



Organization for Tropical Studies

Las Cruces Operational Procedures Manual

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Glossary of Abbreviations and Definitions

LAS CRUCES

LCBS	The Las Cruces Biological Station.
Greater LCBS	The Las Cruces Biological Station and the surrounding region ~10km radius.
WBG	Wilson Botanical Garden
LCMP	Las Cruces Master Plan
LCBS Director	Responsible for scientific administration.
LCBS Administrator	Responsible for operations and financial management of station.
Resident Biologist manages the laboratory.	Assists education groups and researchers. Assigns desk/lab space and
Station Taxonomist taxonomic assistance.	Manager of Las Cruces botanical identification resources and general
GIS Lab Manager Informatics.	Manager of Las Cruces Geographic Information System laboratory, and
Station Naturalist Guide	Responsible for guided tours (tourism) and education outreach at Las Cruces.
Senior Researcher faculty member.	Researchers with a Ph.D. or a fulltime position as independent researcher or
Student researcher	Student (undergraduate or graduate) conducting research as part of their education.
Long-term researcher Cruces for ≥30 days.	Researcher (student or senior) remaining in continuous residence at Las
Nonresident Researchers	Investigators conducting research at Las Cruces or using station facilities, but residing off station.
Research Technician	Research project personnel with access to laboratories
Field Worker	Research project staff without access to laboratories.

OTHER

OTS	Organization for Tropical Studies.
CRO	OTS Costa Rican Office in San José.
MINAET	Environment, Energy and Telecommunications Ministry of Costa Rica (Ministerio de Ambiente, Energía y Telecomunicaciones)

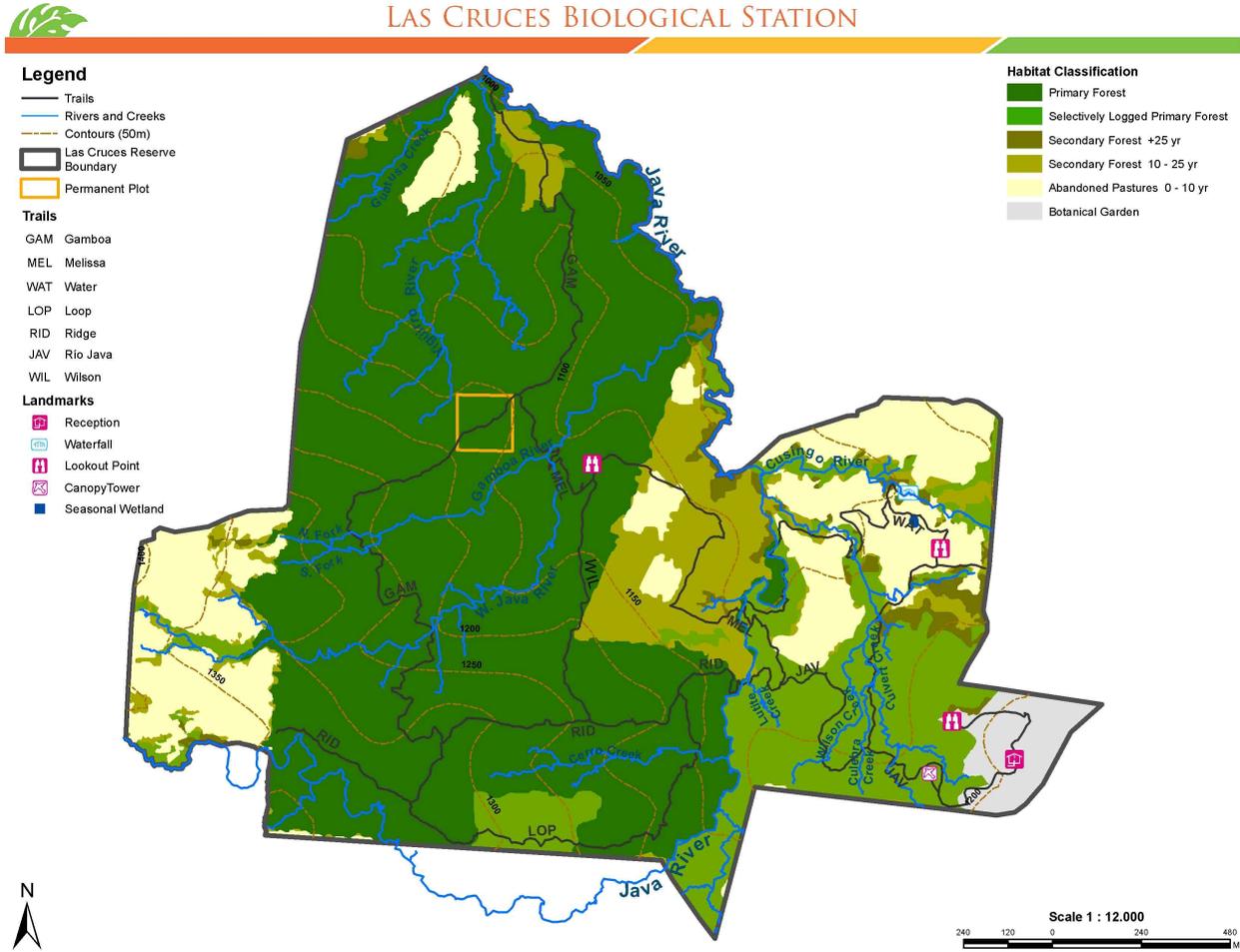


Figure 1. Las Cruces forest trail network and land habitat classification.

I. INTRODUCTION

The Las Cruces Operations Manual provides guidelines for the usage of Las Cruces Biological Station (LCBS) facilities and resources. It should be reviewed and approved biannually by the OTS Science Committee.

II. STATION USE GUIDELINES

A. Overview

These guidelines are intended to support the goals and values of the Organization for Tropical Studies, which include facilitation of research and education, as well as the dissemination and sharing of knowledge of tropical systems. We expect all visitors to Las Cruces to embody the values of honesty, integrity, respect, and professionalism, to maintain a friendly, supportive, and productive atmosphere. All station users, including researchers, students, and natural history visitors, are expected to adhere to the guidelines of this Operational Procedures Manual, the policies of OTS, and the laws of Costa Rica. Non-compliant behavior (including, but not restricted to, sexual harassment, intimidation, verbal or physical abuse, intentional interference with the research activities of other researchers, theft, or vandalism) may result in loss of access to Las Cruces and its facilities.

Facilities and Station Property

The Las Cruces Biological Station (8° 47' 7" N; 82° 57' 32" W) was founded in 1962 by Robert and Catherine Wilson, primarily as a botanical center and experimental farm, and was acquired by OTS in 1973. The station is located at 1200 m ASL along a spur of the Fila Cruces coastal range and is ~300 km southeast of the capital San José, in Coto Brus county. Annual rainfall averages ~4 m, with a distinct dry season from January – March. Las Cruces protects 326 hectares (ha), of which ~200 ha are primary and some 50 ha are secondary forest. The remainder is made up of the botanical garden and recently abandoned pasture (Figure 1). The topography is rugged and elevation ranges from 1000 – 1450 m ASL, that allows for high diversity.

