



IBP1386\_09

NATIVE FLORA RESCUE PROGRAM:  
GASENE PROJECT CASE STUDY  
Serricchio, Claudio<sup>1</sup>, Caldas, Flaviana V.<sup>2</sup>,  
Akahori, Lisa<sup>3</sup>, Jacomelli Jr, José Almir<sup>4</sup>

**Copyright 2009, Brazilian Petroleum, Gas and Biofuels Institute - IBP**

This Technical Paper was prepared for presentation at the *Rio Pipeline Conference and Exposition 2009*, held between September, 22-24, 2009, in Rio de Janeiro. This Technical Paper was selected for presentation by the Technical Committee of the event according to the information contained in the abstract submitted by the author(s). The contents of the Technical Paper, as presented, were not reviewed by IBP. The organizers are not supposed to translate or correct the submitted papers. The material as it is presented, does not necessarily represent Brazilian Petroleum, Gas and Biofuels Institute' opinion, or that of its Members or Representatives. Authors consent to the publication of this Technical Paper in the *Rio Pipeline Conference Proceedings*.

---

## Abstract

Concerning the surrounding flora, the implementation of pipelines may cause fragmentation and isolation of the remaining natural vegetation, possibly changing the forest structure; thus raising the border effect; modifying the ratio of species and life forms, decreasing the vegetal diversity and/or causing a lack of connectivity among the remaining indigenous forest resources.

In the case of pipelines, the most important environmental measure intended to mitigate the damage caused to the flora is the adoption of Indigenous Flora Rescue Programs. This paper is aimed at analyzing the programs currently applied during the implementation of the GASENE project, by conducting a case study.

The main targets of such program are obtaining seeds and fruits with a view to subsidize the potential production of sapling to be further employed in the recovery of areas impacted by the pipeline works; and then relocate the most significant samples of species rescued from the suppressed areas in order to comprise forest areas adjacent to the pipeline's right-of-way.

The programs had little differences in their methodology while being implemented, however, we consider that up to the present moment the results obtained in the preservation of species of native flora have been satisfactory.

## 1. Introduction

In the row crossed by GASENE Gas Pipeline, the forest remnants are rare, though very exuberant. First by the choice of the adopted tracing and second by the fragmentation process in the region due to human occupation, being, therefore of utmost importance the preservation of some species, not only for the maintenance of the local biodiversity, but also for the maintenance of a genetic base and its posterior use in the connection of the fragments existing in the region.

During the implementation of linear projects, impacts on the flora may be identified, such as: the fragmentation and isolation of natural remnants with a consequent change in the forest structure; the increase of the edge effect; the changes in the proportionality between the groups of species and forms of life, reduction in plants diversity and reduction and/or lack of connection among the native forest remnants. These impacts result from the services related to Row opening, which is preceded by vegetation suppression; to the accesses necessary for the movement of equipments and vehicles; and to the implementation of auxiliary areas as work sites and temporary dumping and borrowing sites.

Thus, to mitigate the damages to the flora and the loss of vegetal species, in these projects the main measure adopted is the implementation of Flora Rescue Programs. Among the main actions of these programs, the emphasis is the acquisition of seeds and fruits to subsidize the production of seedlings to be employed in the recovery of the areas impacted by the project; the relocation/transplant of priority species samples (existing in the directed affected area) rescued from cutting areas to forest formation adjacent to the Row; and the completion of training with the workers involved with the gas pipeline construction works for their awareness.

This article intends to analyze the flora rescue programs applied during the implementation of GASENE project through a case study.

---

<sup>1</sup> Mechanical Engineer - PETROBRAS

<sup>2</sup> Master, Civil Engineer – PETROBRAS

<sup>3</sup> Postgraduate, Biologist – TELSAN in service of PETROBRAS

<sup>4</sup> Biologist – AGF in service of PETROBRAS

GASENE Project is composed by Cabiúnas – Vitória (GASCAV), Cacimbas – Vitória and Cacimbas – Catu (GASCAC) gas pipelines and its main purpose is to consolidate the country's natural gas pipeline network and to provide the interconnection of the Southeastern and Northeastern gas pipeline networks. Two of these gas pipelines are in operation phase, and one in construction, the GASCAC. The Southeast-Northeast Gas Pipeline (GASENE) starts in Macaé city in Rio de Janeiro State, at Cabiúnas Terminal, and ends at Catu Compression Station, located in Pojuca city in the State of Bahia. The transition points between the gas pipelines are the Pressure Regulation Station (ERP) of TIMS, in the city of Serra, Espírito Santo State, and Cacimbas Gas Treatment Unit (UTGC), located in Linhares city, also in Espírito Santo State. The extension of these gas pipelines is approximately 1,370 km, considering that other relevant data for the development of this work are presented on Table 1 below.

