

Appendix U: Monitoring Environmental Conditions

Summary

The operational team will monitor environmental conditions in the months preceding the operational window to assess if the environmental conditions on Desecheo during the target operational windows March/April 2016 reach a point that suggest a unacceptable risk of operational failure. This document outlines the strategy that will be used to evaluate environmental conditions on Desecheo leading up to the implementation.

It is difficult to objectively assess how observed short term environmental changes pose a risk to operational success. Consequently, many of the criteria used to evaluate risk will be subjective and biased towards individuals with extensive experience of the island. The operational strategy was designed to account for unfavorable environmental conditions, however operational efficacy is the primary objective and the operation should not be conducted under all observed conditions.

In evaluating the risks posed by environmental conditions the project team should determine if observed and predicted environmental conditions will lead to increases in natural food availability and rodent breeding. If the conditions are similar to or worse than those observed during the previous eradication attempt in 2012, consideration should be given to delaying or postponing project implementation.

The final decision to proceed with the eradication will likely be made immediately before the implementation by the Steering Committee. Prior to this decision, regular assessments will be completed to build a cumulative picture of changing environmental conditions. However, if conditions are observed during one of these assessments that pose significant risks to project efficacy the decision to postpone or delay may be made at that time.

Objective

Monitoring of environmental conditions on Desecheo is designed to periodically evaluate the risk that short term climatic changes could trigger higher productivity which would result in (1) more food availability (2) increased opportunities for rodent breeding and, (3) increased bait competition due to invertebrate abundance. High primary productivity is thus expected to decrease the rate at which rodents could encounter bait and the attractiveness of bait to rats, increasing the risk of operational failure.

Background

A review was conducted in 2015 to identify indicators (rainfall, vegetation greenness, etc.) that could be used to forecast higher risk environmental conditions for rodent eradication on Desecheo. The

assessment criteria presented here are based on the assumptions about the ecosystem on Desecheo identified in that report and summarized below (Figuerola and Will 2015).

As on many other tropical islands, rainfall and soil moisture drive primary productivity on Desecheo. Global climate models predict an overall drying for Puerto Rico in 2016 that will continue to intensify until spring, with El Niño being the dominant factor shaping these events. Below average rainfall is expected through March 2016. With these conditions on the island, primary productivity is expected to be low, flower and fruit production to be low both in abundance and quality (if there is any production at all), and invertebrate abundance to be low although it could increase under the leaf litter accumulated on the ground from trees dropping leaves due to dryness. Any remaining fruits from the prior wet season would fall to the ground earlier than in wetter conditions, most likely during January and February, meaning little fruit would be readily available to rats during March. Also, when rainfall patterns become variable during the wet season and continue to be during the dry season, many plant species stop producing fruits and enter a dormancy stage during the dry season.

On the contrary, if climate predictions for 2016 do not follow these trends and environmental conditions become wetter, primary productivity would likely be high resulting in increased flower and fruit production (both quantity and quality) and higher invertebrate abundance throughout the whole ecosystem. Also, seed germination would be higher since seeds in dry forests need a small amount of water to quickly germinate. Although, as a general pattern, increased rainfall equals increased soil moisture, in the dry forests moisture cannot be retained for long due to evapotranspiration, therefore this relationship is not necessarily directly proportional. **Significant rain events (totaling more than 2") during the end of January and February 2016 would be enough to drive these changes on Desecheo during March 2016.**

Table 1. Changing patterns of habitat components related to primary productivity according to amount of rainfall during the dry season. Blue arrows (↑) mean there is an increase in that component and orange arrows (↓) mean there is a decrease.

Component	Rainfall	
Vegetation Greenness	↑	↓
Flowers and Fruits	Abundance ↑ Quality ↑	Abundance ↓ Quality ↓
Invertebrates	Under leaf litter & other habitats ↑	Other habitats ↓ Under leaf litter ↑

Methods

Schedule

Environmental conditions on Desecheo will be monitored regularly as defined by the schedule in Table 2.

Table 2. Environmental condition assessment dates and project components that would likely be affected by a proceed, delay, or postpone decision. Irretrievable commitments represents the *cumulative* commitments that will be spent completing the project dependencies if a decision to proceed is made.

