurs along the banks of the main river channel, its primary habitat is the cooler streams that feed the river in the environs of Plaisance. It appears to be locally common and most of the streams that were visited pass through a relatively dense overstory of shaded-coffee plantations, plaintain plantations and a mix of timber and fruit trees (e.g., breadfruit, mango, avocado, Hispaniolan oak, snakewood, simarouba). In this case, the road project will have a negligible, if any, direct impact on current populations. However, over the long-term, indirect impacts of the road associated with urbanization, adverse changes in base stream flows and over-exploitation of the crab for food will likely result in population declines that could result in the extirpation of the species in several areas around Plaisance.

Impact on mammals. The only native mammals being considered are the bats. An inventory of the species occurring in the area of the road was not conducted, but possibly at least 8 species are present. The direct impacts of the road would be a result of habitat loss or modification, increased road mortalities and auditory disturbances associated with increased vehicle traffic and noise pollution.

MITIGATION OF ROAD IMPACTS

There are many approaches that can be taken to minimize or mitigate the impacts of the road project on the local biodiversity, particularly the threatened species. While it is much more difficult to avoid and mitigate the overall trends in deforestation and urbanization associated with the effects of the road on local economic development, direct impacts of the road project can be avoided, minimized, rectified, compensated or benefits can be enhanced if careful considerations are made during road construction and maintenance phases.

1. ***Timing of Project Activities.*** The timing of certain high-risk activities (e.g., sediment loads due excavation and dumping into streams and rivers) is critical in order to minimize the ecological damage and stresses to wetlands and riparian ecosystems. Timing issues may also be important for migratory birds in habitats proximal to the road, particularly during the October and November season when these species are selecting their territories in competition with local resident species. The most notable impacts associated with road construction activities relate to lighting (that attract and confuse birds), noise (that interfere with bat echolocation navigation systems) and vehicular traffic during times that certain species are migrating in search of food, nesting and breeding habitats. As such:

   Schedule high-risk, high-impact activities to calendar months when the animal species are less active, mainly the dry season when runoff is not as much a factor and when base flows are at their annual minimum; i.e. during November – March each year; restrict high-risk activities to daylight hours to minimize light and noise impact.

2. ***Setbacks.*** A dominant characteristic throughout the road segment is the private and indiscriminate use of public land – in many cases right up to the edge of the pavement. There does not appear to be any enforcement of a standard set back anywhere along the road despite a Ministry of Environment (MDE) sign admonishing the local residents to refrain from free grazing practices, burning, tethering animals near the road (Figure 11). The range of daily activities taking place at the edge of the road include charcoal manufacture (Figure 12), wood cutting, pasturing, gardening, markets (Figure 13), petty commerce, house construction, and vehicle maintenance. Generally, the road is inadequate to support the various modes of traffic ranging from large tractor trailers to pedestrians and animals.

Figure 11: Ministry of Environment Sign

Figure 12. Charcoal kiln alongside road.

Figure 13. Market alongside road near Ennery.

The establishment of vegetation on both sides of the road, if properly designed and managed, can buffer much of the adverse effects of the road on the biodiversity. Since the roadsides are also much used for foot and animal traffic, and where resettlement of people and agricultural land take is not required i.e. on unoccupied public land:

Plant creeping, sod-forming native grasses (e.g., *Digitaria horizontalis*) that can bind the soil while complying with safety issues along road margins.

Plant trees along road margins, however trees should not be planted as close to the road as generally the case in Haiti, particularly exotic invasive species (e.g., *Azadirachta indica, Casuarina glauca*). In several locations along the road, planted trees are too close to utility cables, even touching them as shown in Figure 14. Safety reasons as well as maintenance issues relating to utility lines and compliance with IDB guidelines regarding invasive species should be considered.

Figure 14. *Casuarina glauca* touching utility

Standard setback distances for trees should be further than utility poles and approximate the mature height of the tree - 20 m being a reasonable distance. Tree species selected for planting should be known for their resistance to wind and saturated soil conditions. Native species that show such characteristics include Mapou gris (*Bourreria* sp.), Gommier (*Bursera simaruba*), Bois Capable (*Colubrina arborescens*), Bois Soumi (*Cordia alliodora*), Gaïac (*Guaiacum officinale*), Campêche (*Haematoxylon campechianum*), Latanier (*Sabal domingensis*) and Acomât rouge (*Sideroxylon salicifolia*). A more complete list of species can be found in Timyan (2010).

The threatened *Cedrela odorata* can also be planted, but provides medium wind resistance and would have to be pruned to increase terminal branch strength and decrease canopy wind resistance. Pruning would also enhance lumber value for which reason the species would be planted on private land. Due the increased aridity of site conditions in proximity to the road, the improved Honduran variety of *Cedrela odorata* is recommended.

