## Social and Economic Setting

Potential impacts of management of the Forest on overall cultural and demographic trends of Puerto Rico are insignificant. However, an understanding of the basic cultural context within which management occurs is key to carrying out the Forest Service's mission in Puerto Rico. A brief discussion of these trends is followed by individual facets of the social-economic environment, and the effects of the alternatives on these resources.

Modern Puerto Rican culture is a legacy of a mix of influences: the native Taínos, Spanish conquest and settlement, African, North American, and to a lesser extent, South American.

The last 50 years have brought profound change to Puerto Rico. The island has gone from a poor agrarian society to a modern industrialized society, with one of the highest per capita income levels in the Caribbean. Much population has moved from the farm country in the interior to towns and cities on the coast, and to the U.S., seeking factory and service jobs. The trappings of modern consumer/automobile culture--highways, cars, suburbs, shopping malls--are prevalent throughout the island, particularly in the San Juan area. Many people express alarm and dismay over the erosion of traditional values, but few would seriously consider reversing the economic progress that has come with cultural change. (Sain, 1982)

The U.S. and Puerto Rico view Puerto Rico's complicated political status from very different perspectives.

Many Puerto Ricans see a strong element of colonialism in their relationship with the U.S. The three major political parties base their philosophies around their preferred political relationship for Puerto Rico with the U.S.: statehood, commonwealth, or independence.

From the U.S. viewpoint Puerto Rico is a commonwealth of the United States--having local autonomy but voluntarily associated with the U.S. The people of Puerto Rico are U.S. citizens. Puerto Rico plays an important role in the national security of the U.S., as the site of a major navy base, and by virtue of its location in major shipping routes. U.S. policy towards Puerto Rico is based on encouraging self-determination and promoting economic advancement and self-reliance, while protecting its national security interests. (Office of Technology Assessment, 1987)

Puerto Rico's population grew from 3.2 million in 1980 to 3.5 million in 1990. Population density was 1028 per square mile by 1990, compared to an average of 60 per square mile in the U.S. The population of the San Juan metropolitan area increased from 1.51 million in 1980 to 1.69 million in 1990, and constituted 48% of the island's total population. Thirty three percent of Puerto Rico's households were classified as rural in 1980, decreasing to 29% in 1990. This trend of increasing urbanization and suburbanization continues.

The Forest, virtually universally known as "El Yunque" by Puerto Ricans and off-island visitors alike, has special significance for Puerto Rico. It is an important attraction for the economically significant tourism industry. Moreover, it is viewed with special pride by many Puerto Ricans as a national treasure and symbol of the homeland ("patria"). The Taínos held this mountain sacred. Many modern Puerto Rican still regard El Yunque with a degree of mysticism, and saw Hurricane Hugo apparently bouncing off the mountains to spare most of the island as an affirmation of its special powers.

## Economy

Puerto Rico's economy has been transformed from an agrarian based past to a present based on industry, services and government employment. This transformation was brought about through the cooperative efforts of the U.S. and Puerto Rican governments known as Operation Bootstrap. Tax incentives have been used to encourage industry to locate manufacturing facilities in Puerto Rico. As a result of economic development and various U.S. welfare programs, the standard of living in Puerto Rico is higher than that of any other country in the Caribbean.

Puerto Rico's economy is very closely tied to the U.S. mainland economy. Most consumer goods are imported from the U.S. and most goods produced are based on mainland raw materials or parts and are exported to the U.S. This results in a very "open" or dependent economy. Money does not recirculate within Puerto Rico to the extent as would occur in a more self-contained economy, before escaping into other larger (mostly U.S.) economies.

The major effects of the Forest on the Puerto Rican economy are the direct effects of salaries paid to Forest employees, and the importance of the Forest to Puerto Rico's tourism industry. Tourism comprises about 7% of the island's economy. In 1988 the Forest received an estimated 635,000 visitors. Approximately half were from Puerto Rico and half were visitors from off-island. (Redmond, unpublished)

Potential timber production from the Forest could only meet a small part of demand for wood products in Puerto Rico. The demand in Puerto Rico for wood products is chiefly for paper and paperboard, construction grade lumber, plywood, cabinet woods, fence posts, and fuel. Except for fence posts and a small volume of fuelwood, virtually all forest products are imported.

A furniture industry persists in Puerto Rico and presumably could absorb some of the better native and plantation grown woods that the Forest could produce. The largest value added use for wood from the Forest would be for the production of hand-crafted tourist souvenirs. Such production is currently quite limited in Puerto Rico, despite the heavy tourist traffic.

**Effects of Alternatives**

The alternatives do not vary measurably, in terms of their effects on Puerto Rico's economy as whole. It is estimated that all of the alternatives contribute some $530,000,000 and 16,000 jobs, directly and indirectly, to the island's economy. About 90% of this contribution is attributed to recreation visits to the Forest, particularly off-island tourists. (The estimates of the Forest's impact on Puerto Rico's economy are based on attributing a share of off-island visitors expenditures; i.e., if it were estimated that the average visitor spends 5% of their total vacation time on the Forest, then 5% of their expenditures would be attributable to the Forest.) The other 10% of the Forest's contribution to Puerto Rico's economy comes from expenditures for employee salaries and project design and construction.

Demonstration of sustainable timber production could have locally important economic effects that would vary by alternative. Alternative A would harvest about 260 MCF per year during the first planning decade. Alternatives C, C-mod and D would harvest about 20 MCF per year over the same time period. Alternative B would include only an insignificant amount of timber harvest (a few trees per year from roadside plots). Only Alternative A would include commercial timber sales. Alternatives C, C-mod and D would include a program of administrative transfer of wood harvested for demonstration to the Puerto Rico Department of Natural and Environmental Resources (DNER) and/or non-profit community organization(s) for milling. The resulting lumber would then be used, under a cooperative effort of the Forest, DNER and the Economic Development Corporation ("Fomento"), to encourage the development of local artisanry and woodworking businesses.

All of the alternatives would provide developed recreation sites on the south side of the Forest, which currently lacks any such developments. This could have positive effects of some small service businesses in the vicinity of Naguabo and other towns on the south side of the Forest.

Costs of managing the Forest under the different alternatives were compared to benefits coming from the Forest to determine present net values. (See Appendix B for a discussion of how these calculations were made.)

The Present Net Value (PNV) calculations only include benefits readily quantifiable in dollars. In all alternatives nearly 98% of benefits are attributable to recreation. Many of the most important benefits of the Forest are not readily measurable in economic terms and are not part of these PNV calculations:

- Endangered species protection and recovery
- Primary forest protection
- Water use
- Environmental education
- Demonstration of tropical forestry

All of the alternatives would have a negative present net value (Table III-4). Alternative A has the lowest PNV because it has the additional cost of more road construction than any of the other alternatives.

**Table III-4. Present Net Value of Priced Outputs and Costs by Alternative (thousands of 1991 dollars).**

*Many of the benefits of the Forest, such as the protection of primary forest, the recovery of endangered species, and the production of clean water, cannot be readily valued in dollars. Of the benefits that are included in these present net value calculations, most result from recreation.*

| Present Value of Costs and Benefits | Alternative A | B | C & C-mod | D |
|---|---|---|---|---|
| Benefits Recreation | 68,520 | 74,080 | 73,990 | 72,950 |
| Costs Recreation | (17,820) | (18,710) | (17,300) | (16,680) |
| Benefits Wildlife | 600 | 600 | 600 | 600 |
| Costs Wildlife | (7,180) | (7,180) | (7,180) | (7,180) |
| Benefits Timber | 3,350 | 30 | 510 | 510 |
| Costs Timber | (2,720) | (1,630) | (2,350) | (2,350 |
| Other Costs | (51,970) | (48,090) | (53,410) | (52,900) |
| Total Benefits | 72,470 | 74,710 | 75,100 | 74,060 |
| Total Costs | (79,690) | (75,610) | (80,240) | (79,110) |
| Total PNV | (7,220) | (900) | (5,140) | (5,050) |
| Benefit/Cost Ratio | 0.91 | 0.99 | 0.94 | 0.94 |

## Lands and Special Uses

### Ownership

In 1876 the King of Spain, Alfonso XII declared part of the Luquillo Mountains a Forest Reserve (Crown Lands). Lands remaining in the Reserve were ceded to the United States by Spain under the Treaty of Paris of 1898, after the Spanish-American War. The Luquillo Forest Reserve was proclaimed in 1903, and covered 12,443 acres of the former crown lands.

