Commentary, questions, and concerns regarding the Environmental Impact Assessment (EIA) conducted by Conrad Douglas and Associates Limited and Archaeological Impact Assessment (AIA) prepared by the Jamaica National Heritage Trust regarding an environmental permit for SML-173 to mine bauxite Applied for by the Noranda Jamaica Bauxite Partners II (NJBP)

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I have over 10 years of experience in conservation research, environmental field work, and biodiversity. I have done research focused on the biogeography and ecology of Jamaican land snails. I have conducted field research of indigenous Jamaican land snails in Cockpit Country, including the area proposed for SML-173. My advisor in the Jamaican snail research is Gary Rosenberg, Ph.D. Dr. Rosenberg has studied Jamaican land snails since 1988, and is intimately familiar with the molluscan fauna of Jamaica having published several studies on Jamaican land snail taxonomy, molecular phylogenies, and diversity (Rosenberg and Muratov 2006; Nekola and Rosenberg 2013; Uit de Weerd et al. 2016; Sei et al. 2017).

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Conclusion Summary:

This EIA is poorly organized, executed, and inadequately performed, and based on the following commentary provided, I reject this EIA. No evidence is provided for adequate taxonomic surveying techniques for any given taxon, and methodology described is confusing and unclear. Several times throughout the report, citations and literature are referred to but not adequately cited or no citation is provided. There is failure to summarize molluscan taxa accurately and adequately in the area described given that it is well-known to be a very diverse area for land snails and slugs. The land-use data is outdated, and the EIA could have obtained access to the updated version from Forestry Department. There is no description or discussion of how karst limestone is integral to the floral and faunal ecosystems and landscape of the region, and how the disturbance of such is known to disturb indigenous species. Karst limestone is also strangely described as “hillocks” and “cockpits” without acknowledging that the land connecting the karst limestone hills is necessary for ecosystems to thrive. The report claims that the area is mostly grassland, however given the landscape and known biodiversity of the area, this is inaccurate. Discussion of environmental remediation is vague, and no evidence provided as to how this could be done in such a way that does not cause harm to the ecosystem or human residents. In addition to the environmental impact, the survey fails to adequately include the cultural and historical importance of the Maroon history and heritage. This EIA does not consider nor discuss in detail the level of displacement of people and destruction of habitat this proposed mining operation would cause.

This EIA is poorly organized, executed, and inadequately performed, and based on the following commentary provided, I reject this EIA. The following commentary, questions, concerns, and statements are provided to point out the flaws, inaccuracy, and inadequacy of the EIA. Commentary is provided in detail to provide insight as to where the EIA should be improved when a follow up EIA is performed.

(Page numbering corresponds to the 711-page pdf count)

1. 183/711 – The EIA discusses ground truthing and mentions that the literature (with no citation provided) indicates that the vegetation is generally homogenous. Without a proper citation, specific examples, and photo evidence, this is a sweeping statement with nothing to back it up. Voucher specimens should be collected, identified, verified by floral experts, and submitted to the Natural History Museum of Jamaica for their natural history collections.

2. 183/711 – The EIA discusses how they randomly divided the 8335 ha into 9 random blocks, but then goes on to say that the 9 blocks covered more than 50% of the 83335 ha – which is it? The EIA report then goes on to say that they analyzed 7 out of the 9 blocks and that's more than the 20% that they say they are required to analyze. The report does not mention where the requirement comes from; why only 20% is adequate; and if there is a citation for the reasoning of only 20% of the total area. These percentages are confusing, no citations are provided, and the divisions seem arbitrary. If the area was randomly divided, they should be citing what method they used to divide the land randomly.

3. 196/711 – The EIA discusses the floral identification techniques and say "…'close in' as defined by the paper" but does not provide a citation. Inadequate citations only contribute to the poor quality of the environmental assessment as each claim or assertion should have supporting evidence. It is commonplace in any report or publication to have a detailed methods section where the citations for the methodologies employed are provided.