It is the overall responsibility of the Station Administrator, under direction of the Station Director, to manage the facilities at LCBS. This responsibility includes managing food service, allocating housing to research and education groups, natural history visitors, and other types of visitors, and managing the staff responsible for maintaining these facilities.

B. Housing

The allocation of housing and reservations is the overall responsibility of the Station Administrator. The priorities listed below are designed to facilitate this responsibility. When unusual conditions arise, exceptions to these policies may be approved by the Administrator, as long as they are done in coordination with the Station Director and do not result in any long-term inconvenience to visitors or damage to the facilities.

Whenever possible, Las Cruces endeavors to provide single occupancy housing for researchers. There are 9 researcher cabins at Las Cruces, with a total of 36 beds divided among 12 rooms. Five cabins are dedicated to long-term researchers, and one family house (with two bedrooms) will be prioritized for researchers with children.

Las Cruces researcher use is affected by the academic calendar. During peak periods (particularly during June-July) it may be necessary to ease the policy on single occupancy housing for researchers. LCBS administration will make every effort to provide advance notification to researchers and arriving visitors to inform them that they will be sharing a room.

1. Family House Assignment Policy

There is one researcher house that can be reserved for researchers with families. This house should be reserved at least 30 days in advance and will be assigned on a first come first served basis.

2. Researcher Cabin Assignment Policy

Las Cruces cabins were constructed to provide more comfortable housing for senior and long-term student researchers. The four older researcher cabins are dedicated to short-term researchers and course faculty. The four new researcher cabins and the family house (Artibeus) are prioritized for long-term researchers. Researchers with a spouse or companion will have priority over single researchers in the family house. As with family housing, research cabins should be reserved at least 30 days in advance in order to secure a cabin for the entire field season. Those not reserved will be rented to short-term researchers with the understanding that they must vacate prior to the next confirmed researcher booking.

3. Policy on Unoccupied Rooms

Station fees will be charged for every day a room is occupied. Rooms will be considered occupied unless the resident checks out at Reception and removes all belongings from the cabin. Special arrangements can be made to accommodate certain circumstances (such as storing bags for a few days if the researcher has to leave).

C. Work Space

Las Cruces will provide ~1.3 m of desk or laboratory bench space to all station researchers. Additional space may be rented upon request. The Resident Biologist assigns lab space and must be notified ahead of time for any special needs. At full capacity, Las Cruces lab space can provide working areas for ~15 researchers. The Resident Biologist will decide on the use of other spaces for laboratory work purposes in case of need.

D. Storage Space

Limited storage space of equipment is available for long-term research projects based at Las Cruces. The station can provide both climate-controlled and ambient environment storage space and must be coordinated in advance with the Resident Biologist. There is no fee assessed for storing equipment, however, all equipment must be packed appropriately and clearly labeled. Contact information and an estimated timeframe for how long equipment will be stored is also required.

E. Non-Resident Researchers and Field Assistants

Non-resident researchers and project technicians or assistants who live offsite must pay the appropriate day use visitor station rate, and (when applicable) have access to the laboratories and other needed facilities only during daytime working hours (8:00am to 5:00pm). Field workers who reside offsite **pay no station** fees and do not have access to the laboratories.

F. Education Groups

Las Cruces limits education groups and professional workshops to 60 overnight participants. Exceptions to this ceiling are possible but will impact housing for other visitors and has to be coordinated well in advance. Students for these educational groups will be accommodated in the Wilson House dormitories whenever possible, whereas faculty will have priority use of one researcher cabin. The Wilson House can accommodate two student groups at the same time (a total of 47 students). Because of interference with researchers housed in the older researcher cabins, courses will not be accommodated there except under extraordinary circumstances. Cabins reserved for Natural History visitors can be used for students in the case of overflow, and only if the Wilson House and the old researcher's cabins are already full.

The Resident Biologist, in coordination with administration, will allocate classroom space as needed and will coordinate among courses if various academic groups are at the station at the same time. Courses

with large groups will have priority to meet in the Wilson Classroom or the Conference Room in the Visitors Center; the Mathias Room is for smaller courses, and the Laboratory is only used for lectures and meetings under exceptional circumstances. Local community groups and Environmental Education and Outreach Program visitors, who typically visit during the day, meet in the Conference Room at the Visitor Center.

G. Natural History Visitors

Natural history overnight visitation is limited to 26 with up to 50 day-use visitors. We have a limit of 315 visitors per week. The 50 day-use visitor limit is intended to provide flexibility to accommodate infrequent peak use days, whereas the weekly limit constrains average use to 45 persons per day (equal to 3 guided walks at 15 persons per walk). Day natural history visitors have access to the Wilson Botanical Garden only. Overnight visitors have additional access to the Río Java and Water trails as well as the Canopy Tower (see Section IX). Use of these trails causes limited physical impact to the reserve and does not cause significant interference with research or education activities. To avoid congestion on trails, and to limit contact between natural history groups and academic users, guided walks are coordinated by the Las Cruces Naturalist and Reception.

H. Food Service

Meals are served at specific times as follows: Breakfast 6:30AM; Lunch 12:00PM; Dinner 6:00PM. The kitchen can accommodate most dietary restrictions; please inform Reception in advance so that appropriate meals can be prepared for you. Although Las Cruces dining facilities are sufficient for normal station use, the dining hall is sometimes crowded at lunchtime. To alleviate dining hall congestion and to make meal-times more convenient for all visitors, on days when the number of plates served exceeds seating capacity (~80 people), the administration will modify lunch hours to implement an extra lunch period. Station users will be informed when they should come to the dining hall.

I. Station Use Limits

Maximum daily station use is set at 230 visitors, with the following user limits by category:

User Group	Daily Limit (persons)
Research (Overnight & Day) (constrained by housing and desk/lab space)	~50 ^a
Project Personnel (limited by desk/lab space for lab users and by overall impact for field workers)	~20 ^b
Education Overnight (constrained by number of classrooms and dormitory spaces)	60 ^c
Education Day and Local Groups (constrained by meeting spaces and overall impact)	30 ^d
Natural History (constrained by trail use and overall impact including conflict with other users)	50 ^e
Other (VIPs, film crews, reporters, government officials, etc.)	20 ^f
TOTAL	230

^aSee Section E.

^bPersonnel on OTS payroll dedicated to projects.

^cBased on available housing for two courses of 30 persons each + faculty.

^dOne group of 30 persons maximum.

^eLimited to a weekly total of 315. See Section G.