Planting and reforestation of the right of way would work well in partnership with the Municipality (see Actions 3 and 6) who would have longer term responsibility for maintaining these areas. The management of these areas will require the involvement and commitment from local partners and the legal basis for implementation. As indicated, planting should be restricted to native species.

3. ***Slope Stabilization.*** The steep slopes adjacent to the road are extremely fragile and risk failure during extreme rainfall and flooding events.

   Plant grass sod, deep-rooted herbaceous species, such as ***sterile*** varieties of vetiver grass (*Chrysopogon zizanioides*), and small native shrubs in dense contour strips.

   Install erosion mesh to reduce exposure of bare soils and prevent channeling and gullying of runoff.

4. ***Drainage and Sedimentation Control.*** To increase the likelihood of road culverts being used as wildlife corridors, especially for the herpetofauna, and to decrease the amount of road mortality:

   Rehabilitate/expand existing road culverts to optimize their functionality .

   Maintain such culverts free of debris as part of the project under "Plan d'Entretien".

   The improved drainage of the road will impact hydrological dynamics and will require designs to avoid soil loss and mass movement of rock and mud slides. The ravines shedding water off the road are undergoing active erosion, as evidenced by deep channel cuts at various points along steep gradients south and north of Puilboreau.

   Provide additional reinforcement of rock dams to slow down runoff velocities and increase infiltration rates in vulnerable areas .

   Provide stormwater retention basins and silt traps to decrease sedimentation rates proximal to natural water courses.

5. ***Invasive Species.*** Disturbed sites generally favor aggressive species that out compete native species and alter the ecology of the flora and fauna. Currently there is little control of invasive species in Haiti, either plant or animal. Certain native species, such as *Leucaena leucocephala* subsp. *leucocephala,* are also invasive and should be avoided. The most common exotic invasives found along the road include *Amaranthus dubius* (herb), *Azadirachta indica* (tree), *Bothriochloa baldhii* (grass), *Casuarina glauca* (tree), *Cynodon dactylon* (grass), *Eleusine indica* (grass), *Melinis repens* (grass), *Panicum maximum* (grass), *Spagneticola trilobata* (herb), and *Themeda quadrivalvis* (grass, Figure 15). In order to avoid contributing to the ecological problems of such species, especially those that are exotic:

Figure 15. Invasive *Themeda quadrivalvis.*

Use only native plant species for any landscaping, slope stabilization, tree planting or aesthetic purpose.

6. ***Partnerships to Enhance Biodiversity Conservation.*** These partnerships and collaborative efforts would be between donor-financed projects and local government and non-government organizations involved in conservation activities. For example, the mayor of Ennery expressed great interest to include the newly formed *Agents Brigade Communale* (ABC) in any remediation or regulatory effort to support conservation efforts in the Ennery commune. The Ennery municipality has received assistance from Groupe d'Action Francophone pour l'Environnement (GAFE) and expressed additional assistance from Société Audubon Haïti (SAH). ABC is helping the mayor to monitor several *arrêtés communals* in the commune. Activities such as mobilizing local groups to plant trees, enhancing signage e.g., working with the MDE in establishing clear signage as to the rules of engagement, and establish native vegetation on vulnerable slopes could be considered. UCE/MTPTC with IDB support to:

Engage local organizations to implement strategies that protect the investment of road improvements and economize on the costs of maintenance.

SUMMARY TABLE

Impacts and risks	Mitigation measures
Changes in vegetation along road edge directly through construction or indirectly through increased access	Revegetation and maintenance of setback using native plants Slope stabilization in all intervened or exposed areas
Invasion by exotic weed species along road edge	Revegetation and maintenance of setback using native plants
Increased mortality of fauna crossing the road	Enhance culverts and bridges to improve faunal crossings
Increased sedimentation and contamination decreasing water quality in streams and rivers	Strict controls on drainage, erosion, and sediment runoff during construction Incorporate into road design, mechanisms to reduce sediment runoff and high flows that may drive erosion Minimize work during periods of heavy rainfall Slope stabilization in all intervened or exposed areas Periodic monitoring of water quality in streams and adaptive management of impacts
Increased exposure to hunting and harvesting along the road	Enhanced implementation of management controls with the Ministry of the Environment and Municipalities

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Annex 1. List of individual and institutional stakeholders along the Ennery – Plaisance road.

