

WILDLIFE RESCUE, CAPTURE OF SNAKES AND ESTABLISHMENT OF ANTI-OPHIDIC STATIONS IN FLOODED AREAS DESTINED FOR BRAZILIAN HYDROELECTRIC POWER PLANTS

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ABSTRACT — The environmental impact by the construction of great reservoirs for hydroelectric power plants, required extensive measures necessary to maintain the ecological equilibrium, as to preservation of the fauna.

Aware of the importance of this problem, the Hydroelectric Companies requested orientation of the Fundação Parque Zoológico de São Paulo and the Instituto Butantan. A joint team of both Institutions was sent not only to instruct riverine populations, technicians and a great number of the hydroelectric employees on the problems related to ophidism, the rescuing of animals, but also to establish stationary and mobile anti-ophidic stations. In this enterprise there were utilized expressive human resources, small aircrafts, helicopters, motorboats, and other conveyances, all equipped with two-way radios. Specialists of the "Vital Brazil" Hospital gave instructions to physicians and nurses about the treatment of ophidic accidents.

UNITERMS — Animal rescue. Capture of ophidians. Installation of antiophidic stations.

At the National Seminary on the Great Reservoirs, Machado (11) in 1974, presented an extense study analysis in the bibliographic references about the effect of the environment on barrages and reservoirs with emphasis to: "The construction of reservoirs defeats the natural equilibrium of their location and in modifying the environment suffers the consequences of this modification".

The most acute problems as to wildlife rescuing in general, arose during the flooding of areas destined for the Hydroelectric Power Plant "Promissão", in 1974, when the Centrais Elétricas de São Paulo — CESP — requested orientation of the Fundação Parque Zoológico de São Paulo (2). In this region, natural basins and woodland became completely submersed, thus provoking the formation of "great pockets" where groups of ten or more animals, mainly monkeys, were retained, and rescued in time by the personnel of the Natural Re-

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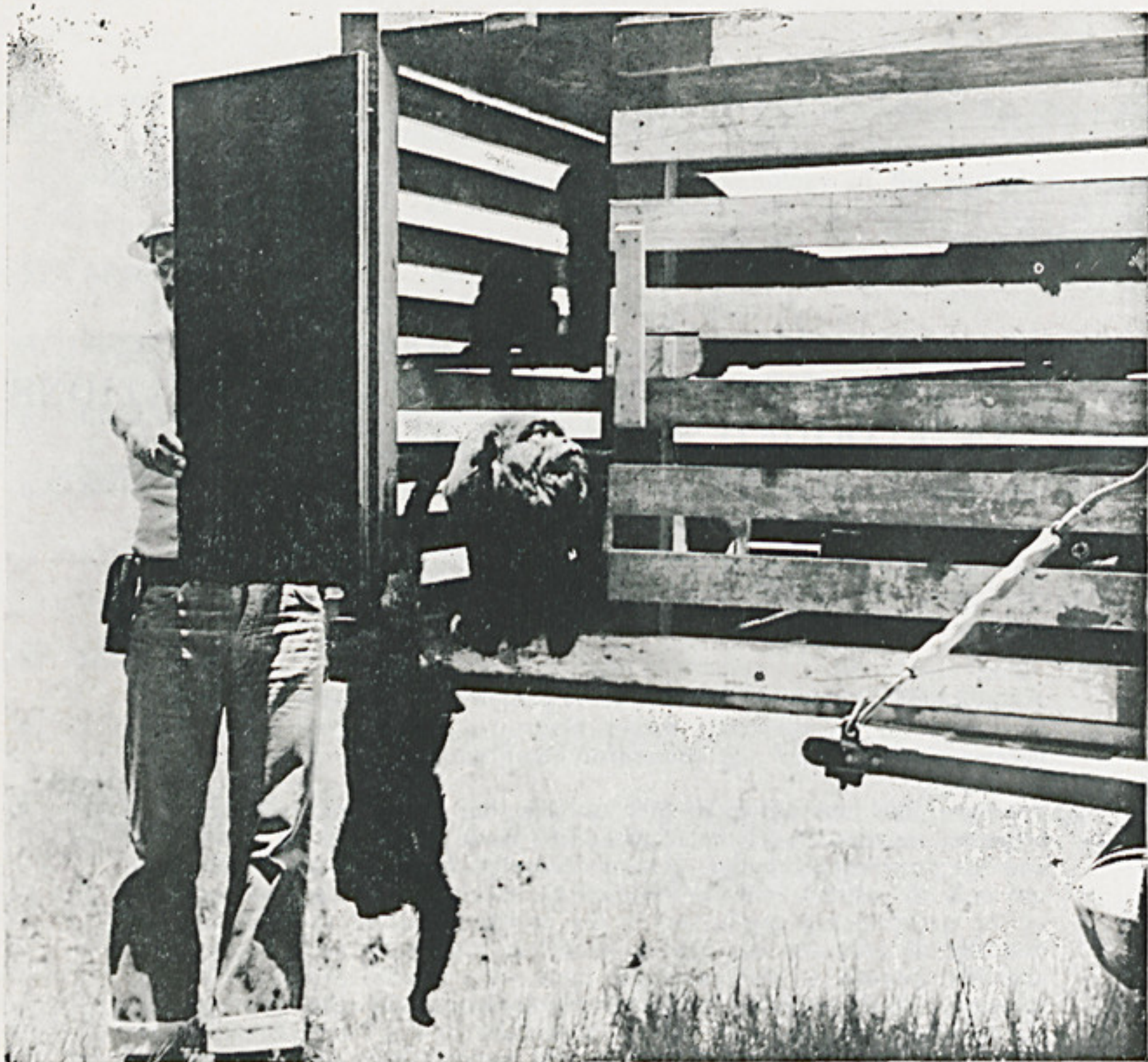


Fig. 1 - Rescued animals returned to nature.

source Police (ex Florestal Police) of the São Paulo State and by the personnel of the very Hydroelectric Company (5).

The Company Furnas Centrais Elétricas, during the water damming at "Marimbondo", aware of the problems, requested orientation of the Fundação Parque Zoológico de São Paulo as to wildlife rescuing and other arrangements.

The Fundação Parque Zoológico de São Paulo, in turn, cognizant of the problems related to the presence of snakes in this region, asked for the participation of the Instituto Butantan. This rescuing operation supplied also data for the study of Bandeira de Mello e Costa Barros (12) in 1975.

Later, the joint team of the Fundação Parque Zoológico and the Instituto Butantan has been invited to give similar collaboration to the Hydroelectric Companies of "Salto Osório" — Eletrosul, "Coaracy Nunes" — Eletronorte, "Capivara" — Centrais Elétricas de São Paulo, and at present, the work continues at the future hydroelectric power plant of "Salto Santiago" — Eletrosul, Rio Iguaçu, in the State of São Paulo, and also a preliminary field test in the area of the Tucuruí reservoir — Eletronorte, Pará State.

In this work, several steps are presented related to the survey of the areas, their problems, planning, programmation, and the results obtained as to wildlife rescue, capture of ophidians, including the establishment of antiophidic stations in the regions in question.

The ichthyologic fauna remained the responsibility of specialists.

The present work only could be accomplished satisfactorily thanks to the full comprehension and unlimited support of the interest hydroelectric companies who, cognizant of the importance of the effort to be accomplished, placed at the disposal of the team all the necessary resources as airplane, helicopter, motorboats, radios, other conveyances, specialized personnel, etc...