^fOnly when family houses and dormitories are not occupied by education groups.

III. RESEARCH MANAGEMENT POLICY

A. On-Site Regulations

The management and coordination of research and education activities at LC is the general responsibility of the Station Director. The goal of this oversight is to promote research and education while maintaining the long-term biological integrity of the site. Detailed research guidelines and regulations are provided below and are posted on the Las Cruces website. A condensed set of regulations and other useful information is provided upon arrival to the station. New researchers are required to receive an orientation from the Station Director or Resident Biologist before they use the facility.

B. Research Proposals and Regulations on Data

A proposal to conduct research at LCBS must be submitted in writing to the Station Director, in either Spanish or English. Researchers arriving on site without prior proposal approval will not be allowed to initiate their project. In addition, all research projects must have their respective MINAET permit issued by the Costa Rican government. The main OTS office in San José can help with this procedure and they charge a fee for this service. It is the responsibility of the researcher to obtain all necessary research permits.

One time, brief ‘exploratory’ research visits will be permitted for prospective researchers who wish to evaluate whether Las Cruces is appropriate for the type of research they wish to conduct. Such exploratory visits do not require submission of a written proposal, but do require prior approval of the Station Director. Researcher station reservations will not be valid without Las Cruces Station Director approval. Proposals should be submitted electronically (in word or pdf format).

- **Proposal Contents.** Proposals should describe the project objective, nature of the methods to be used, location where the research will be conducted, whether or not specimens will be handled, collected or exported, and the duration of the project. Proposals written for other purposes, such as grant or thesis proposals, are usually acceptable, but prospective investigators are advised to review the research regulations below and ensure that project methods are described in sufficient detail to evaluate the potential impact of the proposed research.
- **Outside Review.** At his or her discretion, the Las Cruces Station Director may refer any project for outside review by scientists with pertinent expertise. Projects classified as high impact (see below) are automatically referred for outside review. The Las Cruces Station Director will notify prospective researchers if this is necessary.
- **Duration of Review Process.** The Las Cruces Station Director will make every effort to complete the review process as rapidly as possible. Evaluation of all proposals not requiring outside review will be completed within 14 days of receipt. For proposals receiving outside review, decisions will be made as quickly as possible, but in all cases researchers will be provided with a decision within 1 month of receipt of the proposal by the Station Director.
- **Notification of Results of Review.** Prospective researchers will be notified in writing (via email) of project approval or rejection. In the case of approval, the Station Director will stipulate in the notification any specific conditions that apply. In the case of rejection, the reasons why the proposal was declined will be enumerated and suggestions will be made as to how the project could be modified so it falls in accordance with station policy.

- **Metadata Submission.** Project approval is contingent upon researchers depositing and maintaining metadata for their project upon departure from the station. As part of project approval investigators must acknowledge, in writing or by email, their acceptance of station regulations concerning metadata. Metadata is required of all researchers using station facilities, even for those conducting research outside of station boundaries. See section VII for further details.
- **Archival Datasets.** Las Cruces may also require investigators to deposit datasets of broad research utility with the station. This policy is discussed in more detail in Section VII.E.2-3 (Researcher Responsibility for Metadata and Data Deposition with OTS).
- **Publications.** Researchers carrying out thesis work at Las Cruces are required to donate two copies to OTS, while other researchers must send electronic reprints of all publications resulting from Las Cruces research. Failure to do so may delay future research projects at the station.
- **Government Permits.** All research conducted in Costa Rica requires a Costa Rican Government research permit, even if collecting will not be conducted (approval of collecting is now subsumed within this research permit). Researchers who wish to transport biological specimens or their derivatives outside the country must also acquire a Costa Rican Government exportation permit. Research centered on anything related to **genetics or biochemistry** is particularly sensitive and must comply with the Costa Rican Biodiversity Law (No. 7788), which establishes that they are public domain.

CRO staff can assist researchers in acquiring permits but there is a service fee. Permit acquisition should be initiated at the time of proposal submission to the Station Director, because permits can take some time to complete. Costa Rican Government permits must be renewed every six months. Failure to maintain permits up to date will be cause for rescission of project approval.

- **Animal Care and Use Approval.** Researchers must have IACUC approval from their home institution and may be requested to provide evidence of up to date forms. Researchers from institutions not covered by such protocols must provide comparable animal care and use compliance.
- **High Impact Projects.** High impact research projects are automatically referred to a committee for review. Researchers should provide especially clear methods if high impact activities are being proposed. The following activities constitute high impact research.
 - a. Collecting vertebrates (except as outlined in section D.8)
 - b. Collecting rare species of invertebrates or plants
 - c. Large-scale destructive plant or invertebrate sampling
 - d. Collecting significant numbers of seeds or seedlings outside of designated seed collection zones. (see section D.5.)
 - e. Tree coring
 - f. Long-term allocation of plots >100 m²
 - g. Habitat manipulation at a scale >100m² in intermediate restriction research areas
 - h. Application of substances such as isotopes, herbicides, pesticides, or fertilizers
 - i. Introduction of exotic animals, plants, microorganisms or genetic material
 - j. Installation of major equipment or infrastructure
 - k. Proposed experimental manipulations (e.g., forest cutting, pesticide application) in a broad spatial and temporal context that specifically includes:
 - Effects of proposed manipulation on the quality of surface water, soil, or ground water draining the area.
 - Effects of the proposed manipulation on use of adjacent areas for other projects now and in the future.

- Consideration of proposed manipulations with respect to the amount of remaining habitat of that type left in the area.
- **Low Impact Projects** (not involving any of the points listed above). These proposals will be reviewed by the Las Cruces Station Director.
- **Post-project Cleanup.** Researchers must allocate funds to cover expected cost of removal of installed equipment and the eradication of exotic species introduced for research purposes. Researchers may be also billed for trash removal or any other cost incurred by LC.

C. Restricted Activities

1. **Machetes.** Use of machetes within Las Cruces without permission from the Station Director is prohibited. Unless research or education personnel have received specific permission, researchers are not allowed to carry a machete in the forest or on any trail in Las Cruces.
2. **Firearms.** The only firearms allowed in Las Cruces are those 1) carried by authorized security personnel and 2) shotguns used for the sole purpose of collecting out-of-reach plant material, with prior permission of the Station Director. Researchers using firearms must have all the necessary permits required by Costa Rican law and file copies of these permits with the Las Cruces Administrator. All firearms must be kept in locked cabinets when not in use.
3. **Canopy Access.** Researchers and students must obtain permission from the Station Director before initiating any project or other activity involving canopy access. In granting permission, the Station Director will consider both how experienced the individual is at climbing and how adequate safety measures will be. Inexperienced climbers should never climb unless accompanied by an experienced climber.