Location	Organization	Individual	Tel. No.
2ème Section Ennery	Conseil d'Administration de la Section Communale (CASEC)	Josias Granvil	3314-8270
4ème Section Puilboreau	Conseil d'Administration de la Section Communale (CASEC)	Louis Dieudonné*	3739-2315
4ème Section Puilboreau	Assemblée de la Section Communale (ASEC)	Augustin Micanor	3693-8474
4ème Section Puilboreau	Assemblée de la Section Communale (ASEC)	Ernst Similien	3718-7292
4ème Section Puilboreau	Assemblée de la Section Communale (ASEC)	Dezemo Elistor	3643-7304
4ème Section Puilboreau	Assemblée de la Section Communale (ASEC)	Jean Abraham	3650-8087
Puilboreau	Mouvman Fanm Solid Pilboro (MFSP)	Fenelus Renelus	3771-7487
Bwad Chènn	Groupman Leve Kanpe Bwadchenn (GLKB)	Marc Fils-Aimé	4847-5215
Bois Neuf	Asosyasyon Peyizan Bwa Nef (APB)	Jean Wilson	4752-2292
Lasalle	Brase Lide Lasal (BLL)	Philémon Emmanio	3660-8900
Jumo	Asosyasyon Fanm pou Devlope Jumo nan Pilboro (AFDJP)	Jean Louis Syltane	3145-7048
Jumo	Assistant to biological field survey team	Choute Tavius	3600-2799
Puilboreau	Projet de Developpement Communal (PRODEC)	Delavarre Dieuseul	3750-9099
Lamòt	Tèt Kole Lamòt (TKL)	Cepaudy Irleus	3627-8075
8ème Section Gde Rivière	Conseil d'Administration de la Section Communale (CASEC)	Frantz Henry Revenge	3817-0318
Plaisance	Maire	Anthony Josaphat*	3823-7484
Ennery	Maire	Uvens Alexis*	3845-1288
Ennery	Agents Brigade Communale	Uvens Alexis*	3845-1288

* Met during the biological field survey.

Contacts at Ministère de Travaux Publiques, Transport et Communications (MTPTC), Banque Inter-Américaine (BID), SNC-Lavalin, and LGL.

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SNC-Lavalin	Philippe Larouche	2813-1813	philippe.larouche@snclavalin.com

Annex 2. Species not listed in IUCN Red List, but occurring in habitats along the Ennery – Plaisance road.

Amphibians and Reptiles present in the road area of Ennery-Plaisance in addition to Table 1 species. LC = Least Concern, NA = Not Assessed.

Species	IUCN Status	Likelihood E-P Area	Notes
Amphibians			
Eleutherodactylus abbotti	LC	Yes	Widespread. Observed during this study.
Eleutherodactylus inoptatus	LC	Yes	Widespread.
Osteopilus dominicensis	LC	Yes	Widespread. Observed during this study.
Rhinella marina	Intro.	Yes	Widespread, common in agricultural areas.
Reptiles			
Amphisbaena manni	NA	Yes	Widespread.
Ameiva chrysolaema	NA	Yes	Widespread. Observed during this study.
Ameiva lineolata	NA	Yes	Localized in dry riverbeds, open or under bolders.
Ameiva taeniura	NA	Yes	More mesophilic than *A. chrysolaema* with ground and tree cover.
Anolis aliniger	NA	Yes	Widespread in mesic vegetation.
Anolis chlorocyanus	NA	Yes	Widespread. Observed during this study.
Anolis christophei	NA	Yes	Along mesic ravines & streams.
Anolis cybotes	NA	Yes	Widespread. Observed during this study.
Anolis distichus	NA	Yes	Widespread. Observed during this study.
Anolis eugenegrahami	NA	Maybe	Along mesic ravines & stream in Plaisance area.
Anolis olssoni	NA	Yes	Xeric grassy dry riverbanks in Ennery area.
Anolis ricordii	NA	Yes	Uncommon in mesic wooded areas.
Anolis rimarum	NA	Maybe	Along Puilboreau-Marmelade ridge in mesic limestone tallus.
Anolis semilineatus	NA	Yes	Widespread.
Celestus costatus	NA	Yes	Widespread.
Celestus curtissi	NA	Yes	Widespread.
Celestus stenurus	NA	Maybe	More xeric than *C. costatus* in Ennery area if present.
Epicrates gracilis	NA	Yes	According to local informant in Gimeau. Listed on CITES Appendix II (UNEP-WCMC, 2008).
Hypsirhynchus ferox	NA	Yes	Widespread.
Hypsirhynchus parvifrons	NA	Yes	Widespread.
Ialstris dorsalis	NA	Yes	Becoming rarer, special concern (Henderson & Powell, 2009).
Leiocephalus personatus	NA	Yes	Plaisance area.
Leiocephalus pratensis	NA	Yes	Xeric vegetation along gullies in Ennery area.
Leiocephalus schreibersii	NA	Yes	Xeric vegetation, under rocks in gardens in Ennery area. Observed during this study.
Sphaerodactylus altavelensis	NA	Yes	Xeric vegetation (*Agave,* cactus) in Ennery area.
Sphaerodactylus cinereus	NA	Yes	Xeric-mesic conditions under surface debris, wall slats.
Sphaerodactylus difficilis	NA	Yes	Ennery area.
Typhlops pusillus	NA	Yes	Widespread.
Uromacer catesbyi	NA	Maybe	Occurs according to local informant in Gimeau.
Uromacer oxyrhynchus	NA	Yes	Widespread.