STUDY AREAS

The areas destined to reservoirs for the hydroelectric power plants mentioned below are the subject of this paper:

1. Hydroelectric Power Plant "Marimbondo" — Furnas Centrais Elétricas S/A, Rio Grande, boundary of the São Paulo and Minas Gerais States.

Working period: April 16 — 25 1975
May 12 — 16 1975

2. Hydroelectric Power Plant "Salto Osório" — Centrais Elétricas do Sul (Eletrosul), Rio Iguaçu, Paraná State.

Working period: June 07 — 11 1975

3. Hydroelectric Power Plant "Coaracy Nunes" — Centrais Elétricas do Norte (Eletronorte), Rio Araguari, Território Federal do Amapá.

Working period: June 23 — 30 1975

4. Hydroelectric Power Plant "Cativara" — Centrais Elétricas de São Paulo and Paraná (CESP).

Working period: November 10 — 14 1975
December 02 — 04 1975
December 17 — 24 1975
December 26 — 30 1975
January 02 — 09 1976
January 10 — 19 1976

Hydroelectric Power Plant "Marimbondo" — Furnas Centrais Elétricas S/A

1. *Visiting period* — April 16-25, 1975.

2. *Site* — Rio Grande, natural boundary of the São Paulo and Minas Gerais States, between the former "Cachoeira de Marimbondo" and "Porto Colombia" (Fig. 2) along an extension of 140 km, where the river bed reaches an 800m average width.

In the operational phase, most of the Rio Pardo water reaching the areas of periodical overflow will be utilized.

3. *Inundation area* — 340 km². The water level will reach approximately 20m in the initial phase causing a mean overflow of 3.500m along the actual river banks.

4. *Source of information* — Data supplied by the hydroelectric company and by the teams from the Fundação Parque Zoológico de São Paulo and the Instituto Butantan (2).

Hydroelectric Power Plant "Salto Osório" — Centrais Elétricas do Sul

1. *Visiting period* — June 07-13, 1975.

2. *Site* — Rio Iguaçu, Paraná State, between Salto Osório and Salto Santiago (Fig. 3). The Rio Iguaçu presents rapids, waterfalls, and canyons.

3. *Inundation area* — 55 km². The accumulation basin will develop, in part, in the canyons, stretching out later.

4. *Source of information* — Data supplied by the hidroelectric company, and the reports by the Fundação Parque Zoológico de São Paulo.

Hydroelectric Power Plant "Coaracy Nunes" — Centrais Elétricas do Norte.

1. *Visiting period* — July 23-30, 1975.

2. *Site* — Rio Araguari, the region where formerly the Cachoeira do Paredão (Fig. 4) was located, approximately 125 km distant from Macapá, Território Federal do Amapá.

3. *Inundation area* — 23 km². The accumulation basin proportionates the formation of a lake in a 120m range.

4. *Source of information* — Data supplied by the hydroelectric company, and reports by the Fundação Parque Zoológico de São Paulo and Instituto Butantan.

Hydroelectric Power Plant "Capivara" — Centrais Elétricas de São Paulo.

1. *Visiting period* — November 10-14, 1975

December 02-04, 1975

December 17-24, 1975

December 26-30, 1975

January 02-09, 1976

January 10-19, 1976

2. *Site* — Rio Paranapanema between the States of São Paulo and Paraná, at the region of Porto Capim (Fig. 5).

3. *Inundation area* — 500 km². Forming an accumulation basin along the actual river bank.

4. *Source of information* — Data supplied by the hydroelectric company, and reports prepared by the team of the Fundação Parque Zoológico de São Paulo and the Instituto Butantan.

WORKING PROGRAM

The working program was divided into three parts:

A. Inspection of the areas to be flooded or already flooded, fauna of the region, and other problems.

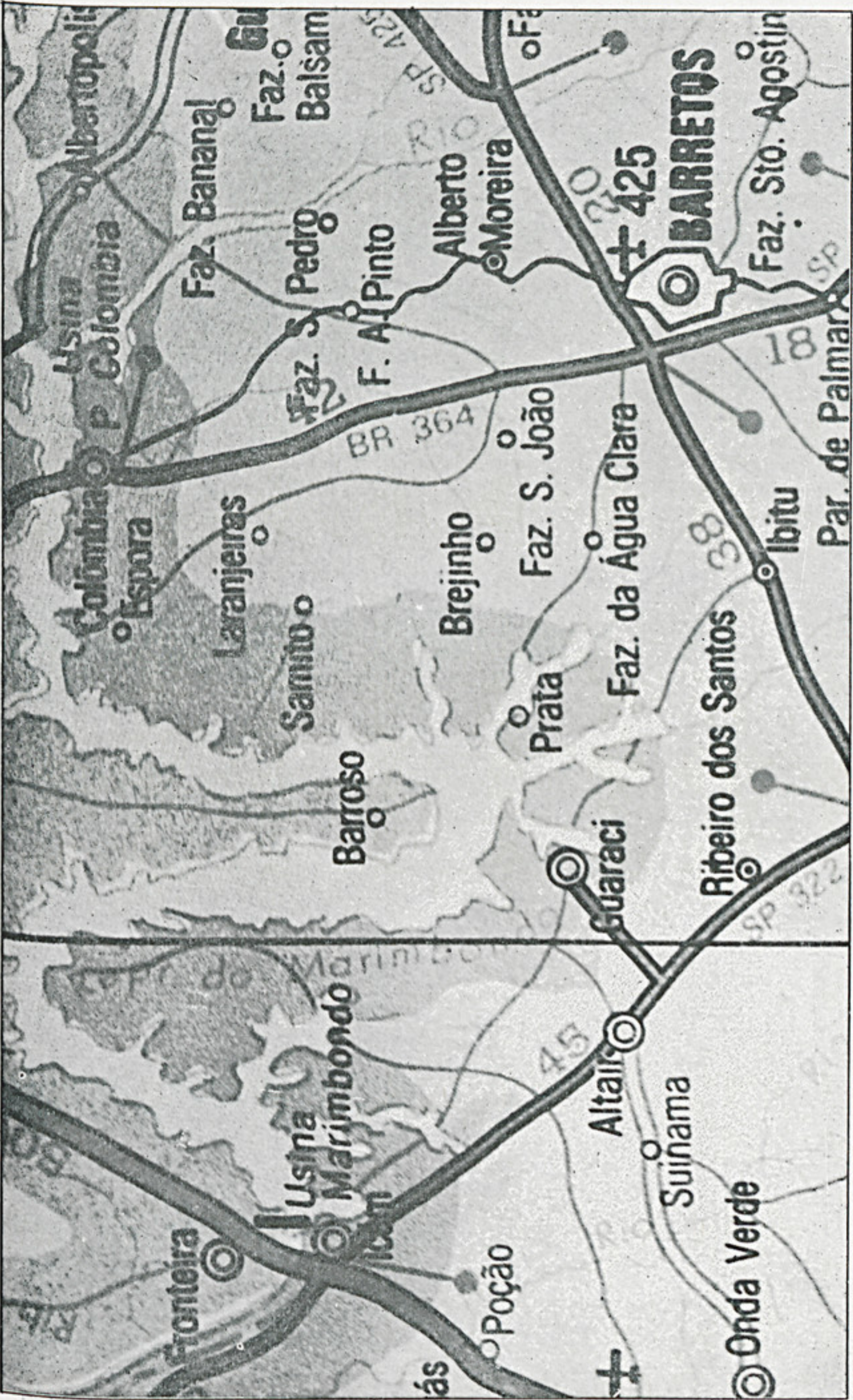


Fig. 2 — Geographical localization of the Hydroelectric Power Plant «Marimbondo». Courtesy by GEOMAPAS - 1978.