4. 196/711 – Towards the end of this page, the EIA discusses the low-lying areas of this region. It basically states that the low-lying areas' biodiversity would not be impacted since most of the biodiversity is on the "hillocks", but that is not how ecosystems work. The low-lying areas connect the karst limestone hills, so any disruption in the flow between low-lying areas to areas of higher elevation would be affected. Additionally, the use of "hillock" is inaccurate that it dismisses how integral the karst limestone is to the area in terms of the biodiversity they support. The theory of island biogeography focuses on islands, but it is also discussed in reference to places like the Cockpit Country and adjacent areas that have similar geomorphology and species composition (MacArthur and Wilson 1967). Hills and mountains are connected by their low-lying areas and if these areas are disrupted, then the flora and fauna of the areas may experience lower genetic diversity since the connectivity between habitats and populations of species was disrupted (MacArthur and Wilson 1967).

5. 196-197/711 – The EIA discusses the quadrat size of the vegetation survey plots along the transect, but it is unclear how the data are actually being collected since multiple methodologies

are discussed. The methods discussed are not necessarily efficient for evaluating floral diversity, especially since no detailed modeling or results are discussed other than an attempt at a species list.

6. 201/711 – On Table 5-9, the waypoints were listed for the transects completed for the survey. The length of the transects were not mentioned, the GPS locations of the quadrats that were supposedly surveyed were not listed; and the EIA report does not discuss how plant samples were collected or if they took photos or samples of unidentified species. Again, as discussed in the previous comment, it is unclear how the data are being collected and analyzed. Multiple methodologies are discussed but not necessarily outlined in detail as to how the surveys were done. How far apart were the quadrats? How long were the transects? Were all plants in the quadrat surveyed? Was canopy accounted for? Were non-vascular-plant life accounted for like lichen, moss, and terrestrial algae? These items need to be addressed in a floral survey.

7. 200/711 - Figures 5-61 through 5-67 give visuals of transects as a point when they should be lines as the word “transect” indicates. It is still unclear what the lengths of the transects were. If bird point counts were included along these transects, they may not have been done properly given that if the points were not at least 200 meters apart, there would be overlap of species and therefore double counting of birds would have occurred. Again, these factors were not addressed so the lack of information is inadequate for the assessment.

8. 217/711 - Section 5.3.2.2.2 Herpetofauna methods: The EIA is still not specific about localities or methods, and this section is generally confusing and vague. The quadrat method is mentioned and that they were done along a transects but specific GPS points were not provided. Locality data should be reported for amphibian and reptile data collection. Additionally, the researchers spent only 90 minutes doing this survey which is insufficient time to do a proper herpetological survey. Many herpetological researchers will spend several hours over a series of days in a small area to make sure that all species were documented due to the difficulty of detecting amphibians and reptiles, however it should be noted that field methods will vary dependent upon the taxon being studied (Rice et al. 2004; Mazerolle et al. 2007).

9. 219/711 - Arthropod methods: The EIA does not discuss specific localities of arthropods surveyed, and species were not always identified to the species level. The light trap that is demonstrated in the photo is not the appropriate way to attract insects to a light trap. In order to maximize the attraction of insects to the sheet, the lighting should be under the sheet, not facing it on a small area. By placing the light under the sheet, it allows the light to illuminate the entire sheet and create a larger area in which to attract nocturnal insects to the light trap.

10. 223/711 5.3.2.2.4 Gastropods: The assessment methods were not discussed nor any efforts or techniques for identifying molluscan species identification which they did for other sections such as plants.

11. Beyond the plant survey methodology section, methods for identification were not discussed in any sort of detail, and the mollusc results indicate that at least some portion of the species discussed throughout the EIA were not identified properly.

12. The land-use data referred to in the EIA is from 1999-2000, but there is updated land-use data available through Forestry Department and NEPA that the authors of this report should have referred to when discussing land use.