In the 1930's the Toro Negro Purchase Unit (about 7,800 acres) near the central part of the island and the Luquillo Purchase Unit (about 11,000 acres) were added to the Forest. At the same time the name was changed to "Caribbean National Forest". The Toro Negro Unit was exchanged with the Puerto Rico Department of Natural Resources for some 1,500 acres in the Luquillo Mountains in 1970. This exchange, along with land purchases during the 1930's and 1940's increased the Forest's area to 27,846 acres. Additional purchases brought the total to 27,890 acres through the end of 1992.

The Forest owns approximately 50% of the land within the proclamation boundary. Arroyo, Sandoval, and La Condesa parcels on the southwestern part of the Forest and Río Blanco parcel on the Forest's southern part, are the only Forest tracts separated and surrounded by private land. These four parcels contain about 750 acres. Many small farms, scattered homes, and small but fast growing urbanizations are located on the surrounding private land.

There are two private inholdings totaling about 85 acres and containing 12 to 14 ownerships. There is a potential to acquire additional lands to reduce inholdings and irregular boundaries, and to acquire critical wildlife habitats and recreation sites.

### Land Surrounding the Forest

Eight municipalities (the Puerto Rican equivalent of counties) directly surround the Forest: Canóvanas, Ceiba, Fajardo, Juncos, Las Piedras, Luquillo, Naguabo and Río Grande. In 1983 in response to increasing development pressures near the Forest, the Puerto Rican Planning Board adopted a Special Zoning Rule for Non-Urban Areas in Municipalities Surrounding the Caribbean National Forest. The objective of this Rule was to establish standards and regulate use and development on these lands so as to provide a buffer zone to protect the Forest.

Six special zones were established by the Rule:

- A1 - the most fertile and flattest agricultural land
- A2 - agricultural land of moderate fertility and slope
- A3 - the least fertile and steepest agricultural land
- B1 - interior (or upland) forest
- B2 - mangrove forest
- PR - resource preservation areas (high value natural areas)

These zones restrict or prohibit construction and subdivision. However, enforcement of these zoning regulations has not been entirely effective. Furthermore, the Rule does permit the Planning Board to grant requests for variances of this zoning. As a result, development pressures remain high around the Forest, and the area is becoming progressively less rural.

Although development on surrounding lands is of concern to the Forest, the U.S.D.A. Forest Service has no jurisdiction over private or Commonwealth owned lands within the area covered by the Special Zoning Rule (even within the Forest proclamation boundary). The Planning Board does regularly consult with the Forest when variances to the Special Zoning are requested. The Forest's position has been that variances are the purview of the Planning Board, but that the Special Zoning Rule does help protect ecological, scenic and recreation values, and that variances in the zoning generally result in increased development in what was intended to be a protective buffer zone for the Forest.

## Boundary Lines

Approximately 73 miles of landlines delineate the Forest boundary. By 1991, about 40 miles of boundary had been surveyed and signed by modern standards. Boundary line establishment and maintenance costs are high due to steep terrain and dense vegetation.

After Hurricane Hugo, down trees, vines, landslides and debris obscured many of the landlines. Through the end of 1992, 15 miles of key boundary lines had been re-established.

## Special Uses

There are approximately 100 special use permits on the Forest. They are summarized in Table III-5. Electronic facilities, water systems, tour guides and research are the predominate special uses on the Forest.

**Table III-5. Summary of Special Use Permits from 1991 to 1993.**

*The number of special use permits has been reduced by consolidating many individual electronic site user permits into association permits--improving cooperation among users and service to the public.*

| Type of Use | Number of Permits* 1991 | 1993 |
|---|---|---|
| Electronics/Communications | 127 | 7 |
| Outfitters/Guides | 12 | 24 |
| Water Supply | 15 | 15 |
| Recreation Residences | 15 | 15 |
| Research | 8 | 10 |
| Road Easements | 6 | 6 |
| Organization Camps | 3 | 3 |
| Other | 11 | 11 |
| **Total** | **196** | **91** |

* Approximately 50 additional temporary special use permits are issued annually.

## Recreation Residences

As of July 1996, there are 15 recreation residence permits on the Forest. The termination date for all recreation residence permits on the Forest is 1997. These residences are located in two groups: Upper Molindero (PR 9938 or Mt. Britton Loop) and Lower Molindero (PR 930). Three residences remain active, all on Lower Molindero. Remaining residences are not currently used, fees are delinquent, and permit holders have expressed interest in terminating their permits. Inspections indicate that most of the inactive residences are in disrepair and have suffered some level of vandalism. A number of these residences have asbestos that would have to be disposed of, if they were to pass into national forest ownership.

## Electronic Sites

El Yunque and East Peak Electronic sites are located at two of the high peaks in the Forest. They encompass 31 acres of land that was covered primarily with the dwarf forest type. Both peaks make ideal electronic sites because of their height and location.

East Peak was initially designated as an electronic site for the U.S. Navy, although the Federal Aviation Authority (F.A.A.) has been allowed to develop there also. Because of the need for security of the U.S. Navy Facilities and operations, the East Peak site has been designated to be used only by federal government agencies.

El Yunque Peak was first used as an electronic site during World War II and has been used for communications since. The site is used by government and private, commercial and non-commercial entities. Management of this electronic site is based on the El Yunque Peak Electronic Site Plan which was approved November 1991. Emphasis of this plan is to maintain the current permitted area, to accommodate compatible electronic uses, and to reduce visual impact and electronic interference by reducing the number of permits, structures, antennas.

## Effects of Alternatives

The alternatives do not vary in terms of their effects on lands and special uses. All alternatives would:

- Follow the same land acquisition plan.
- Emphasize bringing unpermitted tour guides into compliance.
- Maintain the area permitted for electronic sites at 31 acres.

Note: for discussion of recreation residence permits, see the Recreation section.

## Recreation

### Introduction

The Forest is one of the most popular recreation areas in Puerto Rico. It is also an international recreation resource drawing thousands of visitors from the United States mainland and other countries to experience a tropical rain forest. Approximately 650,000 recreation users visit the Caribbean National Forest a year, making it one of the most heavily-visited forest per acre in the National Forest System.

The Forest provides high quality recreation opportunities of a kind not readily available elsewhere on the island. Recreation occurs in a setting of scenic landscapes, clean and abundant water, fresh air and cooler temperatures than the nearby city, and relative isolation.

Recreation use occurs year-round in Puerto Rico's tropical climate, but does vary seasonally. Use in the summer months is approximately four times greater than during the winter months. Use by local visitors is greater during the summer, while more international visitors come during the winter. The total number of visitors is approximately evenly divided between residents of Puerto Rico and off-island tourists.

Forest recreation activities include picnicking, hiking, water play, driving, scenic viewing, and nature study. Summer home occupancy and primitive camping are relatively minor uses. The Forest's tropical setting, high visitation and proximity to a major population center combine to form a unique opportunity for interpretation and environmental education about tropical forests.

The steep, rugged topography, dense vegetation, and frequent rain of the Forest limit most recreation use to areas near roads. Most developed facilities and recreation use occurs on an area of about 1,500 acres on the north side of the Forest along PR Highway 191. This pattern of use results in crowding, parking and traffic problems, particularly on hot summer weekends.

El Portal Tropical Forest Center is a visitor information and environmental education center which opened in June 1996. Its objectives include recreation, interpretation, environmental education and training. It has the potential to welcome about one million visitors per year, increasing total Forest visitation by about 20%.