Fig. 3 — Geographical localization of the Hydroelectric Power Plant «Salto Osório». Courtesy by Sociedade Comercial e Representações Gráficas Ltda, Curitiba - Pr.

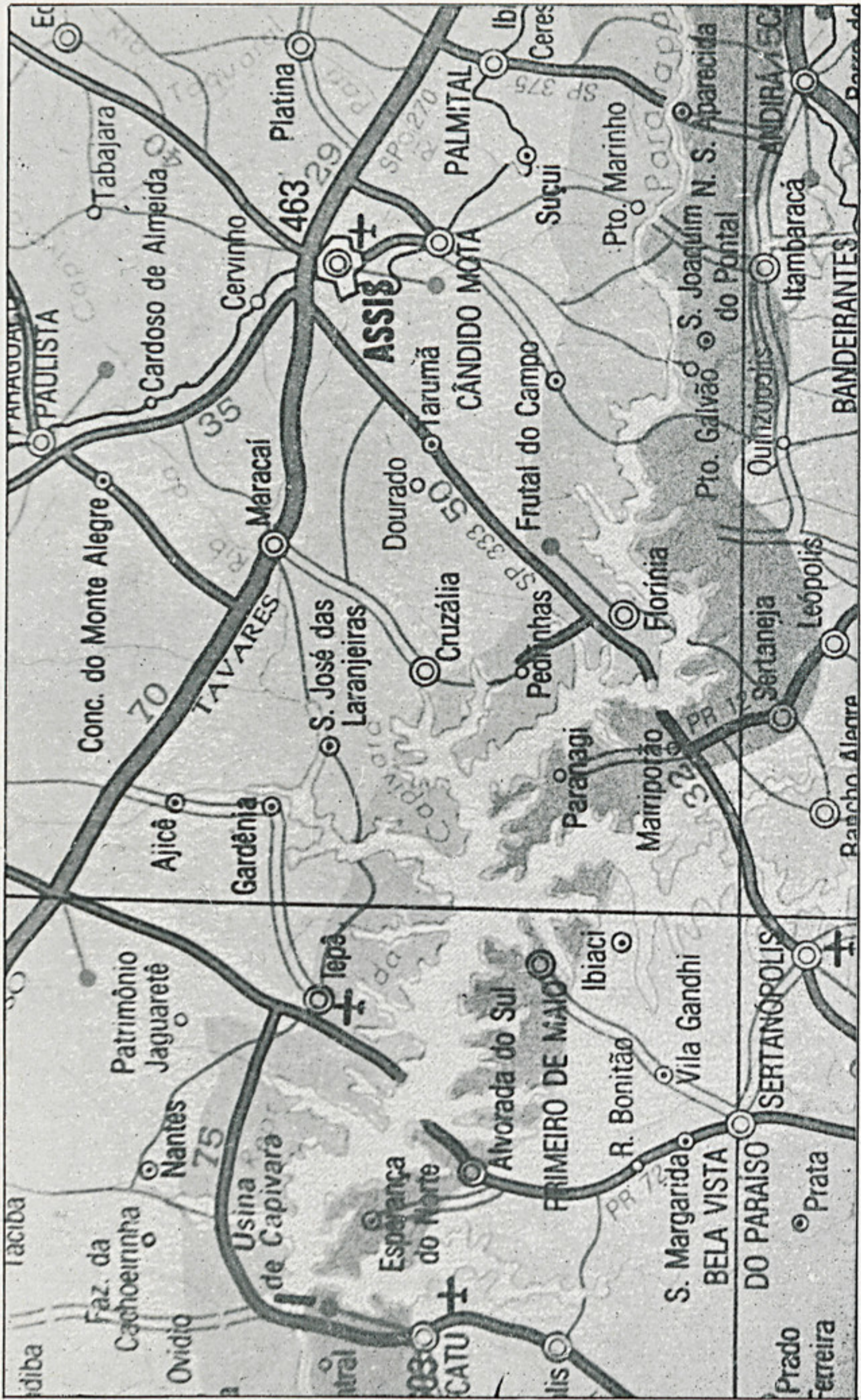


Fig. 5 — Geographical localization of the Hydroelectric Power Plant «Capivara». Courtesy by GEOMAPAS - 1978.

B. Planning.

C. Programming and accomplishment.

All conveyances supplied by the hydroelectric companies were utilized. The inspection projects were elaborated according to charts with the collaboration of specialists of these companies.

A.1. Inspection of the areas destined to the reservoir of the Hydroelectric Power Plant "Marimbondo", fauna of the region, and other problems.

1. *Inspection of the region* — The aerial, fluvial, and terrestrial survey allowed to appreciate in separate the details of the riverbanks and vicinities, to examine areas less accessible, and those considered more important.

Most of the riparian region is covered by sparse woods followed by the areas constituted by farms and pastures besides those where signs of periodical inundation are found. Two regions present areas of expressive woodland, however, of reduced extension.

The nature of the land, and the study of the "Marimbondo" engineering corps revealed that damming of the water will not cause formation of new islands, and those already existing, characterized by the absence of wood, will become submersed. The upward slope of the banks up to the anticipated inundation limits, will impede the formation of "great pockets" where animals could become retained.

The areas comprehending the municipalities of Fronteira, Frutal and Planura on the Minas Gerais side, and Icém, Guarací, Barretos, Colombia, and Guaira on the São Paulo side, were inspected to allow a discernment of the region, conditions of the dirt roads and the time it will take to cover them, of the ecologic problems, a survey of the amount of anti-ophidic sera existing in hospitals and drugstores, as well as inquiries about the ophidic accidents in the whole region. Frutal presents the highest accident rate with an estimate of about three cases per month; in Fronteira and Guarací, only a few cases were reported.

2. *Fauna of the region* — The absence of woodland diminishes much the presence of the wildlife in the region, but even so there may be cited as representative components, the following animals: maned wolf (*Chrysocyon brachyurus*), Capuchin monkey (*Cebus* sp), saguin (*Callithrix* sp), howling monkey (*Alouatta* sp), deer (*Mazama* sp.), tayra (*Tayra barbara*), fox (*Dusicyon* sp), Raccoon (*Procyon cancrivorus*), great anteater (*Myrmecophaga tetradactyla*), tapeti (*Sylvilagus* sp), catamount (*Felis* sp), capybara (*Hydrochoerus hydrochoeris*).

In the same area are found venomous snakes, represented by rattlesnake (*Crotalus durissus*), jararaca (*Bothrops jararaca*), caissaca (*Bothrops moojeni*), urutu cruzeiro (*Bothrops alternatus*) and some species of true coral snakes (*Micrurus* sp).

Also in the area of Rio Grande is noted the presence of huge non venomous snakes as anaconda (*Eunectes murinus*) and boa constrictor (*Boa constrictor amarali*).

3. *Problems* — The nature of the area enables the flight of most of the animals. There are no sites for the formation of pockets. The problem will be

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greater with animals considered "late-comers". These, are represented in general by monkeys, mainly howling monkeys, capuchin monkey and saguin. Animals escaping from the water, settle in tree tops, unable to move on later.

The two areas of expressive woodland, may shelter late-comers, and small elevations of the ground eventually may present similar situations.