13. Mitigation methods as discussed on PDF page 465/711, section 8.1, that would occur as a result of mining are only vaguely discussed and not specifically planned. Mitigation measures need to be explicit and backed by evidence in order for them to be seriously considered. Any disruption to the ecosystem in SML-173 will disrupt adjacent ecosystems, and sufficient mitigation measures would be difficult to accomplish in a satisfactory manner. The methods claim that the mined area will revert to its original state once rehabilitated, but rehabilitation methods are not discussed in detail. It is stated that displacement of biodiversity "can be replaced upon completion of rehabilitation", but again no mitigation plan is outlined in detail as to how this will occur. The methods also state that the "loss of vegetation" can be "easily replaced once operations cease". As with all of the aforementioned claims from the EIA, there are no detailed nor discussed mitigation plans which should include items such as detailed biodiversity assessments, nor what kinds of impacts would mining operations would actually cause on biodiversity.

Although the level of impact is discussed in a series of tables starting with Table 7-1 (442/711), there are no citations or evidence provided that the time frames suggested are what actually occurs and the discussion of impacts is confusing and unclear. For example, Table 7-1, outlines what the levels of impact would be for particular items such as ecological effects, stakeholders, socio-economic effects, and consequence for proponent. In regards to ecological effects of Table 7-1, the level of impact varies depending on the recovery potential which "major" is anything longer than two years, and "moderate" is anything within two years; with minor and levels below that seen as "natural variability". What is this two-year period based on? Is it based on the known recovery of a particular species of plant or animal? Why is two years considered to be an acceptable amount of recovery time? This is not a seasonal, natural event like hurricanes where the flora and fauna of the island have evolved to deal with this reoccurring natural event (MacArthur and Wilson 1967; Pederson et al. 2009). Mining and the associated pre-operations, present-operations, and post-operations effects can completely change an area for decades or even longer through negative impacts such as acid mine drainage, poor water quality, and extirpation of species (Hogsden and Harding 2011; Stretesky and Lynch 2011).

In the next table 7.1. Impacts to Physical Resources, where specific impacts are actually rated, there is no evidence provided as to how these ratings are accurate. For pre-operations under Project Design & Engineering, Item A1, suggests that there could be possible flooding of adjacent lands due to the design and engineering of haul roads and mining of orebodies. The magnitude of this impact is suggested to be low in magnitude and short-term in duration, and considered a local and minor negative level impact. However, if there is possible flooding to adjacent lands, there is no discussion of whether this flooding is temporary (minutes to several hours) or short-term (days) or long-term (weeks to months to years). If this is supposed to be short-term, it may not be absolutely devastating; but given that this is not an aquatic area, any level of flooding where there may not normally be could be a major level of negative impact to local terrestrial flora and fauna and cause local extinction. A greater level of detail with evidence to support the claims is needed to take any of these mitigation measures and efforts seriously.

14. The molluscan results as reported are either inaccurate or misleading. The photos provided in the report are insufficient for confirming identification. Photos of the aperture, dorsal view, ventral view, and a view which includes all the whorls are the minimum needed to identify the shell. Additionally, like other taxa, specimens should have been collected and deposited to the Natural History Museum in Kingston for their natural history collection.

It is claimed that *Thelidomus congata* (not cognate as it is misspelled) was found while doing surveys, however this species does not occur in Cockpit Country. This species (*Thelidomus cognata*) only occurs in the western part of Jamaica, specifically Westmoreland and Hanover Parishes. The species that the surveyors likely saw was instead *Thelidomus aspera*. However, if the surveyors had done a sufficient literature and data search, they would have found publicly available terrestrial molluscan species range data available through iDigBio. Among other things, iDigBio takes museum collection data and makes it publicly available so that they data may be accessed, studied, and analyzed. The data referenced in Figures 1 through 5 are available through iDigBio (2020), and the majority of it was collected during the Jamaican Biotic Surveys conducted by Gary Rosenberg and associated researchers from 1999-2002 (Rosenberg & Muratov 2006). Despite the EIA (on PDF page 311/711, Section 5.3.3.4.2.5. Gastropods) stating that there is no available checklist, the publication by Rosenberg and Muratov (2006) does include a checklist of species for the island on pages 141 through 161 (Rosenberg and Muratov 2006), and a copy of the open-source publication is attached to the email containing this commentary submission. Figure 2 shows the geographical range of *Thelidomus aspera*, which is likely the species that the surveyors saw in their surveys. The only place these two species consistently overlap is in the western side of the island (Figure 3).