## Effects of Hurricane Hugo

The majority of recreation sites on the Forest were heavily damaged by Hurricane Hugo in 1989. Facilities such as picnic shelters, restrooms, visitor centers, interpretive sites, power and water systems, and surfaced trails were either damaged, destroyed or covered with thick mats of vegetative debris. Most trails were damaged by debris and erosion.

Recreation facilities had been completely rehabilitated by July 1992, when the Palo Colorado Picnic Area was re-opened.

## Recreation Opportunities

National forests provide opportunities for a wide range of recreational experiences. In order to describe potential recreation opportunities more accurately, the Forest Service has developed the Recreational Opportunity Spectrum (ROS). How the ROS system was applied to analyze recreation demand and supply on the Forest is described in detail in Appendix B.

The Forest has been classified into six ROS classes. Based on similar recreation experiences and management opportunities, these six ROS classes are combined into three groups in this discussion, as indicated in Table III-6:

**Developed** includes the Rural and Roaded Natural Developed ROS classes.

**Roaded Undeveloped** includes the Roaded Natural Undeveloped and Semi-Primitive Motorized ROS classes.

**Back-Country** includes the Semi-Primitive Non-Motorized and Primitive ROS classes.

| Table III-6. Existing ROS Classes and Practical Capacities. | | | | | |
|---|---|---|---|---|---|
| *Six ROS classes are combined into three groups.* | | | | | |
| **ROS Group/Class** | **Acres** | **Percent of Forest** | **Capacity** | | **Current Use** |
| | | | **PAOT** | **MRVD** | **MRVD** |
| Developed | 251 | 1 | 665 | 39.9 | 86.7 |
| Rural | 195 | 1 | 65 | 3.9 | 15.9 |
| Roaded Natural Developed | 56 | <1 | 600 | 36.0 | 70.8 |
| Roaded Undeveloped | 8,274 | 30 | 3,857 | 232.4 | 39.5 |
| Roaded Natural Undeveloped | 6,745 | 24 | 3,800 | 227.9 | 38.1 |
| Semi-Primitive Motorized | 1,529 | 6 | 57 | 4.5 | 1.4 |
| Back-Country | 19,325 | 69 | 77 | 5.6 | 6.7 |
| Semi-Primitive Non-Motorized | 18,385 | 66 | 67 | 4.8 | 6.2 |
| Primitive | 940 | 3 | 10 | 0.8 | 0.5 |
| **Totals** | **27,850** | **100** | **4,600** | **277.9** | **132.9** |

**Developed Recreation**

Developed recreation makes up only about 1% of the Forest's area, but supplies about 65% of total recreation use (Figures II-5a/b). Capacity for developed recreation is much more dependent on facilities than on area.

Recreation facilities on the Forest are mainly for day-use activities such as picnicking, hiking, scenic viewing, water play, nature study, and Forest interpretation. There are currently 14 developed sites offering visitors outdoor recreational opportunities on a year-round basis. These are summarized in Table III-7. There are no developed camping facilities. The only current fee site is El Portal Tropical Forest Center.

**Table III-7. Existing Developed Recreation Facilities.**

*All developed sites except Quebrada Grande Picnic Area are located along the central Highway 191 corridor on the north side of the Forest. There are currently no developed sites on the south side of the Forest.*

| Facility | PAOT | Development Level* | Accessibility Level** |
|---|---|---|---|
| Interpretation | | | |
| Sierra Palm Visitor Center | 30 | 4 | 4 |
| Palo Colorado Visitor Center | 20 | 4 | 4 |
| El Yunque Ranger District | 10 | 4 | 4 |
| Subtotal | 60 | | |
| Picnic Areas | | | |
| Palo Colorado | 296 | 4 | 4 |
| Caimitillo | 80 | 3 | 4 |
| Sierra Palm | 160 | 4 | 4 |
| Quebrada Grande | 64 | 3 | 3 |
| Subtotal | 600 | | |
| Observation Sites | | | |
| Yokahu Tower | 100 | 4 | 4 |
| Mt. Britton Tower | 25 | 2 | 2 |
| La Coca Falls | 40 | 3 | 3 |
| Bano de Oro | 20 | 3 | 3 |
| Bano Grande | 30 | 3 | 3 |
| El Yunque Peak Tower | 25 | 2 | 2 |
| Los Picachos | 25 | 2 | 2 |
| Rio Espíritu Santo | 15 | 2 | 4 |
| Cabezas de San Juan | 10 | 2 | 4 |
| Subtotal | 290 | | |
| Trailheads | | | |
| Mt. Britton | 24 | 1 | 4 |
| Angelito | 12 | 1 | 4 |
| Big Tree | 48 | 3 | 4 |
| Subtotal | 136 | | |
| **Total Capacity** | **1,086** | | |

* Development level refers to the facilities available at a site. Level 1 is the most primitive, and Level 4 is most developed.

** Accessibility level refers to relative ease of access at a site. Level 1 is most difficult or primitive, while Level 4 is easiest access.

El Portal Tropical Forest Center is located in this ROS area. It has the potential to welcome 1,000,000 visitors annually.

Recreation occurs in a setting where the natural environment has been highly modified, but remains attractive. Good roads, buildings, and other improvements are typical. Opportunities for interactions with other people are very great. Most facilities have flush toilets, lighting, and piped-in water for public convenience. Facilities outside the central recreation area are more rustic. Few challenges or risks are available.

A combination of steep slopes, high rainfall, and dense vegetation have limited the areas where acceptable recreation development can take place. This is especially true in higher elevations and the rugged interior.

Most of the Forest's recreation developed facilities, with 75% of the total developed site capacity, are located along PR Highway 191 on the north side of the Forest. Many of these facilities were built by the Civilian Conservation Corps (CCC) in the 1930's. Facilities for parking were added in 1980 at Quebrada Grande on the west side of the Forest, the first development outside the central recreation complex.

The growth of recreation use has placed pressure on the existing facilities, which have not had a major expansion project since 1940. Developed recreation use has steadily increased since the 1930s except for a sharp decline during World War II. The 1960's and 1970's produced the greatest recreation use rise. This increase rate moderated during the 1980's recession.

Demand for developed recreation exceeds existing capacity by an estimated 300-400% on summer weekends. Parking is the limiting factor at many of the Forest's developed sites. On busy summer weekends cars are parked outside designated areas along Forest roads causing traffic congestion and safety hazards.

There are few opportunities to expand parking sufficiently to meet demand at existing sites. Opportunities do exist to develop new sites outside the crowded central recreation corridor. Alternative transportation systems de-emphasizing private cars will also need to be considered in the future, as a means to meet increasing demand, provide quality recreation experiences, and protect the Forest's resources.

## Roaded Undeveloped Recreation

About 29% of the Forest's area is classified as roaded undeveloped, supplying about 30% of total recreation use (Figures II-6a/b).

Roaded undeveloped recreation occurs along roads, where recreation facilities such as picnic grounds, are not provided. The environment appears predominately natural. Permanent roads, including highly traveled roads, provide access. Improvements include non-paved roadside pullouts, trails and trail shelters. These usually harmonize with the environment. Interaction with other people may be fairly high, and the chance of solitude is low.

Driving for pleasure, guided bus touring, picnicking and water play are the key activities in this ROS class.

Water is a focal point for many users of roaded undeveloped areas. These users prefer undeveloped stream sites, rather than the developed picnic areas away from water along Highway 191.

Much of the use that occurs in roaded undeveloped areas is unsatisfied demand for more developed sites. Several bridges around the Forest (including Puente Roto on Highway 988 and the Río Icacos Bridge on PR Highway 191 on the south side of the Forest) serve as undeveloped picnic and water play sites. They are particularly popular on hot summer weekends. Surveys have reported up to 250 cars parked at Puente Roto, virtually blocking traffic on the road. Heavy use combined with a lack of sanitary facilities, inadequate parking and garbage collectors at these areas, results in site deterioration, water pollution, and traffic congestion.

The types of recreation experiences supplied in this ROS class are popular with local residents and off-island visitors alike. Demand for opportunities in these ROS classes is expected to continue to grow.

Aside from areas of concentrated use such as Puente Roto, the Forest's capacity to provide roaded undeveloped recreation far exceeds demand.