Young and bird nests are inevitably affected. The progressive inundation along the riverbanks will shove away the snakes thus allowing the prediction of ophidic accidents with a probability higher than normal, aggravated by the fact that several urban areas will then be located near the water.

A.2. Inspection of the areas destined for the reservoir of the Hydroelectric Power Plant "Salto Osório", fauna of the region and problems.

1. *Inspection of the area* — Helicopter, high-speed motor-boats, and vehicles equipped with radios.

The flooding had been already. The river, in a general way, runs mostly within deep canyons.

The accumulation basin allows the water to drain from the canyon, and to climb reasonable distances of the generally steep borders deforested beforehand up to the proposed inundation quota.

2. *Fauna of the region* — The fauna in this region practically will not be affected due to the type of accumulation basin and deforestation.

The region shows exuberant woodland.

The most representative venomous snakes are: true coral snakes (*Micrurus corallinus*), jararaca (*Bothrops jararaca*), cotiara (*Bothrops cotiara*), jararacussu (*Bothrops jararacussu*) and rattlesnake (*Crotalus durissus terrificus*).

3. *Problems* — The anticipated deforestation of the marginal or elevated areas to be flooded, foreseen in the respective quotas incites the withdrawal of animals, inclusive snakes existing in a reasonable number in the whole region, and eventually will diminish their isolation.

A.3. Inspection of the areas destined for the reservoir of the hydroelectric Power Plant "Coaracy Nunes", fauna of the region and problems.

1. *Inspection of the area* — Motor-cars and boats were used. The cofferdam in an extension of 112m maintains the water at a 97m level thus causing the disappearance of the Paredão rapids.

No artificial islands were formed.

The lake will invade areas, where the deforestation along 2km, dam upward, was made up to a 114m quota.

Most of the animals had already left for the borderline areas. The total rising of the water is proposed up to a 115m level, but the hydroelectric company is prepared to extend the deforestation up to 120m quota, the maximum bearable by the dam.

The forests in this environment are magnificent.

2. *Fauna of the region* — Animals will not be affected any more. The partial inundation and the previous deforestation further their relocation. This

region of the Território do Amapá presents a series of transitions between forest, marshland and scrubland according to Joly (9), 1970. The most representative snakes in this region are: rattlesnake (*Crotalus durissus*), one of the few sites of the Amazonia where the species occurs; jararaca (*Bothrops atrox*), surucucu pico de jaca (*Lachesis muta muta*), some species of true coral snakes (*Micrurus*) and, last not least, the huge non venomous snakes as anaconda (*Eunectes murinus*) and boa constrictor (*Boa constrictor constrictor*).

3. *Problem areas* — In the regions adjacent to the exuberant forests, where the water covers the ground, leaving part of the trees half submersed, the intricate arboreal mass facilitates the relocation of the animals.

Upstream, near the region of the "Caldeirão", several islands with periphereic levels at a 115m range, and areas well over these limits may present during the operational phase precarious equilibrium to the fauna there existing. It has not been possible to determine whether heavily wooded islands are inhabited by animals. There are venomous snakes in the whole region.

A.4. Inspection of the area destined for the reservoir of the Hydroelectric Power Plant "Cativara", Rio Paranapanema (November 10-14, December 2-4, 1975) fauna of the region and problems.

1. *Inspection of the area* — All available conveyances as helicopter, vehicles and motor boats were used. The riverine region is sparsely wooded. The construction of the reservoir provoked, besides the rainfalls since October, the inundation of the lower borderlines covering partially small trees thus inciting the departure of animals from these areas.

However, next to the actual area to be flooded prevails the soja agriculture on the Paraná side and pastures on the São Paulo side, allowing a reckoning of the local ecologic problems; to make a survey of the amount of antiophidic sera existing in hospitals and drugstores, get a briefing on the ophidic accidents within the whole region, at a rate of 10 or more per year although of difficult estimate because there is no coercive notification. Distances were calculated, and the road conditions during the rainy season were estimated.

2. *Fauna of the region* — The few existings forests (some already cut up to the limit of the expected inundation) may still harbor monkeys as capuchin monkey (*Cebus sp*), saguin (*Callithrix sp*), and one specimem of hedgehog (*Coendou sp*). The capybara itself (*Hydrochoerus hidrochoeris*) is rarely found in the region. According to the topography of the region, the following snakes may be found: rattlesnake (*Crotalus durissus terrificus*), jararaca (*Bothrops jararaca*), jararacussu (*Bothrops jararacussu*), caissaca (*Bothrops moojeni*), urutu cruzeiro (*Bothrops alternatus*) probably cotiara (*Bothrops cotiara*), and various species of true coral snakes, mainly *Micrurus corallinus*. A series of non venomous snake genera are also noted.

3. *Problems* — The marginal slopes, within the anticipated limits, present only few problems as to the formation of "great pockets" where animals, mostly monkeys as capuchin monkeys, howling monkeys and saguin could become retained. No animals were found on the existing islands, already partially submersed through the impact of the cofferdam.

The few artificial islands in formation throughout the woodland were already deforested or in phase of deforestation within the limits considered minimal

by specialists (2 meters). Regions constituted by cropland will be isolated, since harvesting of the crop must be considered, after which the operational phase is continued.

In these areas there will be a belated danger by venomous snakes even with the high index of mechanization of soja and wheat farming.

Other crops existing in the area as maize cause much anxiety in relation to snakes.

B. Planning

The planning for wildlife rescue, capture of snakes, and installation of anti-ophidic stations was elaborated according to the characteristics of the different regions already flooded or in phase of inundation.

The projects were developed, appraised and approved in joint meetings with the management engineers or responsables for the hydroelectric companies, in general with the participation of components of the Security Department, assigned specialists, doctors, officers of the Natural Resource Police, and the team of the Fundação Parque Zoológico de São Paulo and the Instituto Butantan, by the following criterium:

I. *Data obtained through inspection*

1.1. Type of the area inundated for the reservoir formation

1.1. Common river

1.2. River in canyons

1.3. Lakes

1.2. Geographical accidents

forested

2.1. Disappearance of islands without forests

with agriculture

with forests

2.2. Formation of artificial islands without forests

with agriculture

1.3. Type of vegetation

3.1. Forests

3.2. Cropland or pasture

3.3. Others (scrubland, etc.)

II. *Faunal data*

II. 1.1. Known local fauna — wild animals

1.2. Local fauna observed during inspection

II. 2.1. Known local fauna — poisonous snakes

2.2. Local fauna observed during the inspection

III. *Material resources necessary for the practicability of the planning*

III. 1.1. Location of wild animals, boats and flatboats, vehicles, besides areal support.

1.2. Capture of animals — nets, net-bags, snares.

III. 2.1. Capture of snakes — boxes for transportation, lariats or capturing hooks.

III. 3.1. Acquisition of antiophidic sera

3.2. Installation of fixed or mobile antiophidic stations

III. 4.1. Cages to maintain sick animals

III. 5.1. Communication between the different groups by two-way radios.

IV. *Human Resources*

IV. 1.1. Personnel of the hydroelectric companies

1.2. Team of the Fundação Parque Zoológico de São Paulo and Instituto Butantan.

1.3. Components of the Natural Resource Police (ex Florestal Police).

V. *Training of the personnel*

V. 1.1. Theoretical — practical instructions to personnel of the Department, boat-crew, drivers, including components of the Natural Resource Police.