Table 1. Gas pipeline data

Gas pipeline	Extension (km)	Native vegetation suppression area (ha)	Program implementation period	Crossed ecosystems
GASCAV	300	16,70	From June/2006 to September/2007	Deciduous and Semi-deciduous seasonal forest
Cacimbas-Vitória	130	16,82	From March/2005 to January 2006	Restinga, Board forest
GASCAC	940	105,85	Started on April 2008 (in curse)	Restinga, Manguezal, Board, Rainforests, Reconcavo

## 2. Description of the Flora Rescue Program

The flora rescue and conservation works are implemented in the areas directly affected by the gas pipelines implementation works, being the implementation of the program in accordance with the Work Schedule. Thus, the program starts before the RoW opening phase, when the vegetation suppression happens and ends some months after suppression is completed, when the follow-up of the species transplanted/relocated ceases.

Considering the three studied projects, the phases of this program comprised:

1. Teams planning/mobilization: in this initial phase the teams are defined (considering the number of Spreads of the Work), trainings, acquisition of equipments, preparation of the Work Plan, among other planning activities. Regarding the available team, it's observed that only in GASCAV work the same team developed flora and fauna rescue works;
2. Obtainment of specific environmental licenses for botanical material collection and transportation: by federal environmental agency;
3. Recognition of the project area by the identification of the main forest remnants mentioned in the project's forest inventory;
4. Definition of the main species for rescue: threatened species and in extinction risk listed from the official threatened flora lists at national and state level, endemic species defined from specific literature and vegetable species of botanical interest. Considering Cacimbas – Vitória gas pipeline, the environmental agency itself, through the Installation License condition, defined the main botanical families to be rescued;
5. Intensive campaign for Fruits and Seeds Collection in the Direct Influence Area (DIA): phase not completed in GASCAV;
6. Flora Rescue and Material Collection for Conservation and/or Propagation Purposes;
7. Vegetable material selection and destination;
8. Follow-up of the transplanted/relocated individuals;
9. Training involving site assistants and awareness moments of subcontractor's employees, accomplished mainly during the Safety, Environment and Health Daily Dialogues – DDSMS, especially with the vegetable suppression team.

For a better understanding, the methodologies adopted on stages 5, 6, 7 e 8 are detailed below.

### 2.1. Collection of seeds and fruits

Before suppression and after the delimitation (by topography team) of the areas which will be suppressed, an intensive campaign for the collection of seeds/fruits of native tree species is conducted, especially of the ones

threatened of extinction and of those for conservation interest. In addition, after the toppling of the tree the seeds/fruits which could not be previously collected due to risks to collector, are then collected. (CTA, 2009).

Concerning the collection effort, it can be observed a difference in the adopted methodology for GASCAC and Cacimbas-Vitória gas pipelines. The teams which made GASCAC's work followed all pipeline extension during the performance of the services and collected the material along the RoW of 20m. Regarding Cacimbas-Vitória gas pipeline, all areas which could have a crossing of the pipeline and native or anthropogenic vegetation fragments, but which could contain samples of botanic relevance, were identified. From this survey and jointly with the technicians of the licenser environmental agency, the areas for the collection of fruits and seeds were defined, limiting to the RoW.

Fruits and seeds with physiological maturity are collected, once is in this period that they present greater force and higher germination percentage. After collection, the selection of the material is made and later the removal of the pulp, washing (fleshy fruits) and drying. All material is packed by species (Figure 1) and followed by an identification card with the name of the species, date and collection place, geographic coordinates, quantity, in addition to extra information as general aspect and kind of environment collected.



Figure 1. Seeds collected in GASCAC packed in bags per species (CTA, 2009)

## **2.2. Collection of Herbaceous and Shrubby Individuals**

This collection happened in two moments: after the delimitation of the row by the topography team of the construction and assembly company and during vegetation suppression activity, after the cut of the greater size trees (removal of the epiphyte individuals which are in highest areas). For it, is fundamental the constant dialogue between the construction and assembly team and the rescue team for the planning of the activities.