	Assessment Period	Target Date	Project Dependencies	Irretrievable Commitments	Assessment Criteria	Outcomes
#1	3 months prior	Dec 18	-Operational planning	\$40K	-Climatic Review	-Proceed -Delay -Postpone
#2	2 months prior to operation	Jan 18	-Bait Manufacture	\$100k	-Climatic Review -Island Site Visit	-Proceed -Delay -Postpone
#3	1 month prior to operation	Feb 18	-Bait Shipment -Gear Purchase -Personnel Deployment -Contract Execution	\$255K	-Climatic Review -Island Site Visit	-Proceed -Postpone
#4	1 week prior to operation	Mar 10	-Operational Execution	\$555K	-Climatic Review -Island Site Visit	-Proceed -Postpone
#5	2 weeks prior to second application	Mar 28	-Operational Execution	\$805K	-Climatic Review -Island Site Visit	-Proceed

Assessment Criteria

Regional Climate Review

This assessment is intended to provide an overview of the regional climatic conditions observed in western Puerto Rico and a forecast of conditions over the next several months.

Regional Climate Perspectives

The Southeast Regional Climate Center provides daily climate perspectives from several stations in Puerto Rico. The closest to Desecheo is at Coloso, PR (~ 30 km east) where a weather station has been operating since 1905. The climate perspectives ranks the total precipitation and temperature observed

each year at various time intervals (daily, weekly, monthly, etc.). It also calculates the departure from normal based on data collected between 1981 and 2010.

The perspectives will be acquired from:

- <http://www.sercc.com/perspectives>

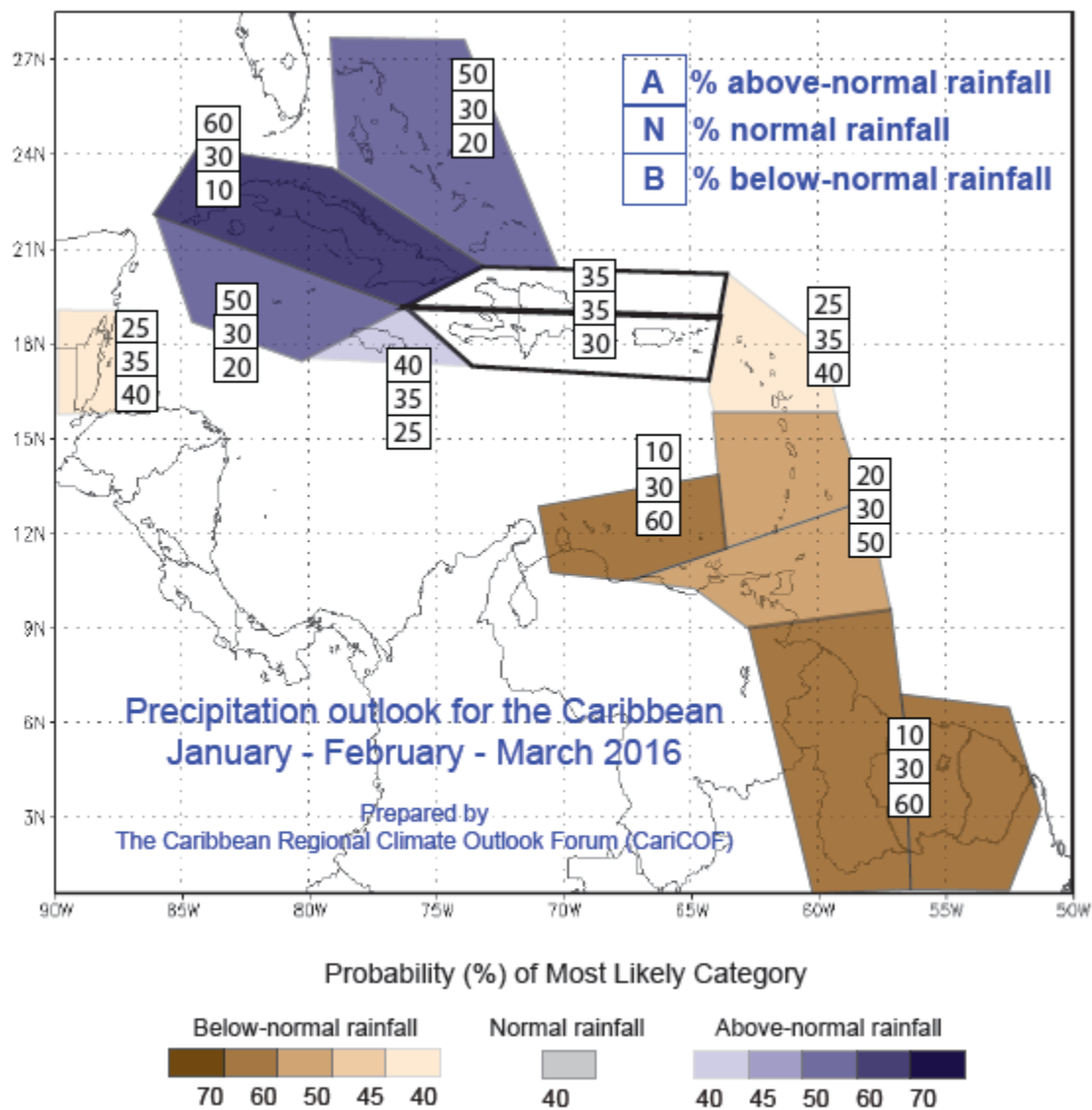
Conditions will be considered **abnormal** if:

- Month to Date total precipitation is ranked in the top third
- Past 3 Weeks total precipitation is ranked in the top third
- Past 2 Weeks total precipitation is ranked in the top third

Regional Climate Forecasts

Caribbean Institute for Meteorology and Hydrology produces precipitation in the form of probabilities of above-, near-, or below normal rainfall based on the latest observed climate state (e.g. tropical sea surface temperatures). The precipitation and temperature outlooks are issued in the form of a map detailing tercile probabilities showing regions having homogeneous forecast probabilities for below, near, and above normal precipitation. The terciles separate the possible outcomes into three categories (terciles) based on the historical precipitation record. The probabilities add up to 100 (Figure 1).

Figure 1. CariCOF precipitation outlook for the Caribbean in Jan – Mar 2016.



These outlooks will be acquired from:

- <http://rcc.cimh.edu.bb/long-range-forecasts/caricof-climate-outlooks/>

Conditions will be considered **abnormal** if:

- The probability of above-normal rainfall conditions is greater than 50%

Local Climate Review

This assessment is intended to provide an overview of the local climatic conditions observed near Desecheo. The closest active weather station to Desecheo is located at the Rincon Power Plant (~20 km). Monthly rainfall will be compared against averaged monthly climate data.

These rainfall totals will be acquired from:

- Daily: <http://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:RQ1PRRN0003/detail>
- Monthly: <http://www.ncdc.noaa.gov/cdo-web/datasets/GHCNDMS/stations/GHCND:RQ1PRRN0003/detail>
- Real-time: <http://www.rinconadventure.com/Weather/wxindex.php>

Conditions will be considered **abnormal** if:

- Any observed monthly rainfall is > 1" above normal

Figure 1. Average monthly climate data near Desecheo Island (Rincon Power Plant), between 1968 and 2015 for February and March (precipitation in inches, temp. in °F) (Southeast Regional Climate Center 2015).

	FEB	MAR
Mean precip	1.75	1.64
S.D.	1.95	1.57
SKEW	2.07	1.49
Max precip	8.49	6.26
Min precip	0	0
Mean max temp	85.62	85.99
Mean min temp	67.48	67.78

Island Site Visit Assessments

This assessment is intended to provide a subjective analysis of the climatic conditions on Desecheo. Many of the methods below are intended to help focus the attention of personnel with experience of the island on assessing climatic conditions. Given that many of these methods aren't comparable with previous years the final assessment of island conditions will be based on experience and determining if any of the observed climatic conditions pose unacceptable risks to operational efficacy.

Conditions will be considered **abnormal** if:

- High rainfall is observed
 - More than >2" of rain is recorded over a month long period
- Food availability is pervasive
 - The majority of vegetation is fruiting or in flower
 - The majority of mature vegetation has a high yield of fruits and flowers
 - The majority of vegetation cover appears to be increasing based on time-lapse cameras
- Rodent breeding is pervasive

- More than 5 female rats are trapped and the majority show signs of recent or imminent breeding

Rainfall

There is no long term historical rainfall data available for Desecheo. A rain Gauge data logger will be placed on Desecheo that records hourly precipitation in increments of 0.01” during Assessment #2. This data logger on Desecheo will allow the operational team to compare rainfall on Desecheo with both the regional and local climate reviews and detect if rainfall amounts are significantly different.

On each subsequent assessment the data will be downloaded and compared to data from the mainland Rincon station to see if there is a significant difference.

Food Availability Transects

There have been no previous studies done on Desecheo measuring the abundance of fruiting or flowering plants. However, several studies monitoring phenology events in Puerto Rican dry forests of have found that flowering is rarest during the dry months of February and March and that most fruits fall during the dry period from February to April. A subjective analysis of the percentage of trees fruiting and flowering can provide a quick estimate of how productive the ecosystem is.