1.2. Reconnaissance of typical local animals including endangered species.

1.3. Reconnaissance of the local venomous and non venomous snakes.

1.4. First aid, transference of accidented, training in the capture of living animals, location of first-aid stations.

1.5. General instructions to engineers and other technicians, assigned by the hydroelectric companies, as to rescue problems, animal species probably existing in the region, mainly poisonous animals, outlines of emergency assistance.

1.6. Special instructions to nurses rendered by specialists of the hospital "Vital Brazil" of the Instituto Butantan, with regard to ophidic accidents and treatment according to the precept of this hospital.

Observation: All expenses were covered by the Hydroelectric Companies.

B.1 Planning of animal rescue, capture of snakes and installation of anti-ophidic stations in the area destined for the reservoir of the Hydroelectric Power Plant "Marimbondo" (Fig. 6).

1. During the damming of the water, two airplanes of the companies inspected the region, not only to localize belated animals but also to give assistance where necessary, making use of 16 airfields for this kind of assistance. Two high speed motor launches equipped with radio, and motor boats cover continuously the inundation areas in search of animals in difficult conditions, imprisoned on tree tops or elevations of the terrain.

The rescue of these animals was done as follows:

A motor boat, towing at a certain distance a flatboat containing food, gives the animals the possibility to jump on this flatboat for food.

The animals considered reluctant to this kind of help are collected with the aid of a kind of net-bag.

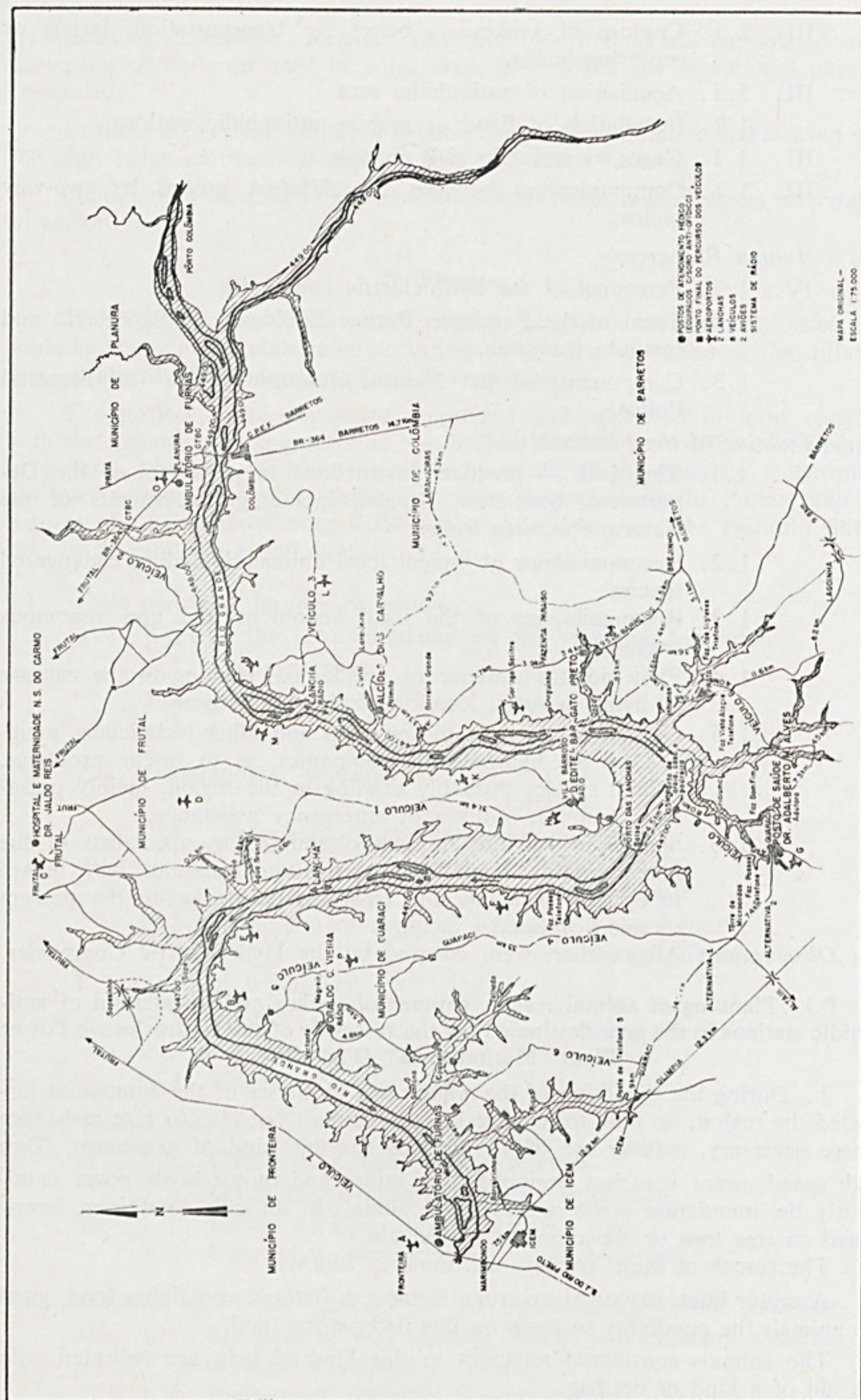


Fig. 6 — Planning of rescue at «Marimbondo».

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2. Those animals in need of treatment are maintained in special cages to recuperate before being returned to nature.

3. Twenty components of the Natural Resource Police of each of São Paulo and Minas Gerais States will be present to cooperate in all work, disposing for this of 8 vehicles equipped with radio — four on each side of the river — supplied by the management of the company.

4. The company will provide the six anti-ophidic stations maintained during the inundation period for eventual first aid services with anti-ophidic and anti-elapidic sera or reinforce the existent stock. Four of the stations are permanent in the cities of Planura, Fronteira and Guarací, respectively, and three stations located in areas more distant or of difficult approach, located between Icém and Guarací (adjacent to the Anglo Frigorific Plant), at Vila Barroso (pertaining to the municipality of Frutal), in the area called "Chatão do Rio Grande" and the last one in Brejinho, between Guarací and Colombia. The mobile stations will have in stock at least twenty vials of anti-ophidic serum each; the permanent stations, besides the serum already enrolled, will receive also twenty vials of the same serum plus five vials of anti-elapidic serum.

The stations of Frutal will have in stock fifty vials at the request of the responsible doctor, namely anti-ophidic serum, anti-crotalic and anti-bothropic serum besides the already existent stock in local drugstores of about 200 vials.

The permanent stations will be attended by doctors and nurses, and the mobile stations by nurses.

The stations, due to their location, have the possibility to attend accidented persons from a maximal 3 hour distance, in accordance with the norm established by the Hospital of the Instituto Butantan.

Leaflets containing instructions about the treatment of ophidic accidents, and other venomous animals according to the specifications of the Hospital "Vital Brazil" of the same Institution, will be distributed.

5. Lectures will be given with respect to ophidism, the first to nurses in Planura assigned to this kind of assistencial work, and the second to the personnel indicated by the hydroelectric company.

There are considered visits and lectures to the permanent medical centers (hospitals and medical clinics) and to the mobile stations (eventual) in Guarací, Vila Barroso, Frutal, the ambulatories of Furnas located in Planura and Fronteira with the participation of a specialized doctor of the Hospital "Vital Brazil".

6. The hydroelectric company will take charge of the confection of capturing material, net-bags, snares and snake-transport boxes.

7. The prefecture of Guarací sent an employee of that municipality to the Instituto Butantan to be trained in snake capture.