## Back-Country Recreation

About 70% of the Forest is classified as back-country. Only about 5% of total recreation use occurs in the back-country (Figures II-7a/b).

The Forest includes the largest contiguous area of undeveloped forested land in Puerto Rico. Dense vegetation and extreme topographic relief provide visual isolation from human development and activities soon after leaving developed sites and roads. Thus, despite its small size as compared to U.S. mainland national forests, it provides opportunities for primitive and semi-primitive recreation experiences, particularly as perceived by the local population. Opportunities for this type of recreation experience are rare in Puerto Rico, outside the Forest. Opportunities are of short duration (two days or less), due to the Forest's relatively small size.

Primitive and semi-primitive recreation takes place in essentially unmodified natural environments in which permanent structures are rare. Interactions between users are low. There is no motorized usage. The chance of experiencing solitude is high. The dense vegetation and rugged topography makes travel off trails difficult and challenging, and provides opportunities for adventure and risk taking. Typical activities are hiking and backcountry camping.

Primitive and semi-primitive recreation has been less popular among Puerto Ricans than the mainland population. Demand for this type of recreation is expected to increase as appreciation of wildlands and knowledge of how to enjoy them increases, and barriers to use are removed. The interest in "eco-" or "nature-based" tourism is expected to increase interest in, and demand for, this type of recreation for both Puerto Ricans and international visitors. Natural attractions play a key role in choosing travel destinations. Interest in tropical forests, the accessibility of El Yunque, and the opening of El Portal, will strengthen the attraction of the Forest for back-country use.

This use is currently suppressed on the Forest by a lack of facilities--safe trailhead parking, trails, backcountry camping sites--and information. It is estimated that providing such facilities and better information could lead to a doubling of present use.

**Forest Trails**

There are currently 24.3 miles of recreation trails and 12 miles of administrative trails on the Forest (Table III-8). All trails are designated for foot travel only. No trails currently accommodate wheelchair use. The Forest has very limited suitability for the development of horseback or mountain bike trails because of steep slopes, wet unstable soils, and

**Table III-8. Existing Recreation Trails.**

*The existing trail system provides few trailheads or trail loops.*

| Trail Name | Number | Difficulty | Length | Development Level* | Accessibility Level** |
|---|---|---|---|---|---|
| Río Chiquito | 1 | M | 0.9 | 2 | 3 |
| Río Sabana | 6 | M | 1.0 | 2 | 3 |
| Angelito | 7 | E | 0.4 | 3 | 3 |
| La Coca | 8 | M | 1.8 | 2 | 2 |
| Carrillo | 9 | M | 1.9 | 2 | 3 |
| Tabonuco | 10 | D | 0.3 | 1 | 2 |
| Bisley | 11 | M | 1.1 | 2 | 2 |
| La Mina | 12 | M | 0.7 | 4 | 3 |
| Big Tree | 13 | M | 0.9 | 4 | 3 |
| Arboretum | 14 | M | 0.2 | 2 | 3 |
| El Yunque | 15 | M | 2.6 | 3 | 2 |
| Mt. Britton | 16 | M | 0.8 | 3 | 2 |
| Los Picachos | 17 | M | 0.2 | 2 | 2 |
| Caimitillo | 18 | E | 0.5 | 4 | 4 |
| Mt. Britton Spur | 19 | E | 0.8 | 3 | 2 |
| Grand A | 21 | M | 1.0 | 2 | 2 |
| Grand B | 22 | M | 0.8 | 2 | 2 |
| Río de la Mina | 24 | M | 0.5 | 2 | 2 |
| Baño de Oro | 25 | E | 0.2 | 4 | 3 |
| El Toro | 34 | D | 2.2 | 2 | 2 |
| Tradewinds | 35 | M | 3.9 | 2 | 3 |
| Upper Espíritu Santo | 36 | D | 1.3 | 2 | 2 |
| Roca El Yunque | 39 | M | 0.3 | 2 | 2 |
| **Total Length** | | | **24.3** | | |

Difficulty Abbreviations: E = Easiest M = More Difficult D = Most Difficult

* Development level refers to the degree of improvements of a trail. Level 1 is most primitive, and Level 4 is most developed.

** Accessibility level refers to relative ease of access of a trail. Level 1 is most difficult or primitive, while Level 4 is easiest access.

High rainfall and the year-round growing season result in the need for intensive trail maintenance. Many trails require maintenance two times per year to keep them open and prevent erosion. Trails receiving more than light use must be surfaced to keep them from becoming muddy trenches. Relocation of some trail sections is necessary to avoid landslides, unsuitable soil conditions, or conflicts with other resources, and to improve hiking opportunities.

Most of the Forest's trails were constructed in the 1930's by the Civilian Conservation Corps. Many of these trails now need reconstruction or relocation to service current use levels.

The current trail system is composed primarily of short trail segments. Few loop opportunities exist. Several trails depend on hazardous road segments to connect sections of trails or to provide a return route to the trailhead.

Few trails have developed trailheads with adequate or safe parking. Use of trails, which do have adequate parking and well-marked trailheads, such as Big Tree Trail, is heavy.

The limitations of the trail system play a large role in the suppression of back-country recreation use described above. Opportunities exist to improve user safety and enjoyment through improvements to the system, such as constructing connecting links between trails to provide loops, providing some longer trails outside the developed recreation zone, and constructing and improving trailheads.

The Forest has two interpretive trails: Big Tree Trail which has interpretive signs; and Caimitillo Trail which has numbered posts and an accompanying handout. El Toro/Tradewinds Trail (3.9 miles) has been designated a National Recreation Trail for its outstanding scenic and recreation value.

Not all areas of the Forest are suitable for trail development. Reasons to manage areas without recreation trails include the protection of primary forest and sensitive vegetation, endangered species recovery and the protection of Research Natural Areas.

## Effects of Alternatives

### *Developed Recreation*

All alternatives increase developed recreation capacity by at least 200%, as is displayed in Figure II-5a and Table III-9. Between 77% (Alternatives A and B) and 88% (Alternative D) of the increase in interpretive sites, picnic areas, and observation sites is attributable to three facilities that are proposed under all alternatives: El Portal Tropical Forest Center, Puente Roto Picnic Area, and Río Sabana/Río Blanca Picnic Area. The alternatives thereby satisfy, to a large degree, the public's desire for increased information, environmental education, and picnic areas near rivers, as well as the need to protect and rehabilitate heavily used undeveloped areas.

**Table III-9. Recreation Facilities by Alternative.**

| Facility Type | Unit* | Existing | Alternative A | B | C and C-mod | D |
|---|---|---|---|---|---|---|
| Interpretation | No. | 3 | 4 | 10 | 9 | 8 |
| | PAOT | 60 | 860 | 1080 | 1020 | 990 |
| Picnic | No. | 4 | 9 | 9 | 7 | 6 |
| | PAOT | 600 | 1904 | 1704 | 1534 | 1470 |
| Observation | No. | 9 | 7 | 9 | 9 | 9 |
| | PAOT | 290 | 265 | 290 | 290 | 290 |
| Camping | No. | 0 | 4 | 2 | 1 | 1 |
| | PAOT | 0 | 160 | 52 | 40 | 40 |
| Trailheads | No. | 3 | 4 | 12 | 10 | 9 |
| | PAOT | 136 | 93 | 188 | 160 | 140 |

Alternative A would meet projected demand for developed recreation through the first decade, but demand would exceed capacity by the fifth decade. Alternatives B, C and D would meet projected demand through the fifth decade (Figure II-4a).

Alternative D would close the Quebrada Grande Picnic Area to provide maximum protection to endangered species that occur in the vicinity. While Alternative D would meet overall demand for developed recreation, visitors who have a preference for this site would be adversely affected.

All alternatives would provide developed site(s) on the south side of the Forest, which currently lacks any developed recreation facilities. All alternatives would include a picnic area near the Río Sabana/Río Blanca bridge, which currently receives concentrated use, but lacks any facilities. This is a similar situation to Puente Roto on the north side of the Forest. Alternatives A, B, C and C-mod would also include a picnic area on the Río Cubuy on the southwest corner of the Forest.