D. Specific Regulations on Research

1. **Collecting.** Any collecting at Las Cruces must satisfy the general criteria listed below.
 - a. The need for specimens is justified by the research proposal submitted.
 - b. The evidence indicates that the level of proposed collecting would not damage Las Cruces populations (considered here is the estimated abundance of the species, whether or not it is widespread in Las Cruces, and the number of individuals to be collected).
 - c. Collecting by education groups must be coordinated with Station Director.
2. **General Collecting.** This refers to the collection of specimens that are not directly required for an approved research or educational project. Such collecting is not permitted at Las Cruces.
3. **Costa Rican Permits.** Collections can only be made when approved as part of a Costa Rican research permit. Permit regulations require that when collections are made, duplicate voucher specimens are deposited with a Costa Rican government institution. The collector must provide OTS with complete information on these specimens, including origin and deposition.
4. **Deposition of Specimens.** Representative material from all collections should be deposited in a major public access collection (i.e., a facility with permanent curatorship and a loan policy), preferably in Costa Rica. Investigators are also required to deposit duplicate specimens of all plant material collected in the Las Cruces herbarium (HLDG) following the LCBS Collecting Protocol. Duplicate specimens collected by researchers working with other groups of organisms are also encouraged when possible (e.g., lichens, fungi, insects), but we are not creating comprehensive databases of other groups of organisms at present.
5. **Collecting Seeds or Seedlings at Las Cruces.** Collection of seeds or seedlings is destructive sampling with high potential impact for many plant species. Fruits and seeds falling on the ground within trail boundaries, and in the Wilson Botanical Garden (*native species only*) can be freely collected for approved research projects, as can seedlings growing in these sites. For collecting in any other area in Las

Cruces, specific permission must be obtained from the Station Director. The policy for such collecting is as follows:

- a. Species that are known to have extremely limited reproductive output, or whose adults are very rare, may be declared off-limits to collecting. This decision will be made by the Station Director with advice from a committee if appropriate.
- b. Species that are currently under demographic study cannot be collected within 100 m of the study area without the consent of the principal investigator conducting the demographic study.
- c. When allowed, collecting seeds from plants within areas zoned **Intermediate/High Restriction** is limited to a one-time sample of 10% of the standing crop of seeds on the ground or on the plant.
- d. In the Heye Annex, Melissa's Meadow, and the Secondary Forest, seeds of any species in any quantity may be collected for approved research projects (subject to points a and b).

6. Other Plant Materials. Small-scale, non-destructive sampling of common plants (pieces of branches, a few inflorescences, etc.) does not require special approval but should be discussed with the Station Director prior to sampling. Destructive sampling (resulting in the death of an individual plants) requires specific approval.

7. Invertebrates. Collecting directly related to an approved research project does not usually require special approval. Collection of butterflies of the genus *Morpho*, other commercially desirable species, or species thought to be rare at Las Cruces does require special permission. Courses are allowed to collect representative specimens for teaching purposes, with live capture and release of all individuals always preferred.

8. Vertebrates. Collection of vertebrates generally requires a committee review. Exceptions may be made by the Station Director, in the case of limited collecting of a species that is very abundant. The collection of a single voucher specimen for species previously unknown from Las Cruces can also be approved by the Station Director, subject to Costa Rican laws.

9. Salvage collecting. When plots are to be cut at Las Cruces for any purpose (construction, research) OTS requests that the responsible party actively encourage salvage collections of flora and fauna likely to perish as a result of the clearing. The responsible party would notify appropriate interested specialists within and outside of Costa Rica well in advance of the clearing procedures. The party or parties actually doing the salvage collecting would incur the costs associated with that activity.

10. Long-term and Restricted Access Plots and or Taxa. New long-term plots or exclusive access to plots, organisms, or populations of organisms are possible, subject to a committee approval. However, Las Cruces values the concepts of duplication and collaboration as part of the scientific process and, therefore, will discourage exclusivity except in well-justified cases.

Requests for such limitations will be carefully considered in the spirit of minimizing constraints on the entire research and education community. Approval for restricted access will depend on scientific justification of the restriction and impact on other station use at Las Cruces. Requests must include a specific time span for the allocation, as well as any OTS-approved limitations on access by other users. In the case of plots, researchers should include in their request of allocation of space an appropriate buffer zone, if they are concerned about potential alterations around the edges of their study plots by other projects. New long-term plots in intermediate restriction areas will be sited at least 15 meters from the trails. Zoning is described in section V. In the case of a taxon, researchers requesting restricted use must carefully define the distribution of that taxon or population. The investigator may request a specific buffer zone bordering a population so defined.

When other users request access to a long-term plot, taxon, or population for activities not restricted by Las Cruces-approved access limitations, the Station will forward the request to the PI managing the primary research to determine if compatible usage arrangements can be worked out directly by the interested parties. Details of such arrangements must be forwarded by the PI to Las Cruces. If the holder of restricted access finds the request incompatible with the primary research in the plot, he or she must

submit in writing an explanation of the incompatibility. In this event, Las Cruces will decide whether to approve or deny the additional use requested.

11. Use of Chemicals. Approval for the application of chemicals or biocides (e.g. fungicides, herbicides, insecticides nematocides, etc.) must meet all of the following criteria:

- a. Other reasonable methods have been attempted and do not work.
- c. The success of the research project rests on this application.
- b. The researcher and/or technician is judged to be qualified to handle the chemical.
- d. Pesticides are stored safely in a manner approved by the Las Cruces Resident Biologist and the MSDS of the chemical(s) must be provided by the investigator.
- e. The investigator must provide for safe disposal of all chemicals and associated waste brought to the station in a manner approved by the Las Cruces Resident Biologist.

When approval is given for application of a pesticide with persistent toxicity, the following data should be reported to the Station Director and Resident Biologist: name of the substance, date and method of application, and precise location of application. The site of application will be permanently marked by the GIS Lab Manager and if appropriate, in the field.

12. Handling Vertebrates. Research or educational projects that entail the risk of killing vertebrates requires approval of the Station Director. Examples include live-trapping, mist-netting, restraint (physical or chemical), and radiotelemetry. Mist-net operation requires one experienced operator on site and the project PI should have IACUC approval or something equivalent (see Section III B). The experienced operator may supervise mist-netting by inexperienced operators. Any handling of venomous snakes must be associated with an approved research project and must be approved by the Station Director. Investigators should specify when and where sampling will occur and:

- a. The methods to be used, including evidence that techniques are current.
- b. Precautions to be taken to minimize injury and death to an individual.
- c. The extent of the user's prior training in the methods of capture and handling.