B.2 Planning related to animal rescue, snake capture, and installation of anti-ophidic stations in the inundation area destined for the reservoir of the Hydroelectric Power Plant "Salto Osório" (Fig. 7).

1. The nature of the region, the river in canyons, and the anticipated arrangements as to the deforestation of the areas to be inundated, cleaning of

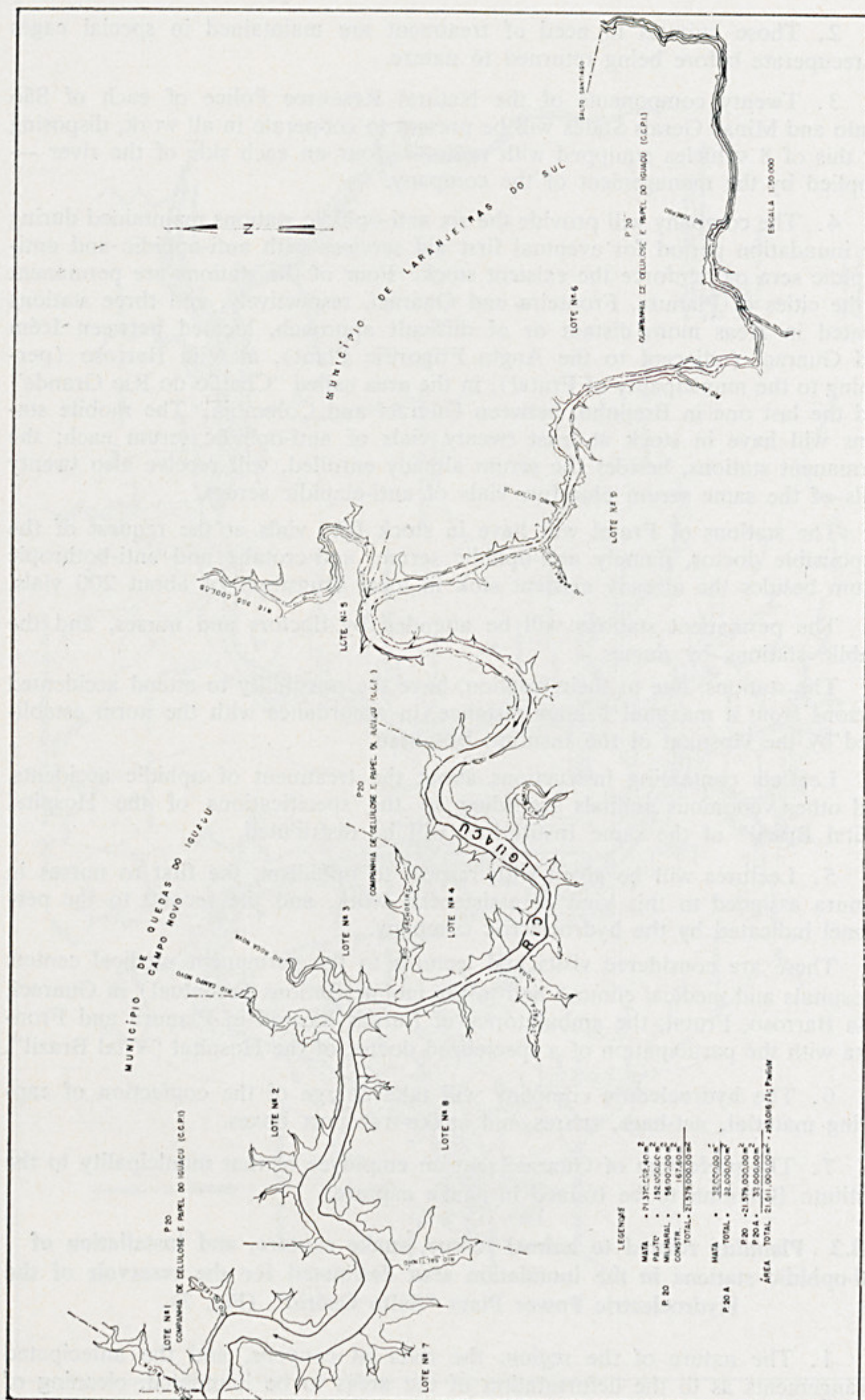


Fig. 7 — Inundation area of «Salto Osório».

the marshland, plantations or elevations that will become submersed, not only dispersed the animals but also depopulated the region.

Although no difficulties as to the animal rescue are expected, high speed motor-boats and vehicles backed by helicopter equipped with radio continue the reconnaissance work between "Salto Osório" and "Salto Santiago", mainly in the marshland.

2. Material, boxes and snares related to snake capture were prepared by the hydroelectric companies and distributed to the security stations where a special staff is entrusted with the inspection of the flooded area's boundary.

3. A general lecture will be given, with respect to venomous animals, as well as an emergency aid outline, to engineers and other technicians. A special lecture is programmed for doctors, nurses, and other technicians of the hospital of the company, with reference to the norms established by the Hospital "Vital Brazil" as to the treatment of ophidic accidents. The amount of anti-ophidic and anti-elapidic serum, to reinforce the stock of the hospital, was calculated.

B.3 Planning related to the rescue of animals, capture of snakes and installation of anti-ophidic stations in the inundation area destined for the reservoir of the Hydroelectric Power Plant "Coaracy Nunes" (Fig. 8).

1. The nature of the region, former "Cachoeira do Paredão" (Paredão Waterfall), the reservoir in the geographical form of a lake, the slow filling of this accumulation basin, the absence of artificial islands, and the already deforested borders, do not demand any foresight as to animal rescue, but only attention to the few areas where tips of woodland may become semisubmersed.

2. Two motorboats in charge of reconnaissance, will continue to scour the region, inspecting mainly the islands located dam upward (region of Caldeirão). In case there were endangered animals on these islands, they will be rescued by the personnel of the hydroelectric company in maintaining, during this period of time, control of the water level through the floodgate of the spillway.

3. The Hydroelectric Company, oriented by the Instituto Butantan, acquired the following sera: 80 (eighty) vials of anti-bothropic serum, 40 (forty) vials of anti-lachetic serum, 30 (thirty) vials of anti-crotalic serum and 10 (ten) vials of anti-elapidic serum as reinforcement of the already existing stock.

Classes with respect to venomous animals, mainly snakes, spiders and scorpions were proposed for the personnel of the hydroelectric company of all schooling levels comprehending treatment and emergency aid, given by physicians of the Hospital "Vital Brazil".

The hydroelectric company will manufacture, according to models supplied by the Instituto Butantan, boxes and snares for transportation and capture of snakes respectively, to be distributed in the area.

For protection, the personnel scouring the areas of the reservoir and the Paredão de Santana lines, will take along ten (10) vials of anti-bothropic and ten (10) vials of anti-lachetic serum.