It is reported that *Pleurodonte peracutissima* was found while conducting the surveys. Figure 4 shows that this is certainly possible given that this species, now called *Dentellaria peracutissima* (Uit de Weerd et al. 2016), occurs in and around the SML-173 area. However, it is not the only species in this family (Pleurodontidae) or genus. Figure 5 shows the range of all pleurodontid snails within the SML-173 and adjacent areas. There are several pleurodontid species within SML-173 and some of which are more common than the supposed documented species. Again, this identification of *Dentellaria peracutissima* can only be confirmed with the proper techniques as summarized above. Additionally, if the reporters had done sufficient research, they would have been more familiar with the updated taxonomic literature of the species' name.

Additionally, there are many species that occur within the cockpit karst of this region, including SML-173. Specifically, there are at least 103 species within SML-173 alone which includes 8 undescribed and unnamed species which require further surveying and study to describe and name (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). When looking at the border of SML-173 and the species found within one kilometer of the border, another 28 species can be found which brings the count up to 131 (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). There are more species of molluscs that can be found within five kilometers of SML-173 (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). Although I accessed the discussed data through an internal digital portal of the Academy of Natural Sciences of Philadelphia (ANSP), this species range data is publicly available through iDigBio and can be shown using basic GIS techniques using software such as Google Earth (Google LLC 2020) or open-source QGIS (QGIS.org 2020). Had the surveyors done sufficient research and field methodologies, they would have found more than three species of land snails and slugs. Jamaica has over 500 species of endemic land snails (Rosenberg & Muratov 2006), and it is very easy to

find them throughout the island without much effort. Basic techniques such as turning over leaf litter and rocks will yield several mollusc species (Sturm et al. 2006).

Closing Statements and Conclusions:

The EIA has failed to accurately and clearly report the methods, the results, any modeling or analysis as a result of the collected data, and what mitigation efforts would occur as a result of the mining. SML-173 is in close proximity to the proposed Cockpit Country Protected Area, and it would be unwise and detrimental to the environmental health of the area to disrupt the continuity of habitat and displace species that may not be found elsewhere on the island. As discussed, there are many species within and adjacaent to SML-173, several of which cannot be found elsewhere on the island and require further study to better document and understand them. Jamaica's molluscan diversity is highly localized and when one area is disrupted for mining, quarrying, or damming, it can have a devastating effect on the local endemic species and contribute to their extinction.