13. Marking Organisms and Plots. The following guidelines pertain to marking organisms and plots at LCBS. As a general rule, the researcher is responsible for clearly marking research sites in a manner that will last for as long as is necessary to protect the integrity of the research. Prior approval is required for a researcher to leave permanent markers in Las Cruces.

a. Plants and Plots. Every researcher is required to consult the LCBS map to become familiar with restricted access areas. Those establishing plots, transects, or permanent markers must consult with the GIS Lab Manager to verify that the location chosen does not lie within an already established research plot. The researcher must clearly mark such plants or sites and register their location. Such markers need to show the researcher's name or be clearly identifiable as belonging to a specific project. If the researcher fails to return to continue the study as planned, the markers will be removed, and the labor costs for removal will be charged to the researcher.

Visitors to Las Cruces, as well as station personnel, are advised not to touch marked plants and to stay out of demarcated plots. Researchers are advised not to mark plots or plants that occur in close proximity to trails, because trail maintenance takes precedence over such markers.

b. Trees. As steel nails are toxic to trees, nails used to affix tags are required to be aluminum. Nails should be driven in at an angle so that the head points downward. Tags will thus hang away from the bark and nails will channel water flow away from the tree.

c. Animals. Researchers must consult with the Station Director before marking animals. In all cases of permanent or long-lasting marks, a list of the marked individuals must be left with the GIS Lab Manager for the Las Cruces database. All marking of vertebrates must be coordinated with existing marking

systems. All external transponders should be removed from animals at the conclusion of a project, unless removal endangers the life of the animal.

IV. INTRODUCTION OF EXOTIC ORGANISMS TO LAS CRUCES

The regulation of exotic species in Las Cruces is necessary in order to maintain the integrity of the reserve. Exotic species that could escape and become invasive in the surrounding rural region of San Vito and adjacent areas, exotic species that might escape and thrive in the natural communities of Las Cruces, and the potential introduction of foreign genes into Las Cruces populations with a consequent negative impact on future genetic studies are matters of special concern.

The objectives of this policy are:

- To insure that experimental introductions of genotypes not native to Las Cruces do not spread, either within Las Cruces or in surrounding areas.
- To minimize the risk of gene flow from the introduction that could compromise future genetic research or harm native populations.
- To encourage and facilitate research directed toward the solution of pressing ecological problems through judicious introduction of exotics or exotic genotypes.

Release of wildlife confiscated by local authorities is not permitted within Las Cruces without prior approval from the Station Director. In order to bring exotic animals or plants into Las Cruces, a researcher must obtain prior approval. In addition they must take complete responsibility for the vigilance, caging necessary to prevent escapes, and the subsequent removal of the individual or population from Las Cruces once the research has concluded. Proposals should summarize available information on the following points, on which an external committee evaluation will be based (this information should be referenced to the literature and other sources):

1. Geographic extent and habitat of the proposed introduction.
2. Taxonomic relatedness to Las Cruces species.
3. Size and characteristics of local populations of the same or related species.
4. Provenance of seeds, in the case of species already at Las Cruces.
5. History of introductions to other areas where not indigenous, especially any evidence that the species may be invasive.
6. Reproductive biology, including vegetative reproduction, pollination, and seed dispersal.
7. Susceptibility to pathogens or pests potentially dangerous to native or economically important species in Costa Rica.
8. Eradicability, in the event of spread.
9. Other relevant natural history information (e.g., invasive congeners).
10. Experimental design including:

- a. Size of plantings.
- b. Type of propagule to be used.
- c. Periodicity and characteristics of monitoring to be carried out by the investigator.
- d. Financial provision for adequate monitoring by OTS Las Cruces and removal of the planting at termination of the study (or earlier, if spread occurs), and post-removal maintenance (if any).
- e. A GIS map/layer indicating the location of the introduction. This coverage must be maintained throughout the project.

The following rules guide the approval of projects by the external committee.

- Approved introductions of exotics will be allowed only outside the primary forest and no species with an invasive history may be introduced. Permission to introduce congeners of such species may also be denied.
- In the case of plants known or believed to have long-distance pollen or seed dispersal, plantings must be outside a 200 m buffer zone beyond the primary forest of Las Cruces.
- Experimental introduction of seeds collected from within Las Cruces (in accordance with section III.D.5—Specific Regulations on Research—collecting seeds or seedlings in Las Cruces), are permitted in all areas of Las Cruces with approval of the Station Director (subject to 8 and 9 above). Seeds or seedlings must be removed when the research is terminated, unless prior approval to leave propagules has been granted.
- If seeds for experimental introductions of native Las Cruces species are not available within Las Cruces in sufficient quantity, or if such species are too rare at Las Cruces, introductions of seed will be permitted on a case by case basis.
- All propagules collected outside Las Cruces must be both clean and intact before being brought into Las Cruces; such propagules should be inspected by the investigator and treated, if necessary, to prevent the introduction of pests and pathogens (see USDA guidelines). In general, non-sterilized soil may not be brought into Las Cruces on plant roots or otherwise; exceptions may be considered on a case-by-case basis, with appropriate precautions required.
- Introductions of exotic genotypes of species, and in some cases, congeners of species that could conflict with contemporaneous genetic studies at Las Cruces will not be permitted. Likewise, introductions of species that conflict with contemporaneous demographic studies at Las Cruces will not be permitted, unless it can be demonstrated that they can be removed before they could affect ongoing research.
- Regular monitoring to detect spread of exotic species will be carried out by OTS as well as by the researchers involved, at the researchers' expense. Researchers nevertheless must report to OTS any signs of spread from their plots. Monitoring introductions will be done at least annually by OTS personnel or consultants hired by OTS. For plantings this will consist of checks for flowering and/or fruiting and intensive surveys for seedlings or vegetative propagation in the 50 m wide annulus surrounding the planting. The frequency of monitoring will be determined based on each proposal. Monitoring for the presence of propagation in and around the plot will continue for 2 years after the planting is removed. The projected cost of post-project monitoring must be pre-paid by each project. Costs of monitoring are born by the investigator.
- Plantings must be removed (by OTS or the researcher, at the researcher's expense) at the prescribed termination of the project. If spread is detected during the project, the planting must be removed immediately. In this event, OTS will make every effort to advise researchers before action is taken.
- Seeds and seedlings of exotic species under active consideration for planting may be maintained at Las Cruces only in containers in nurseries. Exotics not under active consideration for outplanting and not part of an approved research project will not be allowed in nurseries at Las Cruces.

- The Station Director may exempt cultivars that are already widely planted in the area from the above requirements.

V. LAS CRUCES ZONING

Las Cruces is divided into the zones described below. Decisions concerning research activities within these zones will carefully consider the value of (1) the proportion of different types of land-use (e.g., clear cutting, agroforestry plots, etc) within the zone and within the watershed in which they are located; (2) the impact of the proposed project on present and future investigations; and 3) the environmental impacts of the project.