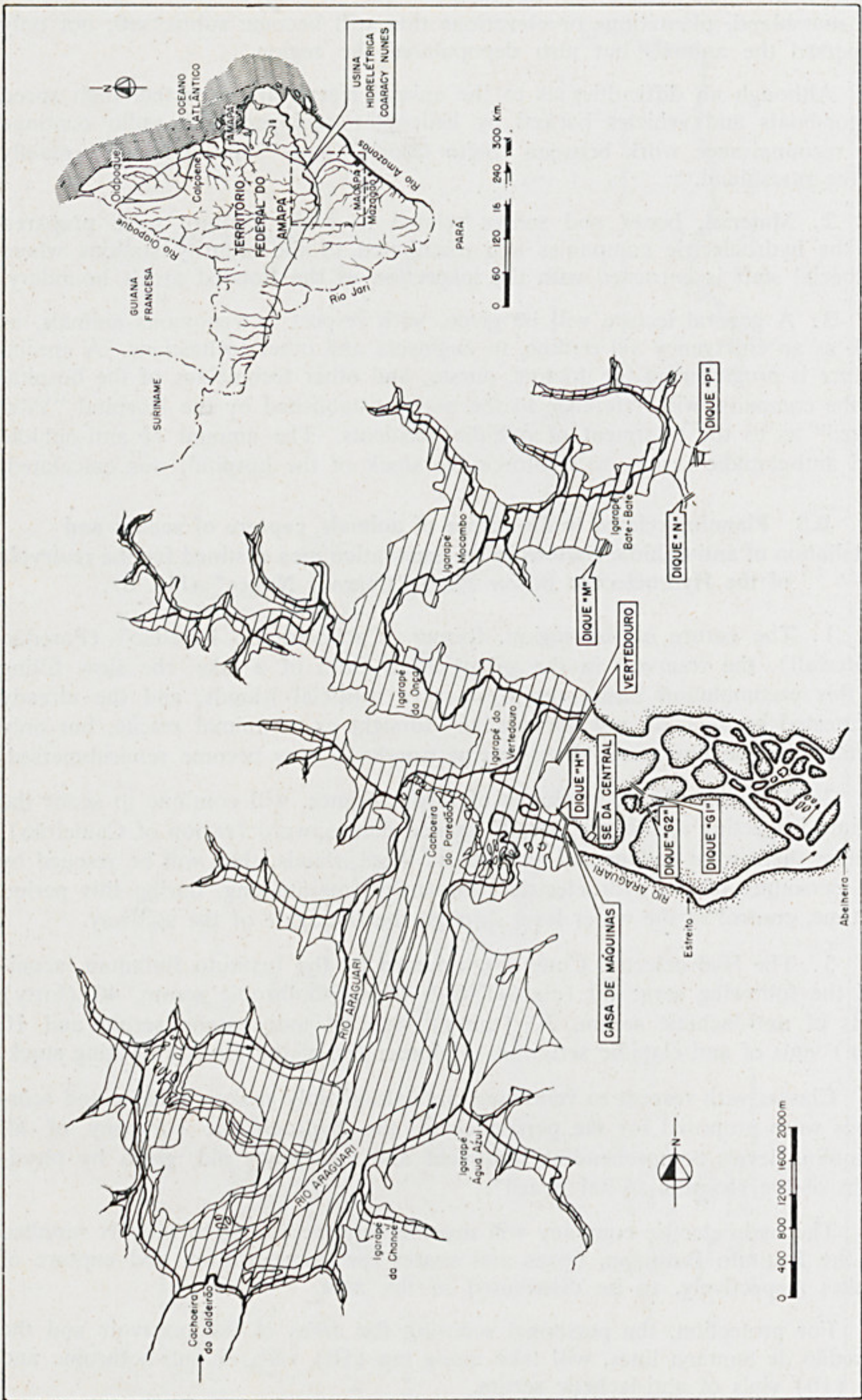


Fig. 8 — Inundation area of «Coaracy Nunes».

B.4 Project relative to animal rescue, snake capture and installation of anti-ophidic stations in the areas destined for the reservoir of the Hydroelectric Power Plant "Capivara" (Fig. 9).

1. During the inundation period, aerial reconnaissance was made by helicopter, terrestrial by motorcars of the CESP (11) equipped with radio, scouring the riverbanks, and fluvial with high-speed and motorboats also equipped with radio. This scheme will permit the localization of isolated animals, the capture of snakes and also render other assistance.

2. Study and approvation of the sites for the anti-ophidic serum distribution.

Establish the dates for lectures to be given by physicians of the Hospital "Vital Brazil" of the Instituto Butantan to doctors and nurses assigned to attend the eventually accidented persons.

Establish dates for lectures and training to be given to components of the Natural Resource Police of São Paulo and Paraná States, summoned to send contingents to the "Capivara" region.

Set a date for the training of boat-crews and drivers in capturing animals with net-bags, snares and hooks. The selected elements must become acquainted with snakes before starting the work. They will receive instructions about first aid, and according to the areas of their work, about the sites to where the accidented have to be taken. For this, the responsables have to carry along directional maps.

Also hospitals, health centers and ambulatories as well as the selected drugstores must be informed about the eventual problems caused by the inundation.

The hydroelectric company "Capivara" shall acquire from the Instituto Butantan polyvalent anti-ophidic sera and place them at the disposition of neighboring cities according to the following schema: Alvorada do Sul, PR-40 vials; Cruzalia, PR-40 vials; Pedrinhas, PR-40 vials; Iepê, SP-30 vials; 1.º de Maio, PR-50 vials. Sertanópolis, PR-40 vials.

The ambulatory of the plant will have in stock 120 vials of anti-ophidic serum, plus 20 vials of anti-arachnidic serum. There will be, of course, flexibility in this distribution and in the dislocation to other needy areas.

The Instituto Butantan will send initially to "Capivara" 50 boxes for snake transportation, 10 snares and one hook for snake capturing, these as models for the manufacture of more items.

The manufacture of net-bags and the construction of six specified cages, which will eventually be used to maintain animals in need of recuperation treatment before being uncaged in safe places, has been proposed.

3. The chart of the programming of services and logistic support necessary to accompany the filling of the reservoir, by Walter Franco de Camargo, was utilized, completed by the list of sites selected for medical assistance according to the 7 preestablished stations.

This way, the components of the teams-motorboats, vehicles, Natural Resource Police-will know where the persons in need of emergency medical assistance have to be directed to.