All material of botanical interest and possible to rescued and transplanted is collected, considering that the specific procedures adopted for collection and relocation vary according to the species (epiphyte, herbaceous terrestrial, herbaceous rupicola, herbaceous epiphyte and hemi-epiphyte, shrubby and arboreous, fleshy plants), also considering their phytosanitary state. The individuals collected and transplanted are identified and numbered and all information related to the species (name, family, phorophyts, date and collection place, conservation status) are registered on a register form that is later used for the register of phytosanitary and phenological conditions (as the emerge of roots, flowers, leaves and fruits) of these individuals during the period of follow-up of the germination and stabilization. Figure 2 demonstrates the moment of transportation of the rescued vegetal material to be relocated – Cacimbas-Vitória gas pipeline.



Figure 2. Transport for relocation purpose occurred in Cacimbas – Vitória pipeline (Biodinâmica, 2005)

### 2.3. Selection and destination of the vegetal material

The place of relocation of the individuals was situated out of the row, in the remnants adjacent to the Work. Each individual was taken to a place next to where it was removed, observing the maintenance of the physical and ecological characteristics of the place of origin, as well as the non interference in the vegetation of the transplanting area (Biodinâmica, 2005).

The collected material (branches and splinters of bark) containing the individuals was tied with cotton string of medium thickness or metal fine wire (for greater size individuals, preferably in trees of the same species or family, observing the original position of the branch and the geographic position (north, south). The seeds collected at GASCAC were destined to vivariums of existing Conservation Units or of Universities in the cities crossed by the Gas Pipeline. Regarding the seeds collected at Cacimbas-Vitória gas pipeline were delivered to the environmental agency that forwarded them to the Federal University including them at the State's seed bank.

### 2.4. Follow-up of the transplanted/relocated individuals

In this follow-up phase, the transplanted species are evaluated as to their phytosanitary state and notes are made concerning the fenological aspects, as emerge of roots, leaves, flowers and fruits. In this work, the fenological aspects work indicating if the individuals are adapting to the transplanted place. This follow-up has been made for a period of 03 (three)-04 (four) months in GASCAC, in general with a revision, however, considering Cacimbas-Vitória gas pipeline, 58,22% of the transplanted individuals we revised twice, for a period of approximately 05 (five) months. This follow-up was not made at GASCAV.

During the revisions, actions are taken as new fixation with strings, if necessary, capping of the terrestrial herbaceous individuals, adoption phytosanitary measures for pest control and maintenance of the epiphytes through the elimination of climbing strangler. (CTA, 2009).

## 3. Results and Discussion

The results obtained for flora rescue and collection of seeds and fruits in the three Works of GASENE are presented on Table 2 below.

Table 2. General results

Project	Flora rescue	Collection seeds and fruits (kg)
GASCAV	123 lots	Not reld
Cacimbas-Vitória	414 individuais	16,980
GASCAC	10.167 individuais	295,24

On Figures 3 and 4 are presented the percentage of the rescued families at GASCAC and Cacimbas-Vitória gas pipelines, in which it can be observed that the Bromeliaceae was the family with more rescued individuals, followed by the Orchidaceae. Concerning GASCAC, the identification of the rescued individuals was limited to family level: Orquidaceae, Cactaceae and Bromeliaceae, not detailing to species or genera, as at Cacimbas-Vitória and GASCAC gas pipelines.

According to Biodinâmica's report (2005), the presence of great quantity of Bromeliaceae may be explained for the importance of this family in ecosystems crossed by the gas pipelines (mainly of atlantic forest), present in forest areas, as well as in open areas. The reproductive strategies of the species of this family provide them and easy adaptation in open or highly anthropogenic areas, acting as focal or pioneer species. Another factor for the establishment of the Bromeliaceae in poor substratum is its feeding form, once the greatest part of nutrients absorption is made by the leaves and not by the roots as in the major part of the other plants.

