



## FIELD STATION PROFILES

### COCHA CASHU BIOLOGICAL STATION

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#### NAME OF FIELD STATION

Cocha Cashu Biological Station (CCBS)

#### GEOGRAPHIC LOCATION

- Peru, Department of Madre de Dios, Manu National Park, Elevation ~400 m
- 11.88° S, 71.41° W; 762256.87 Easting, 1315326.60 Northing, UTM Zone 42P

#### HABITATS

**Riverine vegetation:** The CCBS is situated within the floodplain of the Manu River. Riverine vegetation passes through a series of successional chronosequences of increasing age, stature, diversity, and structural complexity. A belt of the pioneer tree, *Tessaria integrifolia* (Asteraceae), is followed, first, by stands of giant cane (*Gynerium sagittum* - Poaceae) and then by stands of *Cecropia* sp. (Urticaceae). The latter eventually transitions to a longer-lived mixed species forest dominated by *Ficus insipida* and *Cedrela odorata*, with an understory of succulent herbs belonging to the Zingiberales clade. Beyond this mid/late successional zone is a mature forest that includes over 1000 woody species, with an abundance and diversity of understory (*Geonoma* and *Chamadorea*) and sub-canopy (*Astrocaryum*, *Attalea*, and *Iriartea*) palms, understory shrubs (dominated by Nyctaginaceae, Melastomataceae, Myrtaceae, Piperaceae, and Rubiaceae), and emergent trees (*Ceiba*, *Dipteryx*, *Sloanea*, *Hura* and *Ficus* spp.).

**Lacustrine vegetation:** Cocha Cashu (after which the Station is named) (Figure 1) has a depth of ~2 m and an area of 24 ha and remains connected to the Manu River via a small outlet channel such that only the highest floods affect the lake. Lacustrine vegetation includes floating aqua-

tics (e.g. *Pistia stratiotes*) and/or semiaquatic plants such as grasses and sedges. In succession, these are invaded by shrubs and, later, by *Ficus trigona*.

**Terra firma forest:** The ~8 km ribbon of the Manu floodplain gradually transitions to edaphically distinct, non-flooded *terra firma* habitat located above the highest reaches of the river and therefore bereft of its periodic input of sediment. Species composition of *terra firma* vegetation overlaps with floodplain forest but includes a significant proportion of habitat specialists such as the Brazil nut tree



**Figure 1.** Cocha Cashu lake (black) is an oxbow lake formed by the Manu River (brown). © San Diego Zoo Global/Digital Globe/GeoEye Foundation, 2012

*Bertholettia excelsa*. *Terra firma* habitat is also characterized by frequent tree-fall gaps and an understory dominated by the native spiny bamboo, *Guadua angustifolia*.

**Swamp forests:** The area within the CCBS trail system is pockmarked by seasonally inundated topographic depressions created by isolated river meanders or blocked draina-

ges. These swamp forests are typically dominated by a single tree species: the palm, *Mauritia flexuosa*, and the strangler fig, *Ficus trigona*, are the most common. Other characteristic swamp forest specialists include *Xylopia ligustrifolia* (Annonaceae), *Calophyllum brasiliense* (Calophyllaceae), and *Inga chartacea* (Fabaceae).

#### Links to lists of fauna and flora

<http://cochacashu.sandiegozooglobal.org/species-photo-guides/>

<http://cochacashu.sandiegozooglobal.org/species-lists/>

### INFRASTRUCTURE AND FEES

The Station has basic but comfortable infrastructure that can serve about 20 research projects and also accommodate several field courses and student visits throughout the year. User fees are kept to a minimum (Table 1) and include all meals:

- **Main House:** A two-story wooden building (7 m x 18 m) includes changing rooms, tool storage, a staff room, and a reading room on the first floor. The second floor is a large attic that serves as a classroom and additional storage room for research equipment (Figure 2).
- **Kitchen-Dining room:** A one-story wooden building (7 m x 15 m) with a kitchen, the dining room, and food storage areas. The dining room can host up to 30 people. A second temporary dining area is erected during peak periods.
- **Showers:** A single module (3.5 m x 11 m) has eight small shower cabins. Four sinks are located at both ends of the module.
- **Two composting toilets and two latrines.**
- **Tent Platforms:** 27 raised, wooden tent platforms, each capable of holding one or two large tents or several smaller tents, are scattered in the forest. Platforms are covered with a tarpaulin.
- **Offices:** An L-shaped one-story wooden building (5 m x 15 m plus a 3 m x 5 m section) provides space for researchers to operate computers, charge and maintain electronic devices, sort samples, and store equipment and materials. A small library holds 450 volumes which are mostly in the English language.
- **Screen House:** A one-story, simple, wooden structure (5 m x 8 m) covered with plastic screen mesh provides space for investigators to work with plants, seeds, and seedlings in a more controlled environment.
- **River Transportation:** Two wooden motorized canoes (16 m, 15 person capacity; 14 m, nine person capacity) provide transportation to and from the station. A 13 m aluminum boat can carry seven passengers. One-way rates for boat transport are listed in Table 2.
- **Lake Transportation:** Two simple indigenous-style dugout canoes are available.
- **Trail System:** A 52 km trail network provides access to 5 km<sup>2</sup> of terrain.