Citations

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Figures

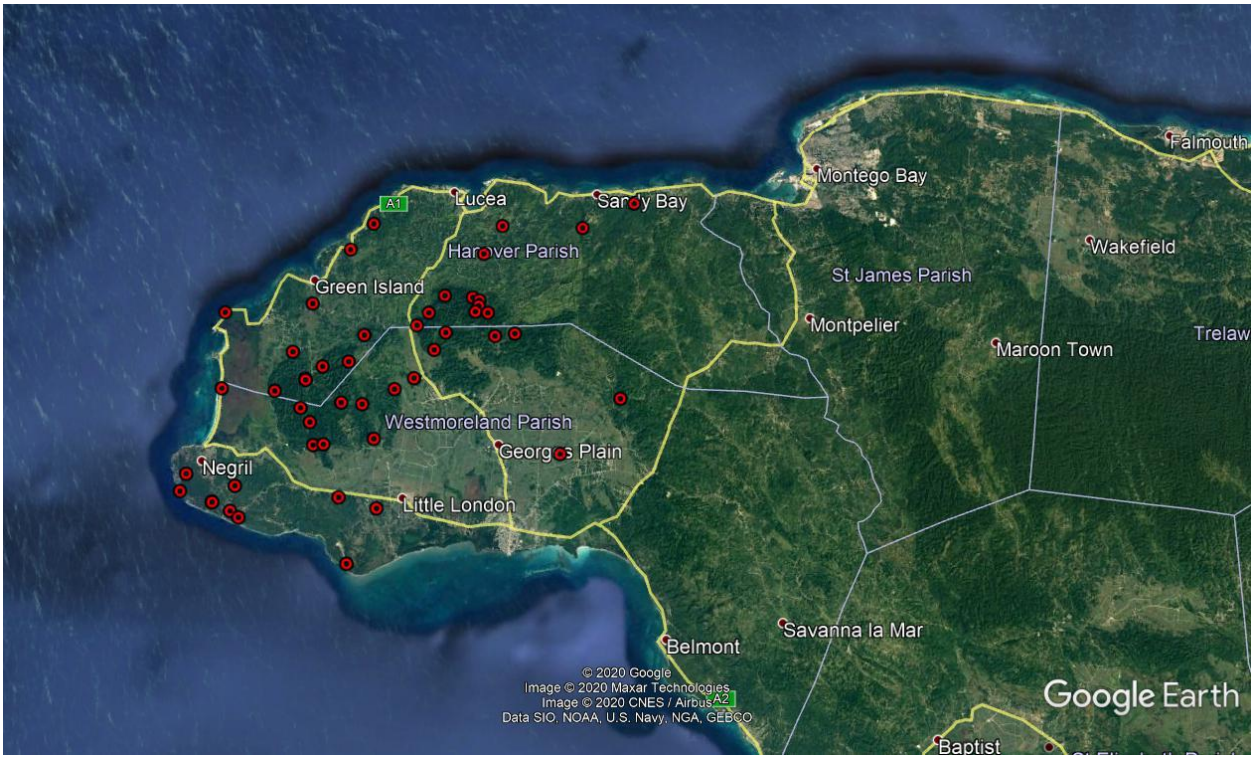

Figure 1. A map of western Jamaica with the species range data of *Thelidomus cognata* (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). This data is publicly available through iDigBio and the ANSP Malacology Collection website.