1. Vegetation Transects

- Long Valley and West Valley will be used as transects (from base to top).
- Take a GPS point at the start location of the transect (bottom) and another one at the end (top).
- Count all the reproductive mature plants (adults) within 1 m from each side of your central path and note:
 - Plant habit: tree, shrub, vine, herb.
 - If they are fruiting and/or flowering.
 - If fruits are immature or mature, if present.

2. Fruit and Flower Quality

- Choose 10 plants with fruits and 10 plants with flowers in the transect or close to it (if available) and determine the fruit or flower percentage in each plant.
 - Mark the plant with flagging tape, noting transect, flower or fruit and plant number: eg:
 - West Valley** - Fruits: WFr1-WFr10 / Flowers: WFl1-WFl10
 - Long Valley** - Fruits: LFr1-LFr10 / Flowers: LFr1-LFl10
 - Take a GPS point for each plant.
 - Take photos and note photo number.
 - Specify plant habit: tree, shrub, vine, herb.
 - Divide the plant in 4 parts and approximately calculate the amount of fruits/flowers in each of the 4 parts.
 - If there is something particular about the arrangement or quantity of fruits/flowers, note it as well (for example, if the plant has only a bunch of 10 fruits, note it as that).
 - If possible, also note if fruits are immature or mature.

3. Fruit Ground Cover

- a. While walking the transect, look for fruits on the ground.
- b. When and if present, establish a 1m x 1m plot and count fruits inside the plot.
- c. Mark with flags the 2 diagonally opposite corners in each plot, noting transect, fruit and number:
 - i. **West Valley** - WFr1, WFr2...
 - ii. **Long Valley** - LFr1, LFr2...
- d. Take photos and note photo number.
- e. Take a GPS point for each plot.
- f. Describe their appearance:
 - i. decomposing,
 - ii. fresh
 - iii. immature
 - iv. predated

Vegetation Monitoring

Vegetation cover will be determined by:

- Time-lapse Cameras
 - Three time-lapse cameras will be established on the island to monitor increases or decreases in vegetation cover and health over time.
 - These cameras will take on picture every 30 minutes from dawn until dusk.
 - Camera cards will be collected during each assessment and reviewed to quantify the change in vegetation cover over time.
- Historical Analysis
 - Visually compare island vegetation cover from survey points established in 2010
 - Photos should be reviewed to estimate the percentage of canopy cover

Rodent Breeding

During the site assessment 20 baited Tomahawk traps will be placed in the West Valley during the morning of the site visit and collected in the afternoon. Any rats collected will be necropsied looking for signs of recent or active breeding activity (presence of juveniles, enlarged mammae, lactation, perforated vaginas, and fetal development).

Thirty rats were trapped in 2009 and seventy rats in 2011 with some signs of recent or imminent mating activity (ie. enlarged mammae, perforated vaginas, and vascularization of the uteri), but no signs of lactation or fetal development.