Alternative C-mod differs from Alternative C in that it does not include expansion of Quebrada Grande Picnic Area, instead adding similar amount of developed site capacity on PR 9966 at a new site to be named Jiménez. This change was made to lessen potential disturbance of endangered species.

Alternatives would not vary in management of recreation residences:

- follow national direction provided in FSM 2721.23 and FSH 2709.11.
- work with recreation residence permit holders to terminate permits for residences which are no longer active.
- Conduct project analyses of Upper Molidero and Lower Molindero recreation residence areas per national direction and the objectives of Management Area 2 (Developed Recreation).

***Roaded Undeveloped Recreation***

All alternatives reduce roaded undeveloped capacity from the current level by converting Puente Roto and Río Sabana/Río Blanco to developed sites. Total capacity for this type of recreation far exceeds demand through the fifth decade under all alternatives (Figure II-6a).

***Back-Country Recreation***

All alternatives would provide increased back-country capacity by constructing trails and trailheads (Figure II-7a). Alternative A and B would include the most trail construction (15 and 16 miles respectively), but Alternative A would include the fewest trailheads, resulting in a smaller increase in back-country recreation capacity.

Alternative D would construct the fewest trails (7 miles), and the second fewest trailheads, after Alternative A. Alternatives B, C and C-mod would meet, or nearly meet, projected demand through the fifth decade. Alternative A would not meet demand in the first decade, and Alternative D would nearly meet demand through the first decade, but fall short thereafter.

Alternatives A and D would forego opportunities to meet the sector of recreation demand with the highest potential for growth, and which are in most limited supply in Puerto Rico. They are less responsive than Alternatives B, C and C-mod to trends in outdoor recreation and nature-based tourism, which focus on natural "re-creational" experiences.

Alternative C-mod differs from Alternative C in terms of trail construction by:

- eliminating the Río Espíritu Santo Loop Trail and Trailhead, in order to lessen potential disturbance to endangered species.
- adding El Negro Trail and Trailhead (outside of primary forest) to provide hiking opportunities from the Cubuy Picnic Area.
- adding the Icacos Trail across the PR 191 landslide area to create a trail loop opportunity from the Río Sabana/Río Blanco Picnic Area on the Forest's southside.

## Roads and Facilities

The Forest transportation system (Table III-10) consists of 44.9 miles of paved roads, which is a density of 1.03 miles per square mile. The entire network is part of Puerto Rico's highway system, except for special use roads FR 10 and FR 27 (totaling 5.3 miles). Eleven bridges and 14 culverts are part of the system. Most recreation use occurs along the main Forest roads-PR 191, PR 186 and PR 988.

**Table III-10. Forest Road System.**

| Road Number | Road Name | Length Miles | Maintenance Responsibility | Surface |
|---|---|---|---|---|
| FR 10 | El Yunque Towers | 2.0 | F | P |
| FR 27 | Pico del Este | 3.3 | OF | P |
| MR-1 | Sandoval | 0.5 | M | P |
| MR-2 | Cubuy | 0.8 | M | P |
| PR-930 | Molindero Loop | 1.0 | C | P |
| PR-930A | | 0.3 | C | P |
| PR 946 | La Condesa | 1.3 | M | P |
| PR 963 | Girl Scout Campground | 0.1 | C | P |
| PR 988 | Río Chiquito | 1.4 | C | P |
| PR 186 | El Verde | 9.9 | C | P |
| PR 915 | Cristal | 3.0 | C | G |
| PR 191 | Highway 191 North | 9.0 | C | P |
| PR 191 | Highway 191 South | 5.8 | C | P |
| PR 903 | Experimental Station | 0.1 | C | G |
| PR 911 | Sonadora Spur | 0.9 | C | G |
| PR 988 | Sabana-Carolina | 4.2 | C | P |
| PR 9915 | Bisley | 0.8 | C | G |
| PR 9938 | Mt. Britton Loop | 0.6 | C | P |
| PR 9948 | La Marina | 2.4 | M | P |
| PR 9966 | Jiménez | 2.3 | C | P |
| PR 9983 | La Perla | 0.6 | M | U |
| | **Total** | **50.3** | | |

Abbreviations:
F - Forest
C - Commonwealth
M - Municipality
OF - Other Federal
G - Gravel
P - Paved
U - Unsurfaced

PR 191 crosses the Forest from north to south. It is the main route into the Forest and has the heaviest traffic of any road in the system. It was constructed during the 1940's as a through road from Mameyes on the north to Naguabo on the south. In 1970 the road was closed by a major landslide during heavy rains associated with a tropical storm. Other storms during the 1970's triggered three other major slides in the same area. The road remains closed between gates at Km 13.3 and Km 21.0. The closure of the road has made management of the south side of the Forest somewhat more difficult as Forest Service personnel must travel longer routes. A number of residents and community leaders of Naguabo have expressed support for re-opening PR 191. They believe through traffic would improve the access to the recreation facilities on the north side of the Forest, and would improve economic opportunities in Naguabo by increasing tourist traffic into Naguabo from the Forest.

The Forest is working with the Puerto Rico Department of Transportation and Public Works (PRDOT), the U.S. Federal Highway Administration and municipal governments to develop a comprehensive transportation analysis of the Forest. This analysis will complement an island-wide transportation plan that DOT has recently completed. The Forest transportation analysis will look at various alternatives to provide improved access, including various mass transportation options. The Forest has begun to look at some of these options [Ramiro's study].

PR 186, El Verde Road, crosses the west side of the Forest. This road serves local traffic from communities west of the Forest, and provides access to several small recreation sites. PR 988 connects the communities of Barcelona and Sabana. It provides access to the Sabana Work Center, and Puente Roto, a popular water play area.

The Forest's building inventory includes 35 structures, including offices, work centers, residences, viewing towers, research sites, and small visitor information centers. Day-use picnic shelters are not included in this inventory.

The first phase of El Portal Tropical Forest Center has been completed near the current ranger station on the north side of the Forest. Facilities now include a major visitor center of approximately 30,000 square feet, and parking for approximately 150 vehicles. A second phase, if funded, would add a conference center to facilitate international trainings and technology transfer.

**Effects of Alternatives**

Alternative A would add 25 miles of roads, of which 22 miles would serve the timber demonstration program. The Sonadora Cutoff, about 2 miles long, would be for general public and administrative use, linking PR 966 and PR 186.

All alternatives would include about 1 mile of road segments for recreation sites access and parking.

Alternatives C, C-mod and D would include about 2 miles of road segments to serve the timber demonstration program. Alternative B would include no sustainable timber production demonstration, and therefore, no road construction for this purpose.

None of the alternatives propose construction to re-open PR 191, nor do they preclude consideration of such an option in the future. However, the allocation of the PR 191 south corridor to Management Area 5 (Wilderness) in Alternative B, and to Management Area 9 (Scenic River Corridor) in Alternative C-mod, are not consistent with re-opening PR 191. The proposal in Alternative C-mod to build a hiking and/or mountain bike trail across the landslide would also conflict with any future decision to re-open PR 191. Under Alternatives B and C-mod a Plan amendment changing these management area allocations would be a necessary part of any re-opening effort.

## Roadless Areas and Wilderness

The Forest currently has no formally established wilderness. A wilderness area on the Forest would be notable because it would be the only tropical forest wilderness in the U.S. National Forest System, and would contribute toward the national goal of a more diverse wilderness preservation system.

Two roadless areas, totaling nearly 85% of the Forest, have been identified: the 12,600 acre El Toro Roadless Area on the west side of the Forest, and the 11,000 acre Mameyes Roadless Area on the east side. Evaluations of the wilderness potential of these roadless areas are presented in Appendix C. Parts of the El Toro Roadless Area have been considered three times previously for wilderness designation, but no congressional designation resulted. None of the Mameyes Roadless Area was recommended for wilderness designation in the Final Forest Plan in 1986 nor in the preferred alternative of the Draft Supplement to the FEIS of 1989, although it was evaluated in the RARE I and RARE II processes.