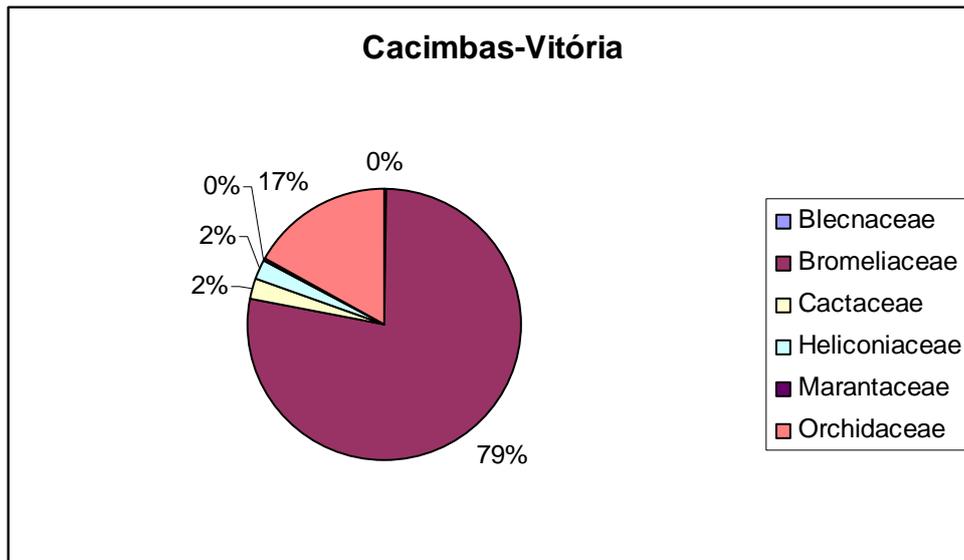


Figure 3. Rescued Families at Cacimbas-Vitória Gas Pipeline

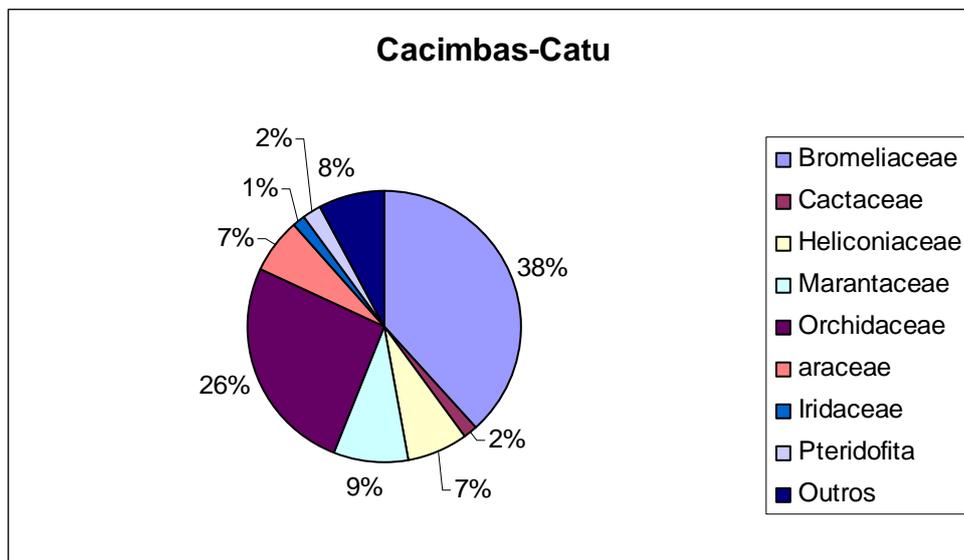


Figure 4. Rescued Families at Cacimbas-Catu Gas Pipeline up to January, 2009.

The results of the follow-up up of the transplanted material at Cacimbas-Vitória gas pipeline demonstrate that 94% of the samples were found alive; 2% were found dead and only 4% were not found. At GASCAC work we have the following numbers up to now, 83% of the samples were found alive; 11% dead and only 6% were not found. The data can be found at Picture 5 below.

The low number of dead individuals may reflect the due use of the collection and relocation/transplant techniques and it can be observed during the follow-up period the emerge of new leaves, germination, new roots, roots adhering to the new phorophytes and the emerge of flowers and fruits in these individuals (Biodinâmica 2005).