Endemic fish species likely to occur in the Trois Rivières and its tributaries (FishNet2, 2013; Vlmanick, 1990).

Species	Endemism	Habitat
Limia pauciradiata Rivas, 1980	Hispaniola	Pools and marshy areas near river and streams; canals.

Limia tridens Hilgendorf, 1889	Hispaniola	Pools and marshy areas near river and streams; canals.
Poecilia hispaniolana Rivas, 1978	Hispaniola	Shallow shoals & riffles of streams and river.

Bird species observed during this study along the Ennery – Plaisance road (July 2-4, 2013). BR = Breeding Resident, LC = Least Concern, VU = Vulnerable.

Species	Latta et al. Status	IUCN Status		Notes (Number observed)
Anthracothorax dominicus	BR	LC		(4). Abundant in semi-arid forests
Bulbulcus ibis	Intro. BR	LC		(10). Common around settlements.
Buteo jamaicensis	BR	LC		(2). Fairly common in mountain broadleaf and pine forests.
Coccyzus longirostris	Endemic BR	LC		(5). Common in shade-coffee plantations and agricutural areas.
Cooereba flaveola	BR	LC		(8). Common in shade-coffee and tree gardens.
Columbina passerina	BR	LC		(9). Common in agricultural areas of lowland and mid elevation mountains.
Corvus leucognaphalus	Threatened Endemic BR	VU		(4). Uncommon resident of lowland rural wooded areas. Declining populations due to habitat loss and hunting pressures.
Crotophaga ani	BR	LC		(6). Common in all low- and midland elevation agricultural and forest areas.
Dulus dominicensis	Endemic BR	LC		(29). Common in all low- and midland elevation agricultural and forest areas.
Euphonia musica	BR	LC		(1). Uncommon, found in trees with mistletoe, its favorite food.
Falco sparverius	BR	LC		(5). Common in all low- and midland elevation agricultural areas, particularly open areas.
Loxigilla violacea	BR	LC		(4). Common in dense brush and tree canopies of lowland and mid elevation forests.
Melanerpes striatus	Endemic BR	LC		(27). Common in wooded areas.
Mellisuga minima	BR	LC		(14). Common in open wooded areas.
Mimus polygottos	BR	LC		(16). Common in all lowland and mid elevation forests and settlements.
Myiarchus stolidus	BR	LC		(2). Common in dry to mesic forests.
Passer domesticus	Intro. BR	LC		2 seen. Common in urban and lowland settlement areas.
Patagioenas inorta	Threatened BR	VU		Not observed, but Watson (2008) noted presence during his survey along the Plaisance road to Limbé.
Patagioenas squamosa	Threatened BR	LC		(27). Fairly common in mosit broadleaf forests, but declining populations due to hunting pressure and habitat loss.
Phaenicophilus palmarum	End. BR	LC		(17). Common resident in all forest types east and north of Jacmel Depression.
Ploceus cucullatus	Intro. BR	LC		(1). Common in settlement areas and agricultural pest, particularly rice fields.
Streptoprocne zonaris	BR	LC		(1). Moderately common in mid- to upper elevation broadleaf and pine forests.
Tiaris bicolor	BR	LC		(3). Common in open grassy areas.
Tiaris olivaceus	BR	LC		(20). Common in open grassy areas.
Todus subulatus	End. BR	LC		(11). Common in all forest types up to 1700 m.
Tyrannus dominicensus	BR	LC		(17). Common in open forest types.
Vireo altiloquus	BR?	LC		(12). Common breeding visitor of lowland forest types.
Zenaida macroura	BR	LC		(7). Common in all low- to mid-elevation agricultural and forest areas.

Annex 3. Additional photos of biodiversity field study of Ennery – Plaisance road rehabilitation project.

Photo 1. Endemic *Anolis chlorocyanus* perching on a branch of native *Citharexylum fruticosum.*
Photo 2. Native moth (*Ctenuchidia* sp.) feeding on nectar of *Citharexylum fruticosum.*

Photo 3. Truck dumping fill dirt/gravel waste into Ennery River.
Photo 4. Threatened endemic *Epilobocera haytensis* (juvenile) in upper tributary of Trois Rivières near Plaisance road.

Photo 5. Typical freshwater habitat of *Epilobocera haytensis* near Plaisance.
Photo 6. Man harvesting *Casuarina glauca* on the side of the road.
Photo 7. Native orchid species occurring alongside Plaisance road.