### Effects of Alternatives

Wilderness designation (by Congress) can be considered the most protective of management areas, since once so designated only another act of Congress could change a wilderness area's status. Areas allocated to the Wilderness Management Area would be managed under the following constraints until the designation decision is made, and permanently in the event of Congressional designation:

- No road construction or other development
- No motorized or mechanized (e.g. bicycle) use
- No timber harvesting
- No water development
- No treatment vs. control (manipulative) research
- No mineral activity
- Recreation management for low use, primitive experiences
- Primitive standards for trail construction and maintenance

Table III - 11 displays how each alternative allocates the Forest's roadless areas to management areas. Alternative A would allocate 16% of roadless area to wilderness, Alternatives C, C-mod and D 44% and Alternative B 71%.

**Table III-11. Allocation of Roadless Areas to Management Areas.**

*Alternative A would allocate 31% of Roadless Areas to Wilderness and RNA's. Alternative B would allocate 80%. Alternatives C, C-mod and D would allocate at least 65% to Wilderness and RNA's.*

| | Percent of Roadless Areas by Alternative | | | | |
|---|---|---|---|---|---|
| **Management Area** | **A** | **B** | **C** | **C-mod** | **D** |
| Wilderness | 16 | 71 | 44 | 44 | 44 |
| RNA | 15 | 9 | 21 | 27 | 21 |
| Primary Forest | 0 | 0 | 6 | 0 | 7 |
| Scenic/Recreation River Corridor | 0 | 0 | 0 | 5 | 0 |
| Developed Recreation | 5 | 4 | 3 | 4 | 4 |
| Integrated | 0 | 15 | 22 | 15 | 20 |
| Research | 13 | 1 | 4 | 4 | 4 |
| Timber Demonstration | 0 | 0 | 0 | 1 | 0 |
| Timber Management | 16 | 0 | 0 | 0 | 0 |
| Dispersed Recreation | 35 | 0 | 0 | 0 | 0 |
| **Total** | **100** | **100** | **100** | **100** | **100** |

Proposed recreation developments would not detract from roadless character in any alternative. The roadless area boundaries were mapped so as to nearly reach existing roads and developments. For this reason, all alternatives allocate some roadless area to developed recreation, which all occurs along existing roads.

The boundaries of areas proposed for Wilderness in Alternatives B, C, C-mod and D were located so as to coincide with Primary Forest. As a result, these alternatives allocate all or nearly all of the Primary Forest to either Wilderness or RNA, both highly protective Management Areas. Primary Forest also has a more Wilderness character than Secondary Forest.

Approximately 7 miles of road construction would occur in roadless area allocated to the Timber Management Area in Alternative A. Approximately 0.7 miles of road construction would occur in roadless area allocated to the Management Area 4 (Integrated) in Alternatives C and D. All of this road construction would occur on land previously cleared for agriculture, or partially harvested, on the lower slopes of the periphery of the Forest.

The boundaries of areas proposed for Wilderness and RNA in Alternatives B, C, C-mod and D were located so as to coincide with primary forest, because primary forest has high Wilderness character and value for research, and because these management areas provide a high degree of protection for primary forest.

## Wild and Scenic Rivers

### Designation Process

National Wild and Scenic River designation is a four-step process:

1. Eligibility study - identification of rivers with "outstandingly remarkable" values.
2. Potential classification - Wild, Scenic, or Recreation.
3. Suitability study - comparison of eligible segments and assessment of compatibility with the management of other resources to determine which rivers to recommend for designation.
4. Designation by Congress

### Eligibility and Suitability

An eligibility study and potential classification of the Forest's rivers was completed in 1989, and updated as part of this forest plan revision. This eligibility study is included in Appendix D. A suitability study has been completed as part of this revision and is also included in Appendix D.

The ID Team formulated a designation recommendation for each alternative, based on the goals of the alternatives and on the suitability study. Table II-12 summarizes the eligibility study, classifications, and alternative designation recommendations. The alternative maps (located in the map pocket in the back cover of this document) display river segments recommended for Wild, Scenic and Recreation River designation. Potential environmental effects of these alternative designations are assessed in this section.

Until a final determination is made as to suitability or non-suitability, the Forest Service is obligated to protect those qualities that made the rivers eligible. Once a river is formally designated, a management plan must be prepared within three years. This management plan would establish management guidelines for the river and its corridor (a minimum of 1/4 mile on each side of the river).

| Table III-12. Wild, Scenic and Recreation River Recommendations. | | | | | | |
|---|---|---|---|---|---|---|
| *Alternative B recommends all eligible river segments for designation. Alternative A recommends none. Alternatives C, C-mod and D recommend some of the eligible segments.* | | | | | | |
| | | | Alternative | | | |
| **River** | **Eligible Segment** | **Length Miles** | **A** | **B** | **C & C-mod** | **D** |
| Río Espíritu Santo/ | Wild | 2.9 | | X | | |
| Quebrada Sonadora | Scenic | 0.8 | | X | | |
| | Recreation | 2.2 | | X | | |
| Río Mameyes | Wild | 2.1 | | X | X | |
| | Scenic | 1.4 | | X | X | X |
| | Recreation | 0.9 | | X | X | X |
| Río de la Mina | Scenic | 1.2 | | X | X | |
| | Recreation | 0.9 | | X | X | |
| Río Fajardo | Wild | 3.4 | | X | | |
| Río Icacos | Scenic | 2.3 | | X | X | X |
| Río Sabana | Wild | 2.3 | | X | | |
| | Recreation | 0.3 | | X | | |

**Effects of Alternatives**

Designation would preclude some uses which currently occur, or could occur within river management corridors. New water impoundments would not be permitted within areas recommended for Wild, Scenic or Recreation designation. Existing impoundments or diversions could be maintained, if they are small, inconspicuous, and not detrimental to the rivers' natural qualities. Potential timber demonstration, road construction, mineral development, and utility corridors, would also be constrained to varying degrees under the different classifications.

Designation could increase recreation use of the rivers, by increasing public awareness of the existence and outstanding qualities of these rivers. Such effects are generally assumed to occur on navigable rivers and/or rivers accessible by trail. None of the Forest's eligible river segments are navigable, and several segments are not accessed by trails. Any increased recreation use that would occur, could conflict with wildlife habitat values for species sensitive to human disturbance, and/or research of undisturbed ecosystems.

***Alternative A***

Alternative A would recommend no rivers for designation.

Approximately the lower 1/3 of the Río Espíritu Santo/Quebrada Sonadora eligible segments would be located within Management Area 9 (Timber Management). Timber harvest and road construction could occur in this management area.

Water impoundments would be permitted in the management areas proposed in Alternative A along the lower Río Mameyes, Río Espíritu Santo/Quebrada Sonadora, and lower Río Fajardo.

***Alternative B***

Alternative B would recommend all eligible river segments for designation.

Designation would afford eligible rivers a degree of additional protection, although most rivers would be located within highly protective management areas under this alternative. The Río Sabana , Río Icacos, Río de La Mina, Río Fajardo, and the Río Espíritu Santo/Quebrada Sonadora would be located within Management Area 5 (Wilderness). The upper Río Mameyes would be within Management Area 7 (Research Natural Area).

The lower Mameyes and lower Río Espíritu Santo would be located within Management Area 4 (Integrated), where the construction of impoundments could occur.

Increased recreation use could occur, as a result of designation, along rivers with trail access. Alternative B would include new trail construction along the Río Espíritu Santo and Río Mameyes. An increase in use along the Río Espíritu Santo could adversely affect the use of habitats for species such as the Sharp-shinned and Broad-winged Hawks, and the Puerto Rican Parrot, through increased human disturbance. These endangered species are believed to be highly sensitive to human disturbance, particularly during their breeding seasons.

The upper Río Mameyes is located within the Baño de Oro Research Natural Area. No recreation trails are located in this area, and no new trail construction is proposed, so little increase in recreation use as a result of designation is expected. However, any increased in recreation use which would occur, would detract from the Baño de Oro's value for research of undisturbed ecosystems.