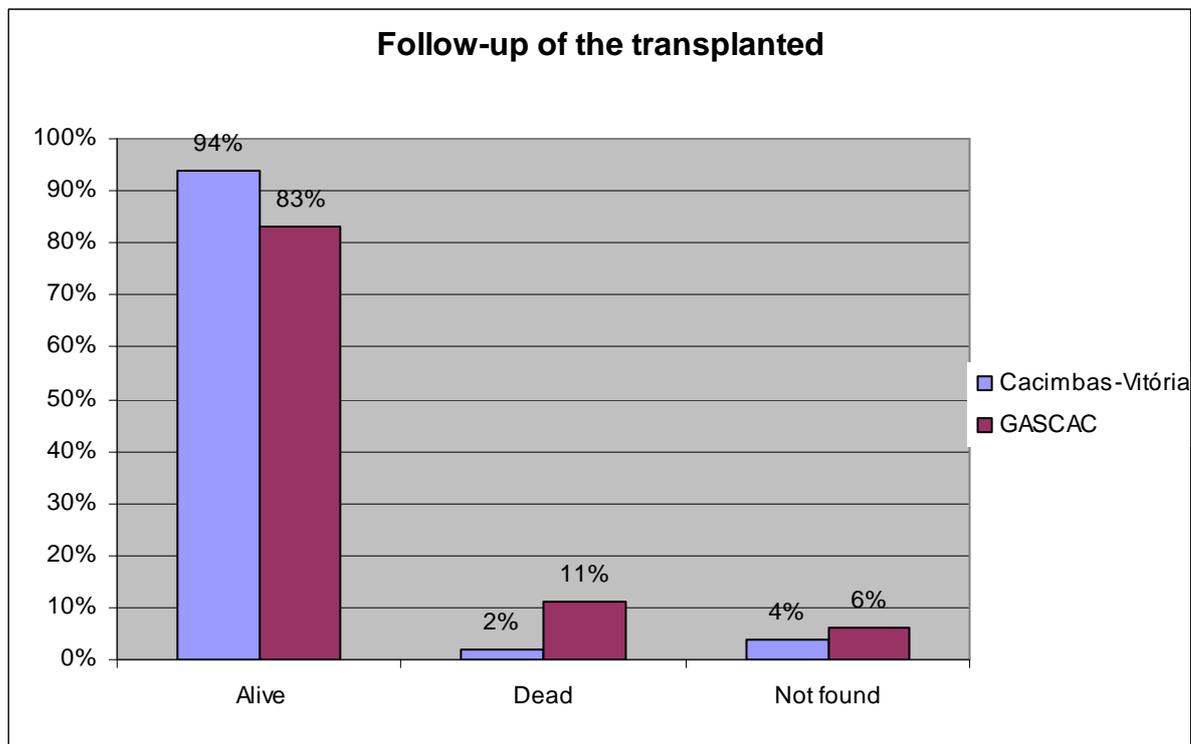


Figure 5. Results of the follow-up of the transplanted at GASCAC and Cacimbas-Vitória.

Other relevant results reached in the development of the programs may be described:

- Rescue of 08 samples threatened with extinction (*Aechmea blanchetiana* (Baker) L.B. Smith and *Vriesea neoglutinosa* Mez; *Rhipsalis crispata* (Haw.) Pfeiff.; *Couepia schottii* Fritsch; *Euterpe edulis* Mart.; *Heliconia angusta* Vell.; *Brasiliopuntia brasiliensis* (Willd.) A. Berger; *Vriesea aff. Morrenii*) and 03 endemic of Espírito Santo Estate (*Vriesea neoglutinosa* Mez; *Aechmea blanchetiana* (Baker) L.B. Smith; *Neurogelia cruenta* (Graham) L.B. SM.), considering the list of the threatened flora in Brazil, the list of the threatened flora in the world and the list of the threatened flora in Espírito Santo. *Paradisanthus micranthus* and *Prosthechea fragrans* were also rescued and considered vulnerable according to FRAGA (2000) (Biodinâmica, 2005).
- 17.330 collected seeds of species that are in the National List of species threatened with extinction and/or in the International List (IUCN) of the threatened species, in the Vulnerable category (*Dalbergia nigra* Vell. Allemao ex Benth, *Joannesia princeps* Vell, *Euterpe edulis* Mart).

These results demonstrate the importance of this kind of program for the conservation of the biodiversity and the contribution for the maintenance of the genetic heritage for the compensation of the lost plant species in the gas pipelines' row.

## 8. References

- CTA. Primeiro Relatório Semestral do Programa de Resgate e Conservação da Flora Nativa do Gasoduto Cacimbas-Catu , 2008.
- CTA. Segundo Relatório Semestral do Programa de Resgate e Conservação da Flora Nativa do Gasoduto Cacimbas-Catu , 2008.
- CTA. Segundo Relatório Semestral do Programa de Resgate e Conservação da Flora Nativa do Gasoduto Cacimbas-Catu , 2009.
- BIODINÂMICA. Relatório Final Banco de Sementes do Gasoduto Cabiúnas-Vitória, 2005.
- BIODINÂMICA. Relatório Final do Programa de Salvamento de Flora do Gasoduto Cabiúnas-Vitória, 2005.
- BOURSCHEID. Plano Básico Ambiental do Gasoduto Cabiúnas-Vitória, 2005.

BOURSCHEID. Plano Básico Ambiental do Gasoduto Cacimbas-Catu, 2007.

BOURSCHEID. Plano de Trabalho do Programa de Salvamento de Fauna e Flora Gasoduto Cabiúnas-Vitória, 2006.

BOURSCHEID. Relatório Final Programa de Salvamento de Fauna e Flora Gasoduto Cabiúnas-Vitória, 2007.