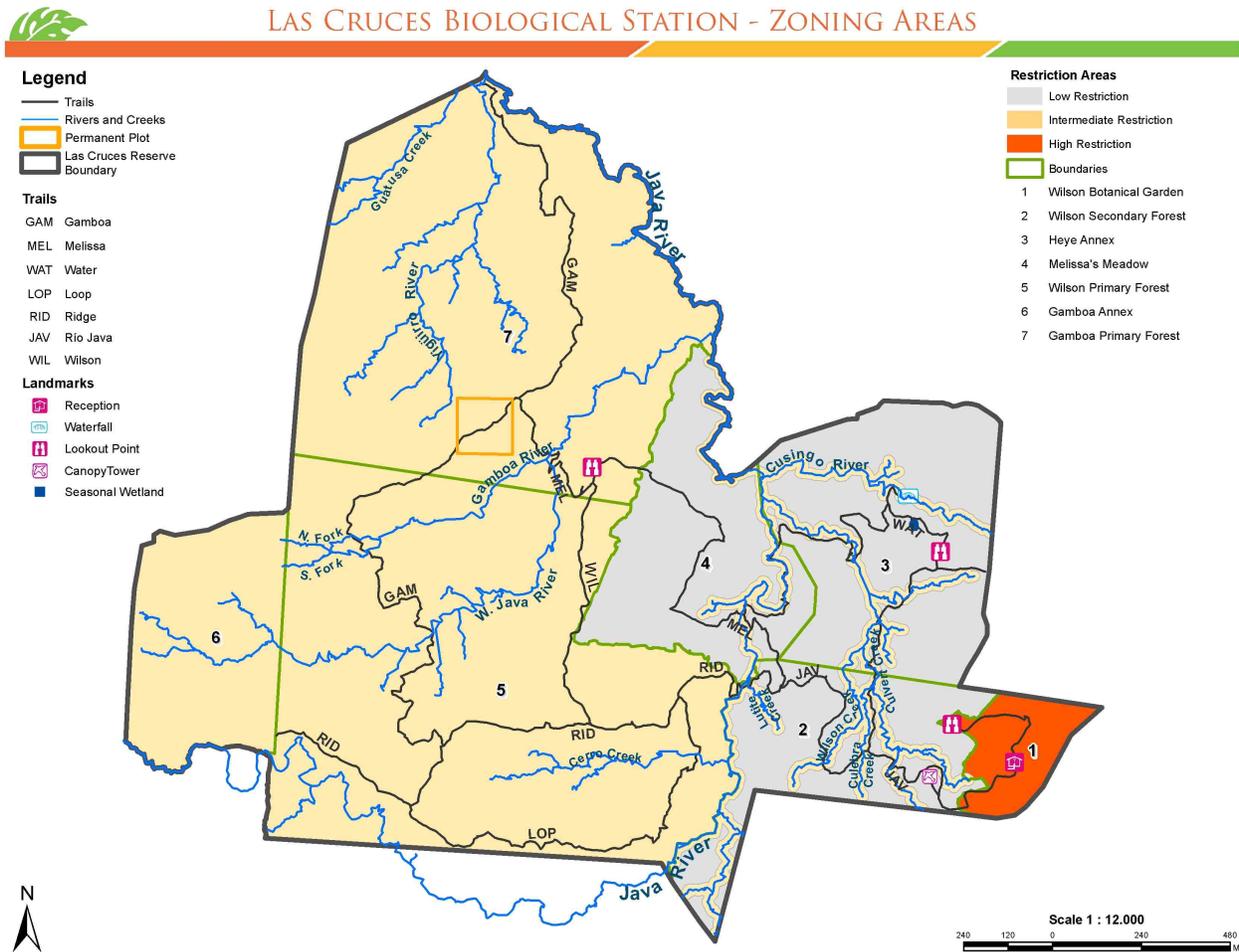


Figure 2. Las Cruces Zoning distribution.

A. Las Cruces Zoning Areas

Wilson Botanical Garden. Established in 1962, covers an area of approximately 10 ha. Located at the eastern end of the property, where all station facilities are housed.

Secondary Growth Forest. A strip of secondary forest in advanced recovery after selective timber extraction >40 yr ago. Located between the WBG and the Gamboa/Wilson Primary Forest on the other side of the Rio Java.

Gamboa/Wilson Primary Forests. The largest area of the property containing ~200 ha of primary forest.
Melissa's Meadow. A 31 ha section of abandoned pasture undergoing recovery for ~10 yr. Bordered to the west and South sides by the Gamboa Primary Forest, and to the east by the new Heye annex.

Gamboa Annex. The 25 ha pasture area on the western side of the Gamboa area. Acquired in 2008.

Heye Annex. The 36 ha section bounded by Melissa to the west and the secondary growth forest to the south. Acquired in 2009.

B. High Restriction Areas

The only zone with this highly restrictive category is the **Wilson Botanical Garden**. Research is permitted, however, it is restricted to observational studies and, subject to approval by the Station Director, non-destructive manipulative studies. Manipulative studies should be small in nature (e.g., on a few plant individuals, an area <10 m²). All studies **MUST** be discrete in nature, given that the botanical garden is a heavily visited tourism site with a lot of foot traffic. In other words flagging tape or marking individuals must be done sparingly and in a manner that does not detract from the landscaping in the garden, research material cannot be left at the site, and care must be taken to not damage or alter the landscaping in the area.

C. Intermediate Restriction Areas

All types of research can be conducted in intermediate restriction zones except for major habitat alteration at a scale greater than 100 m². Small long-term plots and manipulations can be approved and sited by the Station Director. The areas include:

- 1. The Gamboa Primary Forest**
- 2. The Wilson Primary Forest**
- 3. The Gamboa Annex**
- 4. Stream Banks.** No forest removal is permitted within 15 meters either side of stream channels.

D. Low Restriction Areas

Low restriction areas may be allocated to projects for habitat manipulation on a scale >100 m². Sites within this zoning category are ranked such that higher-ranking sites are allocated for manipulation only when lower-ranked sites are clearly demonstrated inappropriate for the project in question.

Low restriction sites ranked from lowest to highest:

- 1. The Heye Annex**
- 2. Melissa's Meadow**
- 3. The Secondary Forest**

High-impact projects (e.g, those involving use of herbicides or large-scale use of fertilizers, or introduction of exotic plants or animals) will be sited in the Heye Annex. If special needs cannot be met in the Heye Annex, siting will be considered on a case-by-case basis, with review by an external committee.

E. Developed Areas

Developed areas are sites where buildings exist or are planned. All developed sites are within the Wilson Botanical Garden boundary with the exception of the Canopy Tower. Perimeters are defined by the edge of all mowed areas in existing building sites, and by the mapped sites of future construction. In these areas, research is encouraged, but with the understanding that site maintenance and human safety take precedence over research needs.