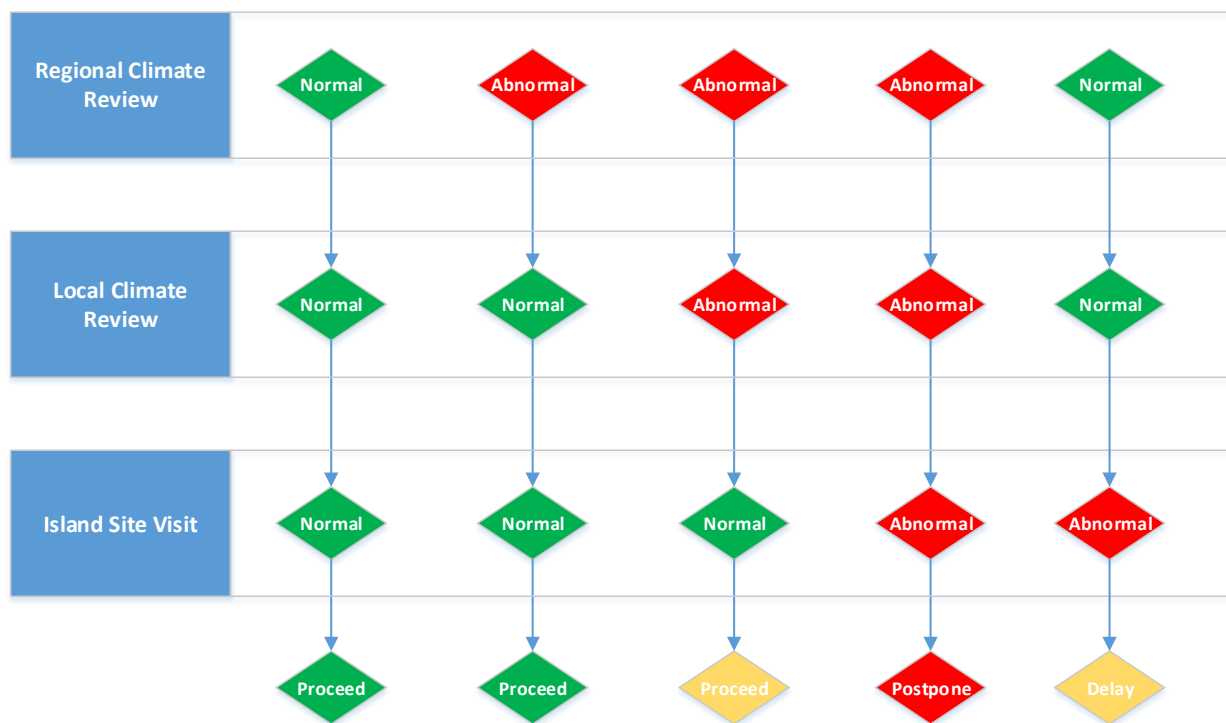
Decision Process

A summary of the evaluations during each assessment period will be provided to the Desecheo Steering Committee summarizing the finding of the regional climate review, local climate review, and island site visit. Any abnormal observations should be reported to the Steering Committee with an assessment of the efficacy risk it poses to the project.

The Steering Committee is responsible for reviewing these findings and in consultation with the project team make a decision to proceed, postpone, or delay the project. It is anticipated that the final go/no-go decision will be made immediately prior to implementation unless observed conditions leading up to implementation are significantly abnormal.

The Steering Committee should follow the decision tree in Figure 2 for recommending how to progress the project based on the information collected during each assessment. In the event of column three, where regional and local conditions suggest abnormal conditions and the island site visit suggests normal conditions, a decision to proceed will need to carefully evaluate the larger picture and risks of proceeding.

Figure 2. Decision tree for progressing project based on the normal or abnormally wet conditions found through the assessment criteria.



Proceed

A decision to proceed suggests that all assessment criteria look as expected and no significant risk to operational efficacy is anticipated.

If a decision to proceed is made in the presence of unexpected climatic conditions then the operational team needs to quantify the operational efficacy risks and provide the justification for proceeding to the Steering Committee. The Steering Committee needs to acknowledge and accept these risks.

Delay

A decision to delay suggests that some of the assessment criteria are abnormal and pose an unacceptable risk to operational efficacy. In suggesting a decision to delay the operational team needs

to quantify the risks of proceeding in abnormal conditions and the likelihood that conditions will improve. This will likely involve consultation with local climate and dry forest ecology experts.

How long to delay and why

If feasible the assessments should be made according to the schedule in Table 2, starting with an assessment 1 month prior to a new application date. There will be significant pressure to proceed after a delay and the operational team should justify why the decision was made to proceed despite the abnormal conditions observed.

Given operational vendor contracts and site constraints, the operational team will likely have a limited ability to delay the operation beyond 1 – 2 weeks after Assessment #3. Therefore, Assessment #3 is likely the last opportunity that the operation can be delayed beyond the end of April. If delay will be beyond this time period then the Steering Committee will need to evaluate the likelihood that environmental conditions will improve, associated vendor risks, and the costs associated with delaying the operation.

In addition to the irretrievable commitments estimated in Table 2, it is estimated that it will cost approximately **\$7,000 per day** for personnel, helicopters and equipment to remain on standby in Puerto Rico after they have been deployed.

Postponement

A decision to postpone suggests that some or all of the assessment criteria suggest that climatic conditions have led to environmental changes that pose unacceptable risk to project efficacy and these risks will not improve over the short term. If suggested, a decision to postpone the operational team should describe the risks of proceeding in significantly abnormal conditions.

Many irretrievable resources will be committed after Assessment #2 (Table 2) and there will be significant pressure to proceed with the operation. The Steering Committee is responsible for making the final decision to postpone, and should prioritize operational efficacy above all else.

References

Figuerola C and Will D. (2015) Can we forecast higher risk environmental conditions for Rodent Eradication on Desecheo? Island Conservation unpublished report