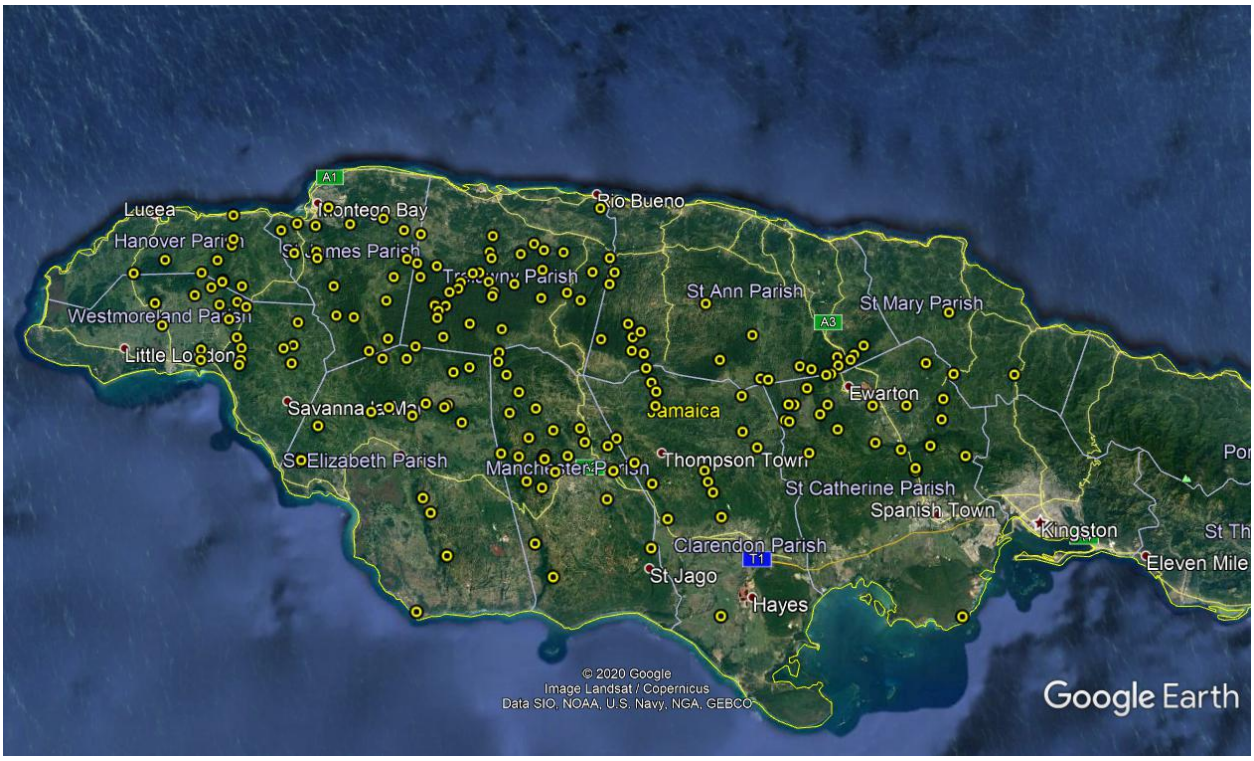

Figure 2. A map of Jamaica with the species range data of *Thelidomus aspera* (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). This data is publicly available through iDigBio and the ANSP Malacology Collection website.