VI. LAND MANAGEMENT AT LAS CRUCES

A. Wilson Botanical Garden

The Botanical Garden is home to an estimated 3,000-5,000 species of plants, and an incredible diversity of wildlife. The garden harbors collections from all over the world with a strong emphasis in palms, bromeliads, and other ‘showy’ cultivated families such as Marantaceae, Heliconiaceae, and Zingiberaceae. Some areas of the garden are heavily manicured (generally the central sections), whereas some of the more peripheral areas are in a semi-wild form. Areas are constantly being cleared of weeds or planted with new species by Las Cruces gardeners and workstaff. Accordingly, all research should take this ‘unknown’ random factor into account in their research plans; as outlined previously, research is highly restricted in this area.

B. Gamboa and Heye Annex

There are 64 hectares of abandoned pasture sites between the Gamboa and Heye Annexes. These areas are still largely dominated by pasture grasses, however, both have riparian corridors of secondary growth that traverse them. There is currently no management of these areas and they are slowly reverting back to forest. The Heye annex is zoned low restriction so large scale studies can be undertaken here, whereas the Gamboa annex is intermediate restriction so research here is more limited. Several restoration projects are underway in both locations.

C. Melissa’s Meadow

Melissa’s Meadow is a former pasture site that has now essentially reverted back to secondary forest. An intensive restoration effort was undertaken by Las Cruces staff when the property was purchased in 1998 and approximately 12 of the 31 ha were planted with 30 species of trees. A further 2 ha were burned on two occasions prior to being abandoned. Active restoration efforts and periodic maintenance (e.g., clearing around trees) ceased in 2006 and no further manipulations by Las Cruces are planned in the future. A complete list of all the species planted, as well as a more detailed outline on the restoration activities undertaken is available from the Resident Biologist.

D. Control of Invasive Exotic Species.

A few species of plants have become problematic invasives in the Las Cruces forest. Management of these species is overseen by Las Cruces gardeners who periodically eliminate new invasive patches and deal with large plants on a case-by-case basis. Researchers interested in working on invasive species are invited to do so, as long as research does not allow for uncontrolled spread of the species. The following species are considered problematic and invasive at Las Cruces:

Species	Family	Origin
<i>Angiopteris evecta</i>	Marattiaceae	Polinesia
<i>Caryota mitis</i>	Arecaceae	SE Asia
<i>Dracaena</i> spp	Asparagaceae	
<i>Impatiens wallerana</i>	Balsaminaceae	
<i>Musa velutina</i>	Musaceae	SE Asia
<i>Musa violascens</i>	Musaceae	SE Asia
<i>Nicolaia rostrata</i>	Zingiberaceae	SE Asia
<i>Palandra aequatorialis</i>	Arecaceae	S America
<i>Phyllostachys aurea</i>	Poaceae	
<i>Pigafetta filaria</i>	Arecaceae	Célebes
<i>Pinanga kuhlii</i>	Arecaceae	SE Asia
<i>Zingiber officinale</i>	Zingiberaceae	SE Asia

E. Trails

Las Cruces maintains a network of ~12 km of trails to: 1) provide access to the forest reserve for researchers and courses; 2) protect off-trail areas of the reserve and reduce the impacts of visitation; and 3) provide for efficient emergency evacuations. Accordingly, to maintain the integrity of the reserve it is also the policy to locate and build new trails in a manner that minimizes impact, and close or modify trails that are rarely used. As specific needs develop trails may be added or modified with prior approval.

Las Cruces gardeners are responsible for the maintenance of forest trails and will clear vegetation along each trail as necessary. Should there be any blockage of a trail, due to a tree fall or landslide, please report the location to Las Cruces staff and a crew will be sent out as soon as possible. Researchers should not mark plants or plots that fall within trails, because trail maintenance takes precedence over plot/plot designation in these areas and could eliminate marks.

VII. INFORMATION MANAGEMENT

A. Maintenance of Collections at Las Cruces

Animals. Because of the cost of air-conditioned space, staff time, and materials, animal collections are not maintained at Las Cruces. Shortage of space prevents the establishment of collections, but if researchers want to build a collection of local species, particularly arthropods, they can consult with the Station Director.

Plants. The Las Cruces Luis Diego Gómez Herbarium (HLDG) houses more than 2,900 herbarium specimens to date and a digital version of the collection with high resolution scans is available on the website (www.ots.ac.cr/herbarium). The Station Taxonomist and Resident Biologist are responsible for maintaining and expanding this collection. Researchers are encouraged to use the digital herbarium to identify samples, but if necessary, they can have access to the specimens by coordinating with the Taxonomist or Resident Biologist. There is a separate document that outlines the protocol for using the herbarium and this has to be read by all researchers prior to entering the facility for the first time. A digital Florula for all Las Cruces species is also available and accessible by any interested party (www.ots.ac.cr/florulac).

Weather Station. It is the responsibility of the Las Cruces GIS Lab Manager to oversee operation of long-term meteorological data. We have two weather stations 1) a manual system for rainfall, barometric pressure, air temperature and humidity sensors; 2) a Campbell Scientific automated systems the measures wind speed and direction, air and soil temperature, humidity, barometric pressure, solar radiation and rainfall. All data are uploaded to the Las Cruces website in real-time and can be freely downloaded by interested parties (www.ots.ac.cr/meteoro). The automated station is revised and calibrated periodically by Campbell Scientific staff.

B. The Las Cruces Library

The purpose of the Las Cruces library is to make available published information about Las Cruces, and to maintain a collection of basic reference works on tropical science. The Don Stone library is maintained by the Resident Biologist. The book collections grow by means of donations of appropriate volumes on tropical biology, the purchase of a few exceptionally useful books/year, and the inclusion of books received as review copies. The library also has a modest collection of different scientific journals in printed form but volumes and years are incomplete in all cases. An electronic listing of is maintained up to date and made available to researchers and students at a computer in the library. The CRO library contents are also available at (http://www.ots.ac.cr/index.php?option=com_wrapper&Itemid=298).

Researchers carrying out graduate work at Las Cruces are required to donate two copies of their thesis/dissertation to OTS libraries; other researchers must provide an electronic copy of all publications resulting from Las Cruces research.

C. Geographic Information System Laboratory

The purpose of the GIS Lab is to maintain a geographic database of LCBS and surrounding areas in Coto Brus County. All satellite imagery and aerial photographs are housed in the GIS laboratory and overseen by the GIS Lab Manager. These layers are made available free of charge to all researchers and students provided they are not used for commercial purposes. A basic list of the layers available is posted on the Las Cruces website (http://www.ots.ac.cr/index.php?option=com_wrapper&Itemid=427). If you need a specific layer or image, an appointment to meet with the GIS Lab Manager must be made in advance; the request should include the purpose, the specific area of interest, and year of imagery. The Lab Manager can also assist researchers who need GIS help and can generate some maps for specific projects. However, given the time constraints on the position, should substantial time be required, a daily fee will be assessed. In addition, the job requested needs to be coordinated in advance with the GIS Lab Manager, and is subject to other time constraints and commitments. Specific requests will be dealt with on a case by case basis. The GIS Lab can also lend field equipment including GPS units, clinometers, and compasses. This equipment must be reserved in advance in coordination with the GIS Lab Manager.