***Alternative C***

Alternative C would recommend the upper and lower Río Mameyes, Río de la Mina and Río Icacos eligible segments for designation.

The upper Mameyes, upper Río Espíritu Santo/Quebrada Sonadora, and Río Fajardo eligible segments, would be located within Management Areas 5 and 7 (Wilderness and RNA) under Alternative C.

The Río Icacos, lower Mameyes and lower Río Espíritu Santo/Quebrada Sonadora, would be located within Management Area 4 (Integrated), where construction of impoundments and timber demonstration could occur. Designation of the Río Icacos under this alternative would, therefore, afford additional protection for this river.

Increased recreation use could occur, as a result of designation, along rivers with trail access. This situation would occur on the Río Icacos and lower Río Mameyes under Alternative C, but would not occur on the upper Río Espíritu Santo. All three rivers flow through potential habitats for the endangered Sharp-shinned and Broad-winged Hawks, only the upper Espíritu Santo flows through currently occupied Puerto Rican Parrot habitat.

***Alternative D***

Alternative D would recommend for designation the lower Río Mameyes, and Río Icacos eligible segments.

The upper Mameyes, upper Río Espíritu Santo/Quebrada Sonadora, and Río Fajardo eligible segments would be located within highly protective management areas (Wilderness, RNA and Primary Forest) under Alternative D.

The Río Icacos, lower Mameyes and lower Río Espíritu Santo/Quebrada Sonadora would be located within Management Area 4 (Integrated), where construction of impoundments and timber demonstration could occur. Designation of the Río Icacos under this alternative would, therefore, afford additional protection for this river.

Increased recreation use could occur, as a result of designation, along rivers with trail access. This situation would occur only on the lower Río Mameyes under Alternative D. Increased recreation could affect the habitat potential of the lower Mameyes for the endangered Sharp-shinned and Broad-winged Hawks. No impacts on currently occupied Puerto Rican Parrot habitat are anticipated as a result of the designations proposed in this alternative.

***Alternative C-mod*** Alternative C-mod proposes the same river segments for designation as Alternative C. C-mod differs from C in that a new management area (MA9-Wild/Scenic River Corridors) is included to provide increased protection for Scenic River segments that are outside areas proposed for Wilderness or RNA. This includes the Río de la Mina/Río Mameyes and the Río Icacos.

## Research and Demonstration

### Research

The Forest has long served as a site for research, conducted by scientists of the Forest Service, the University of Puerto Rico, and around the world. It is uniquely suited to research on tropical forests and their management. Because of its wide elevation and precipitation range, five life zones occur within this small forest. These life zones are representative of more than one-third of the forested lands of the American tropics; 155 tree species occur in the Forest that grow elsewhere in tropical America. Access and facilities are as favorable for tropical forestry research as anywhere in the hemisphere.

Research began on the Forest in the 1930's. Botanical collections began in 1931, studies of natural regeneration began in 1934, monitoring the performance of timber plantations covering 4,500 acres with 28 tree species began in 1936, and tree growth records began in 1943. The Tropical Forest Experiment Station (now International Institute of Tropical Forestry) was established in 1939. The Institute has conducted extensive research on the Forest and elsewhere in the tropics. The ongoing reorganization of the Institute into the International Institute of Tropical Forestry recognizes the critical importance of science and sharing of technology, for the conservation of tropical forests and sustainable development throughout the tropics.

Major studies on the Forest have included the establishment, growth, and silvicultural treatments of native and exotic tree species, and the biology of the critically endangered Puerto Rican Parrot. More recent research emphases on the Forest include the effects of Hurricane Hugo, watershed management, ecosystem dynamics, impacts of recreation, and monitoring of global change. Many studies are cooperative with the University of Puerto Rico and other academic institutions. These studies have applicability on other forests in Puerto Rico and throughout the tropics.

The International Institute of Tropical Forestry maintains a foundation of technical information built on past local research, and one of the best libraries on tropical forest biology and management anywhere.

Research natural areas (RNA) are established by the Forest Service to preserve outstanding examples of natural ecosystems for study and comparison to disturbed ecosystems. In 1953 the 2,172 Baño de Oro Research Natural Area was established on the Forest, to preserve an area comprising the four major forest types. The Baño de Oro remains the only RNA on the Forest.

**Biosphere Reserve** The Forest was designated a Biosphere Reserve in 1976, under the Man and the Biosphere Program of the United Nations. Biosphere reserves, located in some 70 countries around the world, comprise a network of samples of the world's major ecosystems. The program is designed to promote conservation of nature, through scientific research, and management that balances protection, and the interests of people living in and around the forests.

**Demonstration**

Sustainable production of wood is urgently needed throughout the tropics. Virtually all tree cutting has been without knowledge as to when, or if, the remaining trees might produce another harvest. Thus, cutover forests are often cleared for agriculture, livestock production, and other uses.

Silvicultural techniques developed on the Forest demonstrate that secondary forests, with appropriate management, can be more productive than primary forests. Changing demand and improved utilization technology is making more tree species and smaller trees marketable. As this occurs, secondary forests managed for timber production, have the potential to provide higher and earlier yields.

The Caribbean National Forest, with a unique record of 50 years of continuous protection, research, and experience, presents the best locale in the entire American tropics to demonstrate tested techniques for sustainable wood production. Its climate, soils, and 91 tree species are common to roughly one third of the region.

## Effects of Alternatives

***Research***

The utility of the Forest for future research, including that which is unforeseeable, is a function of how much of the Forest is allocated for research, directly, or jointly with other compatible uses.

***Alternative A***

An area of 11,194 acres would be available for treatment vs. control research. It is located throughout the Forest, including fragile ecosystems at upper elevations and on steep slopes. Stand modification due to the installation of comparative studies could produce temporary, small-scale modifications of habitat and accelerated erosion while the responses of the forest to different treatments are compared. No studies will be permitted that deliberately expose the forests to what are recognized as undesirable practices.

3,508 acres are allocated to RNA.

**Alternative B**

An area of 5,934 acres could be used for treatment vs. control studies. The environmental consequences on this area would be as described for Alternative A.

2,172 acres are allocated to RNA.

***Alternative C***

An area of 9,870 acres would be available for treatment vs. control research.

5,146 acres are allocated to RNA.

***Alternative C-mod***

A total of 9,793 acres would be available for treatment vs. control research.

6,372 acres are allocated to RNA.

***Alternative D***

An area of 9,840 acres would be available for treatment vs. control research.

6,516 acres are allocated to RNA.

***Demonstration***

Table II-3 summarizes allocations and outputs from sustainable timber production demonstration. Alternatives A, C, C-mod and D would demonstrate sustainable timber production; Alternative B would not. Alternative A would allocate 5,833 acres (21% of the Forest) to timber demonstration and ultimately produce approximately 750 MCF per year. Alternatives C and D would allocate 1,500 acres (5% of the Forest) to timber demonstration, and gradually increase production to about 280 MCF per year. Alternative C-mod would allocate 1,167 acres (4% of the Forest) to timber demonstration, and eventually increase production to about 220 MCF per year.

The impact this demonstration would have on other tropical forests around the world is not possible to predict. It is safe to conclude that such demonstration would have a wide international audience, given the many forest scientists and managers that visit the International Institute of Tropical Forestry, and the many additional visitors that will be attracted by El Portal Tropical Forest Center.

It is also reasonable to expect that the demonstration of silvicultural techniques alone, without their concurrent demonstration in a sustainable timber production program (Alternative B), would be less persuasive to many potential users of such techniques. They might reasonably ask, "If silvicultural techniques developed on the Caribbean National Forest are recommended for our forests, why aren't those same practices implemented there?"

## Heritage Resources

Heritage resources are buildings, artifacts, or archeological sites that remain from human activity that occurred in the past. They are physical evidence of over 6000 years of human activity on the island of Puerto Rico. Heritage resources may be very prominent and visible, or they may be intangible, or buried under the present land surface. Heritage resources may have archeological, historical and/or architectural values, and each is unique and irreplaceable. When any element of our national heritage is destroyed, it is gone forever.