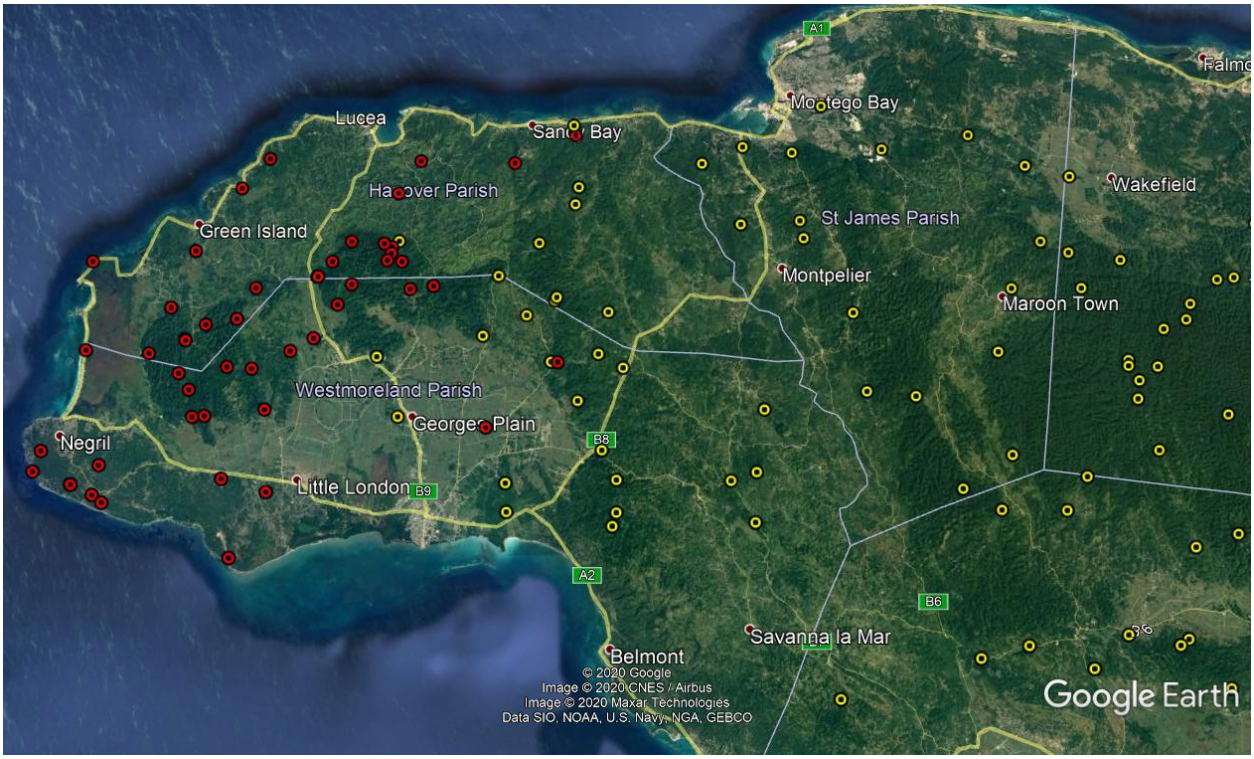

Figure 3. A map of western Jamaica with the species range data of *Thelidomus aspera* and *Thelidomus cognata* (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). This data is publicly available through iDigBio and the ANSP Malacology Collection website.

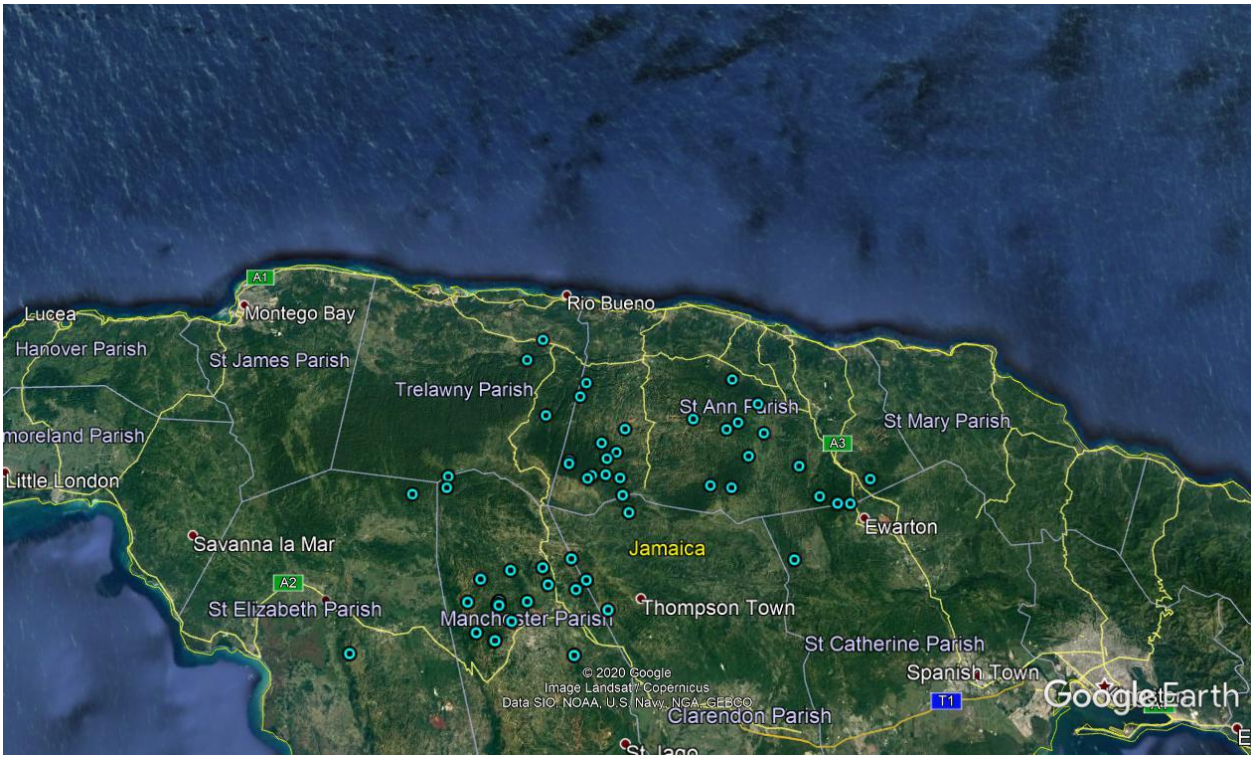

Figure 4. A map of the species range of *Dentellaria peracutissima* within Jamaica (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). This data is publicly available through iDigBio and the ANSP Malacology Collection website.