D. Lists and Keys of Las Cruces Flora and Fauna

The most recent species lists for Las Cruces flora and fauna are posted on the OTS website (<http://www.ots.ac.cr/lc-species>). Assistance in taxonomic identification is available from the Station Taxonomist, however, we ask that all researchers make an effort to minimize the demand on his time. Should the Taxonomist be required to visit field sites to assist with identification for more than a brief period (e.g., several field days), a daily fee will be assessed. The field visit has to be coordinated in advance and is subject to other time constraints on the Station Taxonomist. Specific requests will be dealt with on a case by case basis.

E. Researcher Responsibility for Metadata and Data Deposition with OTS

1. Station Data Management Policy. This Operations Manual summarizes the key points of Las Cruces data management policy and regulations. More detailed information is contained in the documents *Las Cruces Data Management Policy* and *Las Cruces Data Management Procedures*, also available in English and Spanish on the OTS website and from the Station Director on request.

2. Metadata Deposition. As a condition of research approval, Las Cruces Database Management Policy establishes that researchers must submit metadata on their research to OTS and update these metadata as datasets change over time. At the time of project approval, investigators must acknowledge these requirements, in written or electronic correspondence to the Station Director. Instructions for metadata submission and curation may be found in the *Instruction Guide for the Completion of Metadata Fields*, posted on the OTS website and also available from the Las Cruces Station Director. At departure, all researchers will be reminded of the requirement to submit metadata for data sets generated during their visit. At that time, researchers should also review and update the metadata of previously collected datasets that may have changed since submission.

3. Deposition of Data. OTS may also request that researchers deposit datasets of wide utility to the Las Cruces research community with OTS. Obligation to deposit such data will be determined by the Las Cruces Station Director as part of the project approval process. The project principal investigator(s) may elect to restrict access to these data for five years. Access restriction may be extended beyond five years with approval of the Station Director.

F. Informing Researchers of Data Availability

Metadata are information pertinent to datasets gathered in Las Cruces research and items such as the author of the dataset (PI of project that collected the data), the title and nature of the project, key words, source of funding, descriptions of each dataset collected in the project, their format (.txt, EXCEL,

ACCESS, etc.) and size (MB). Metadata constitute the core of Las Cruces' institutional memory and are indispensable for reporting research productivity to the US National Science Foundation and other funding institutions, as well as for providing information to researchers on the legacy of research conducted at the station.

G. Records of Research and Researchers at Las Cruces

Incoming researchers will be asked to provide information on their project upon arrival. These data will be used to update an electronic listing of research activity at Las Cruces viewable on the OTS website. Project listings will be key-worded for retrieval by subject.

VIII. POLICY FOR SUPPORT AND MANAGEMENT OF LAS CRUCES EDUCATIONAL USE

A. Informing Educational Groups of On-site Regulations.

Educational groups are advised of Las Cruces regulations and procedures in the Las Cruces User's Guide and in other documents sent at the time reservations are made. Upon arrival at the station, groups are advised of station regulations and policies by the Resident Biologist.

B. University Courses in Tropical Science

1. Orientation to Las Cruces. Upon arrival at the Station, courses are advised by the Station Director or designated member of the scientific staff of potential conflicts with research projects and they are also referred to the Las Cruces User's Guide. They are required to consult with the Station Director or member of the scientific staff about all non-observational research projects. An effort is made to concentrate manipulative course projects in the areas set aside for such activities, which include the Heye Annex and Melissa's Meadow. Manipulative projects in the primary forest of Las Cruces are not allowed, unless they are proposed as part of a longer-term study involving a follow-up visit and require Station Director approval. Courses are asked to respect the privacy of Station residents.

2. Course facilities at Las Cruces. The primary course meeting space is the Wilson Hall. Laboratory space is located in a separate building and is available upon request and should be coordinated with the Resident Biologist in advance or upon arrival. Courses are expected to be self-sufficient with respect to equipment and supplies. Las Cruces, whenever possible, can furnish basic laboratory equipment including microscopes, computers, and simple laboratory supplies. With the approval of the Las Cruces Resident Biologist and the Station Director, courses are also permitted to use more specialized scientific equipment housed in the research laboratories, contingent upon student experience and supervision. Course coordinators should make arrangements for use of research laboratory and equipment with the Resident Biologist.

IX.SAFETY

Maintaining a safe environment for visitors and staff at Las Cruces is a top priority and the responsibility of everybody at the station. A copy of the Las Cruces Safety and Emergency Procedures is available to all interested parties.

Trail use: Trails at the station are available to access different types of forest by researchers. Tourist access to the forest trails is restricted to overnight guests. Forest trails are marked with a distinctive color and numbered for safety and for research purposes every 50 meters, with the lowest numbers closer to the Wilson Botanical Garden, where all visitor facilities are located. A brochure with a map of the various trails at the station can be obtained at Reception. Establishment of new trails is the sole responsibility of the Station Director and the Scientific Department. New trails for research should be consulted with the

Director. General regulations for trail use include avoiding the production of noise, no trash, not stepping out of the trails unless necessary, reporting any obstructions on the trails.

Canopy Tower: The canopy tower is available for use by all overnight guests to Las Cruces. It is strictly prohibited to use the tower in inclement weather – **NO EXCEPTIONS**. The tower is also closed at night unless permission is coordinated in advance with Las Cruces scientific staff.

Laboratory Safety: Laboratory safety is the responsibility of the Resident Biologist (ext. 3110). Access to the laboratory area should be requested in advance. To insure that the laboratory facility is operated and maintained in a safe manner, the proper use of chemicals and how they should be stored needs to be determined in advance, equipment will only be made available once the user has demonstrated that they know how to operate them properly, and any safety procedures in the lab must be strictly followed.

Emergency procedures and contacts: Please see the Las Cruces Emergency Procedures protocol for details. Emergency numbers are also posted next to all Las Cruces telephones.

X. DOCUMENTS AND DIGITAL RESOURCES REFERRED TO IN THIS OPERATIONAL PROCEDURES MANUAL

Las Cruces User's Guide

www.ots.ac.cr/lascruces

Las Cruces Safety and Emergency Protocol

www.ots.ac.cr/lascruces

Las Cruces Herbarium Collecting Protocol

www.ots.ac.cr/lascruces

Herbarium Website

www.ots.ac.cr/herbarium

Digital Florula Website

www.ots.ac.cr/florulalc

Wilson Botanical Garden Database

www.ots.ac.cr/jbw

Las Cruces Species Lists

www.ots.ac.cr/lc-species

Meteorological Data

www.ots.ac.cr/meteoro