The Forest contains a variety of cultural resources spanning pre-Columbian, Spanish colonial, and the early twentieth century. Since 1983, approximately 8,400 acres of cultural resource surface inventories have been done on the Forest, resulting in the discovery of over sixty historic and pre-Columbian sites. Seven sites have been evaluated for inclusion in the National Register of Historic Places (NRHP). To date, one site has been listed in the Register.

Puerto Rico is known to have been inhabited as early as the fourth millennium before the Christian era. These earliest Puerto Ricans based their economy primarily on foraging and fishing activities. Sedentary ceramic-producing groups, who introduced domesticated plants, are believed to have entered Puerto Rico from South America around the beginning of the Christian era. Foraging and fishing camps, isolated activity areas, agricultural plots, village sites, and plazas, as well as petroglyphs and burial sites, are all potential resources in the vicinity of the Forest.

The larger settlements of Indian activity were initially confined to coastal areas, with penetration into the mountains and thickly forested interior, primarily by travel along stream courses. Petroglyphs were often carved on large boulders. Six such petroglyph groups have been located in the Forest with several more nearby.

Historic resources include habitation/settlement sites and Spanish colonial structures. Early homesteads were located on the lower slopes of what is now National Forest. The majority of the homesteads were subsistence farmers, although until the 1989 hurricane, coffee plantations were widespread and privately owned in the foothills. Above ground, visible evidence of this occupancy is now limited mostly to vegetative differences and refusedumps. Subsurface archeological evidence does remain to document this part of Puerto Rico's past.

Historic activities up to 1898 on the Forest were mostly of Spanish origin. In their quest for gold, the Spaniards placer mined stream sediments and also dug shaft mines. Within the last 85 years, little mining has taken place in the Forest, with copper extraction on La Mina Peak being the only notable occurrence.

The last major historical activity was the work of the Civilian Conservation Corps (CCC) on the Forest during the 1930's. Several CCC camps were established on the Forest and most existing Forest structures, roads and trails were built during this period. Many of these sites and structures have been determined eligible for listing on the National Register of Historic Places.

**Effects of Alternatives**

Cultural resources are protected under all alternatives. All areas are surveyed prior to any earth disturbing activities. Eligible sites are nominated to the NRHP. Significant sites which will be adversely affected by a project will be mitigated under Section 106 of the National Historic Preservation Act under the Memorandum of Understanding between the Caribbean National Forest and the Puerto Rico State Historic Preservation Office. This could include archeological excavation, project re-design, avoidance, and/or construction restrictions. If unanticipated heritage resources or sites are encountered during project work, work is halted until the sites can be evaluated and protected.

Significant sites will be interpreted for the public, if consistent with protection of the resource, under all alternatives.

***Alternative A***

This alternative would include more ground disturbing activities than any other alternative--approximately 138 acres of road, trail and facility construction over 50 years. Also timber harvest would occur on 5833 acres over 50 years.

***Alternative B***

This alternative would include the least amount of ground disturbance of any of the alternatives--approximately 80 acres of road, trail and facility construction over 50 years. No ground-disturbing timber harvest demonstration would occur under this alternative.

***Alternative C***

This alternative would include approximately 76 acres of road, trail and facility construction over 50 years. Timber harvest demonstration would occur on 1,500 acres over 50 years.

***Alternative C-mod*** This alternative would include approximately 77 acres of road, trail and facility construction over 50 years. Timber harvest demonstration would occur on 1,167 acres over 50 years.

***Alternative D*** This alternative would include approximately 74 acres of road, trail and facility construction over 50 years. Timber harvest demonstration would occur on 1,500 acres over 50 years.

## Scenery Resource

The Forest contains some of the National Forest System's most scenic landscapes, including magnificent scenic vistas, spectacular waterfalls, clear rushing streams, and lush tropical vegetation. These visual resources attract tourists from all parts of the nation, as well as nearby residents. The prominent mountains also provide a scenic backdrop for San Juan and for popular recreation areas such as Luquillo Beach.

The Forest's most prominent contrasts to the natural landscape are the electronic structures and security lighting located on El Yunque Peak and Pico Del Este. Although the structures on El Yunque Peak only occupy an acre or two, the negative visual effect extends much further. When the Forest's silhouette is viewed even from a distance of several miles, the mountain's curved lines are interrupted by the unnatural metal forms at El Yunque Peak that can be easily perceived as man made.

Hurricane Hugo, which struck the Forest in 1989, left vegetation over much of the Forest appearing devastated. (See also Vegetation section is this chapter.) By 1992 natural recovery of the Forest's vegetation was such that most off-island visitors are unaware a disturbance occurred. Remaining visual evidence is limited to scattered broken tree trunks and a generally more open tree canopy.

### Effects of Alternatives

A Forest-wide inventory of the scenery resource has not been completed. However, visual quality levels (VQL) have been used to estimate the effects of the alternatives on the Forest's scenery resource. The VQL analysis is based on the USDA Forest Service's Visual Management System, as explained in Agricultural Handbook Number 46, National Forest Landscape Management, Volume 2. The VQL analysis presented here makes assumptions about what percent of each management area will achieve what visual quality levels. These assumptions and their rationales are listed in Appendix B.

Table III-13 summarizes VQL's achieved by alternative.

| Table III-13. Summary of Visual Quality Levels. | | | | | |
|---|---|---|---|---|---|
| | Percent of Forest by Alternative | | | | |
| Visual Quality Level | A | B | C | C-mod | D |
| Preservation | 41 | 68 | 61 | 64 | 61 |
| Retention | 32 | 20 | 26 | 26 | 26 |
| Partial Retention | 21 | 10 | 11 | 8 | 10 |
| Modification | 5 | 1 | 2 | 2 | 2 |
| Maximum Modification | 1 | 0.1 | 0.3 | 0.2 | 0.3 |

Visual Quality Level Definitions:

**Preservation (P)** - Areas in which only ecological change has taken place, except for trails needed for access or for very low level recreational use. Land appears to be untouched by human activities. (Preservation is generally reserved for areas that have been Congressionally or administratively established such as wilderness and research natural areas.)

**Retention (R)** - Areas in which changes in the landscape are not visually evident to the average person unless pointed out. Landscape appears to be natural.

**Partial Retention (PR)** - Areas in which changes in the landscape may be noticed by the average Forest visitor but do not attract attention. Management activities remain visually subordinate to the characteristic landscape. A natural appearing landscape still remains dominant. Changes appear to be minor disturbances.

**Modification (M)** - Areas in which landscape changes are easily noticed by the average Forest visitor and may attract some attention. Changes appear to be disturbances but resemble natural patterns.

**Maximum Modification (MM)** - Areas where landscape changes are strong and would be obvious to the average Forest visitor. These changes stand out as dominant yet may resemble natural patterns when viewed from 3-5 miles or more. They appear to be major disturbances viewed at closer distances.

**Unacceptable Modification (UM)** - Areas where landscape modifications are excessive. Size of activities relate poorly in scale and form and they contrast drastically with the sites form, line, color and/or texture. This visual quality level would never be recommended as an objective but can occur when other uses or objectives have been given precedence over the scenery resource.

As indicated in Table III-13, it is estimated that 73% of the Forest would achieve a VQL of Preservation or Retention under Alternative A. This would increase to 87% - 88% under Alternatives B, C and D. The greater allocations to highly protective management areas (Wilderness, RNA, Primary Forest) in Alternatives B, C and D account for this difference.

VQL's of Partial Retention and Modification would occur on an estimated 26% of the Forest under Alternative A. Percentages of these VQL's would decrease to between 11% - 13% under Alternatives B, C and D. Lesser amounts of timber demonstration and associated road construction account for this difference.

It is estimated that some Modification VQL will occur under all alternatives where intensive research, demonstration or construction activities may occur. Alternative A, with its larger timber demonstration program and Research Management Area, is estimated to result in up to 5% of the Forest in this VQL.

It is assumed that in all alternatives the current Maximum Modification VQL of the electronic sites will be improved through site/equipment modification and rehabilitation.