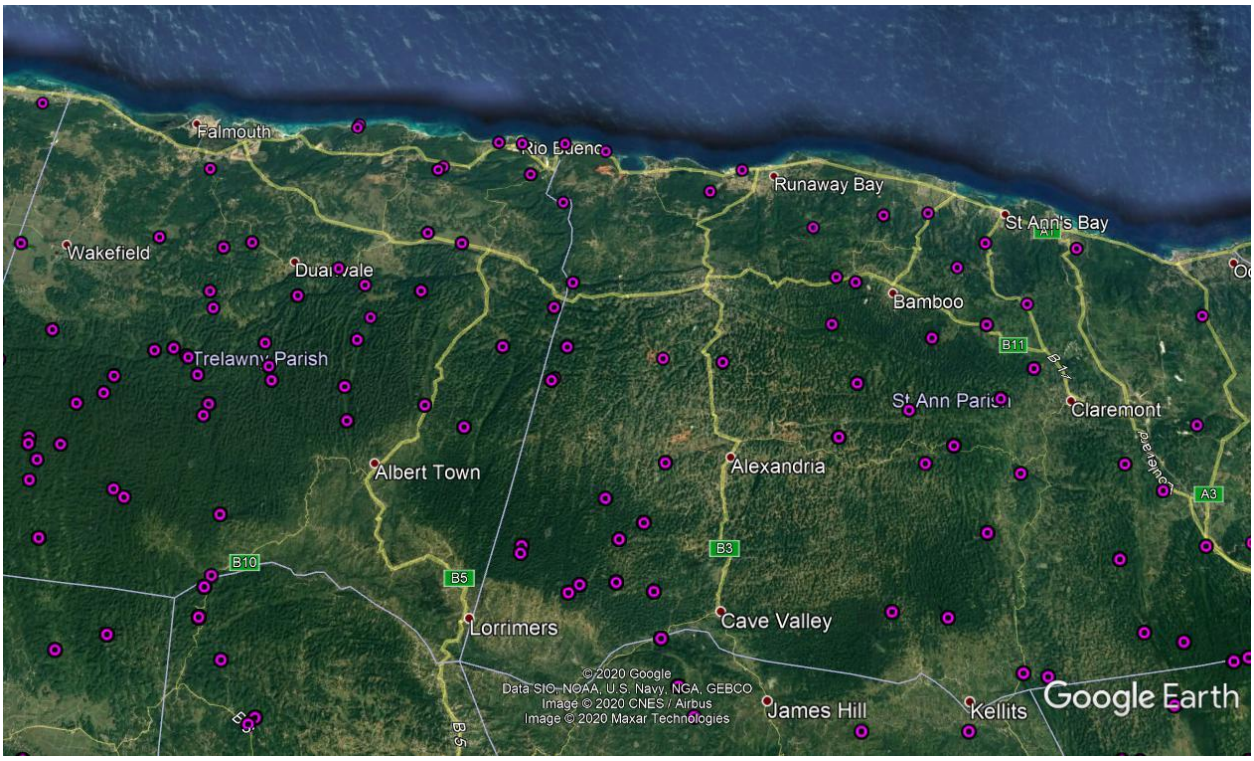

Figure 5. A map of the species range of Pleurodontidae species within northern-central Jamaica (Jamaican Biotic Survey Dataset 2019; Google LLC 2020). This data is publicly available through iDigBio and the ANSP Malacology Collection website. The purple indicates that there is more than one species found at a particular locality.