**Table 1.** Daily Station fees, including accommodation and all meals

STATION FEES (US\$)	Per day
Base contribution	45.00
Stay over 25 days	40.00
Undergraduate/postgraduate student groups	40.00
Peruvian researchers	30.00
Peruvian undergraduate students	20.00



**Figure 2.** A view of the Main House from the lake. © Jessica Groenendijk

**Table 2.** One-way rates (USD) for boat transport between different locations

	Full boat charter	Per person
<b>Carolina (15 passengers max)</b>		
Cashu - Boca Manu (or viceversa)	467	31.1
Boca Manu - Atalaya (or viceversa)	369	24.6
Boca Manu - Boca Colorado (or viceversa)	140	9.3
Cashu - Cocha Salvador (or viceversa)	98	6.6
Cashu - Pakitza (or viceversa)	91	6.1
Cashu - Maizal (or viceversa)	197	13.1
Cashu - Tayacome (or vice versa)	467	31.1
<b>Sharona (9 passengers max)</b>		
Cashu - Boca Manu (or viceversa)	561	62.3
Boca Manu - Atalaya (or viceversa)	443	49.2
Boca Manu - Boca Colorado (or viceversa)	168	18.7
Cashu - Cocha Salvador (or viceversa)	118	13.1
Cashu - Pakitza (or viceversa)	109	12.1
Cashu - Maizal (or viceversa)	236	26.2
Cashu - Tayacome (or viceversa)	561	62.3

## LEGAL REQUIREMENTS

Depending on the nature of your research, you may need to obtain several separate authorizations, including a research permit, a permit to export biological material, and/or a genetic resources contract. Applications are in Spanish. We strongly recommend you check our website <http://cochacashu.sandiegozooglobal.org/permits/> for the latest requirements and guidelines well in advance of your planned arrival.

## KEY RESEARCH

Over its 49-year history, the CCBS has hosted researchers from all over the world in a variety of disciplines, resulting in more than 750 scientific publications and 36 master's and doctoral theses. For over three decades, the field station was operated under the auspices of the Peruvian government by Dr. John Terborgh, Professor of Environmental Sciences at Duke University, and an eminent authority on tropical ecology. Much of the early work focused on primates, which are particularly numerous and easy to observe (Figure 3). Major scientific advances were made in the areas of socioecology and resource limitation, as summarized in Terborgh's seminal book, *Five New World Primates*.



**Figure 3.** A total of 13 primate species can be observed near the Station. © Dano Grayson

With intact communities of apex and meso-predators, a great deal of research has also advanced basic understanding of how predators structure ecological communities, and findings at the CCBS have been important for developing theories of trophic cascades. Foundational research on plants as keystone resources that play a disproportionate role in structuring animal communities was also carried out at the Station, where the concept was first formulated (Terborgh 1986). Similarly, Cocha Cashu is the source of innovative research on ecological engineers or keystone animal species that have disproportionate effects on the ecosystem. These include peccaries which create wallows, and the important role of large primates, birds, and other species in seed dispersal. This line of investigation continues today

but is often couched in a different framework. For example, comparative studies conducted at Cocha Cashu and outside the park where bushmeat hunting is common have shown how this anthropogenic influence has led to a dramatic decline in the diversity of tree species, with the greatest losses among those species dependent on large-animal dispersal.

Despite the Station's location in the Amazonian floodplain between an oxbow lake and the Manu River, aquatic ecosystem research has been neglected historically, contrasting with its strong research record in terrestrial ecosystems. In 2018, Cocha Cashu was awarded a National Science Foundation grant that will significantly enhance future capacity for aquatic research.

## FIVE SELECTED PUBLICATIONS

- Bagchi R, Swamy V, Latorre Farfan J, Terborgh J Vela Apaza C, Pitman NCA, Galiano Sanchez W (2018). Defaunation increases the spatial clustering of lowland Western Amazonian tree communities. *Journal of Ecology* 106: 1470– 1482.
- Davenport LC, Goodenough KS, Haugaasen T (2016) Birds of two oceans? Trans-Andean and divergent migration of Black Skimmers (*Rynchops niger cinerascens*) from the Peruvian Amazon. *PloS One* 11:e0144994.
- Kumar A, Divoll TJ, Ganguli PM, Trama FA, Lamborg CH (2018) Presence of artisanal gold mining predicts mercury bioaccumulation in five genera of bats (Chiroptera). *Environmental Pollution* 263:862-870.
- Paine CET, H Beck, and J Terborgh (2016) How mammalian predation contributes to tropical tree community structure. *Ecology* 97:3326-3336.
- Terborgh J (1983) *Five New World primates: A study in comparative ecology*. Princeton University Press, Princeton, USA.

**Link to a list of all Cocha Cashu publications:**

<http://cochacashu.sandiegozooglobal.org/publications>

**Website link:**

<http://cochacashu.sandiegozooglobal.org>

## REFERENCES

- Beck H, Snodgrass JW, Thebpanya P (2013) Long-term enclosure of large terrestrial vertebrates: Implications of defaunation for seedling demography in the Amazon rainforest. *Biological Conservation* 163: 115-121
- Diaz-Martin Z, Swamy V, Terborgh J, Alvarez-Loayza P, Cornejo F (2014) Identifying keystone plant resources in an Amazonian forest using a long-term fruit-fall record. *Journal of Tropical Ecology* 30: 291-301
- Terborgh J (1986) Keystone plant resources in the tropical forest. In: Soulé ME (ed), *Conservation biology: The science of scarcity and diversity*. Sinauer, Sunderland, pp 330-344
- Terborgh J, Zhu K, Álvarez-Loayza P, Cornejo Valverde F (2014) How many seeds does it take to make a sapling? *Ecology* 95:991-999