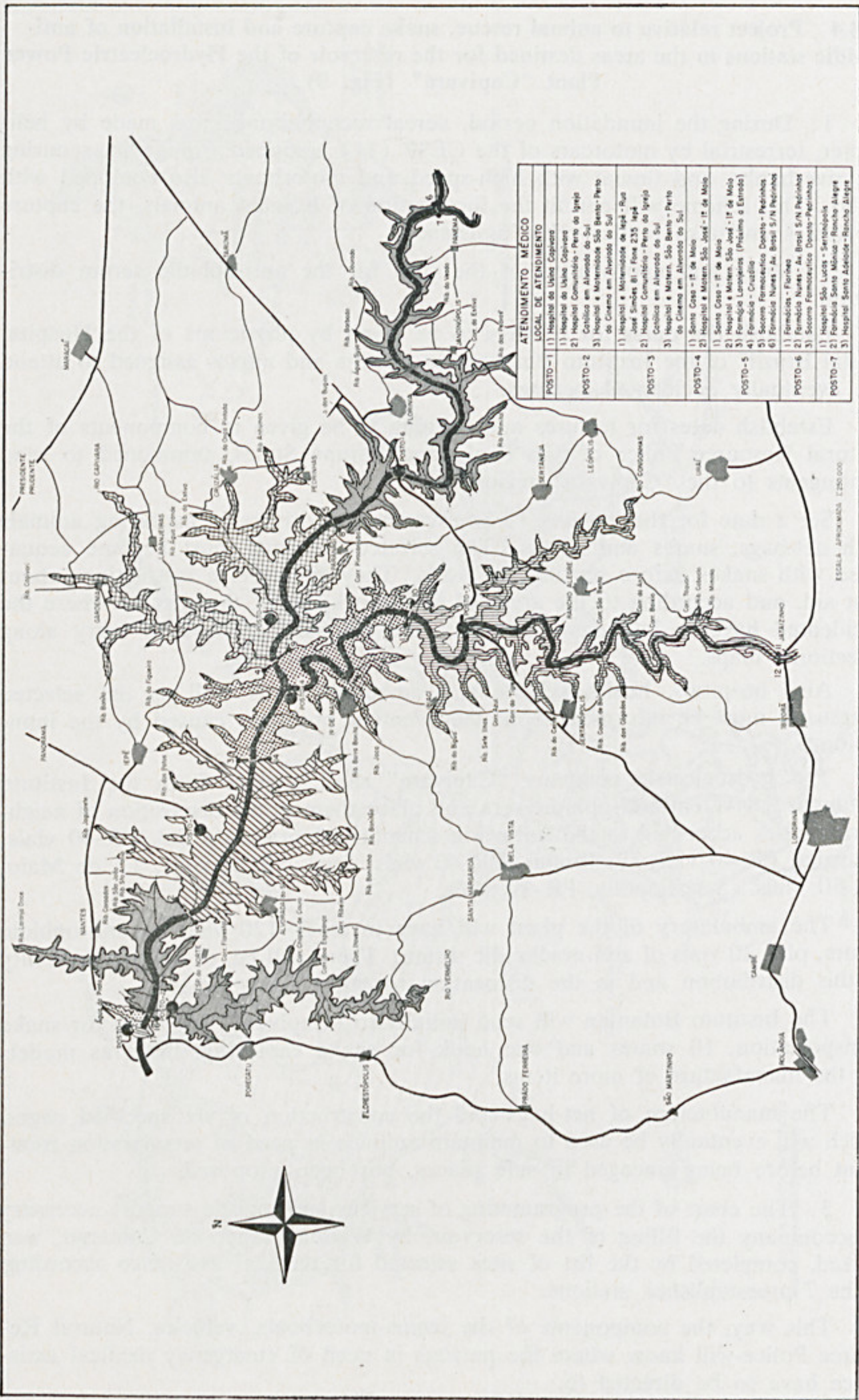


Fig. 9 — Planning of rescue at «Capivara».

4. In classes with regard to wild animals that may be localized, special emphasis will be given to those species considered endangered. These animals, if eventually found and captured will be sent to the São Paulo Zoo, and a scientific destination will be given to them there.

C. Programming and Accomplishment

The projects were accomplished within the proposed scheme utilizing hundreds of persons, personnel of the hydroelectric companies and contingents of the Natural Resource Police. All necessary material resources were mobilized; the expenses including transportation, board and lodging were met by the hydroelectric companies.

Technicians of the Fundação Parque Zoológico de São Paulo and of the Instituto Butantan, took part in the critical phases of the operation, giving assistance in "Marimbondo", "Salto Osório", "Capivara, and Coaracy Nunes".

RESULTS

1. Hydroelectric Power Plant "Marimbondo" — (May 05-21, 1975)

In various inundation regions, including the temporary islands, later submersed, hundreds of animals were rescued, mainly saguin (*Callithrix* sp), hedgehogs (*Coendou* sp), anteaters (*Tamandua tetradactyla*), opossum (*Didelphis* sp), restless cavy (*Cavia* sp) and others. From the tree tops hundreds of saguins (*Callithrix*), tens of howling monkeys (*Alouatta*), tens of opossum (*Didelphis*), several couples of hedgehogs (*Coendou* sp) and anteaters (*Tamandua* sp), were collected, as well as *Myrmecophaga tetradactyla*.

An estimated rate of more than hundred capuchin monkeys (*Cebus* sp), inhabitants of the partially submersed woodland, were able to escape by themselves or with little help.

It has not been necessary to use flatboats with food to save larger groups.

Several female howling monkeys and their young needed treatment and rest (Fig. 1). They received treatment and food, and after recuperation, they were freed.

Two hundred snakes were captured, mainly non venomous: of the venomous snakes, several rattlesnakes (*Crotalus durissus terrificus*), and caissacas (*Bothrops moojeni*). The captured snakes were sent to the Instituto Butantan, and the Instituto Vital Brazil. Tens of captured boa constrictor (*Boa constrictor amarali*), were, later on, released in safe places.

Sites still inaccessible where animals took refuge (tree tops) were demarcated for posterior rescue under better conditions.

One ophidic accident was registered in the region of "Chatão do Rio Grande", although outside the inundation area. The accidented received medical attention and recovered.

2. Hydroelectric Power Plant "Salto Osório"

Only a few animals had to be rescued, because most of them escaped by proper means or had been chased away.

A few exemplaries of poisonous snakes were found, distinguishing in numerical order *Micrurus corallinus*, *Bothrops jararacussu* and *Bothrops jararaca*. Several exemplaries of *Bothrops cotiara* and *Crotalus durissus* were also captured.

3. Hydroelectric Power Plant "Capivara" November 1975 to January 1976

Approximately twenty hedgehogs (*Coendou*), at least one hundred howling monkeys (*Alouatta* sp), and saguins (*Callithrix*), 30 lizzards were saved, and about 1.200 snakes, among the poisonous snakes mostly *Crotalus durissus terrificus* and *Bothrops jararaca*. Although the rescue teams had been specially trained in the recognition of endangered species, they could not find any golden lion marmosets (*Leontides* sp). No ophidic accident has been reported.

DISCUSSION

Inspection of the areas under study, survey of the problems and the obtained results, point out a series of facts to be evaluated:

1. Strengthening the foresight, it is verified that the deforested areas (along the rivers Araguaí and Iguaçu, where forests are exuberant, or next to the rivers Rio Grande and Paranapanema, where the exploration by man almost extinguished the forests), not only drive away the local fauna but also reduce the problems of animal rescuing. These facts accentuate the importance of previous deforestation of certain areas as fluvial islands which later will become submersed, or artificial islands formed during the inundation which will become or not submersed.

2. The type of accumulation basins also is of great importance as evidenced by the "Salto Osório" (50km²) reservoir where the river is almost wholly channeled as well as that of the Rio Iguaçu with its natural obstacles as rapids and waterfalls. These are the basins which bring less problems with respect to wildlife. The water of the accumulation basin of "Coaracy Nunes" (23 km²), downstream the "Cachoeira do Paredão" (Paredão Waterfall), in rising gradually eliminated the esthetic beauty of the waterfall, and in surpassing the upper natural dam will be on level with the upstream basin thus forming one great lake. In this case the fauna also will be less affected, however, the borderline forests will become submersed or, even better, will have to be deforested.

The accumulation basin of "Marimbondo" and "Capivara" similar in their formation, differ from the other two. Although they are named after the rapids and falls, where today the hydroelectric power plants are situated, the Rio Grande and Rio Paranapanema are of appreciable width, and their borders, at sites of the actual reservoir, had provoked in many regions the so called seasonal inundations. The closing of the floodgates caused elevations of the water levels up to the limit of other upstream hydroelectric reservoirs, as that of Porto Colombia on the Rio Grande, and "Salto Santiago" (in construction) on the Rio Iguaçu. The water, gradually rising to spectacular levels, flooded areas of 340-500km², respectively, causing a series of problems, including those related to wildlife rescue that had to be totally anticipated, studied in detail, and overcome.

In these predominantly pastoral or agricultural regions, still exist forests, and these also affected, endured in part deforestation up to the proposed inun-

dation quotas. The evident diminution of wildlife is due to constant extermination.

Inundation areas as the accumulation basin of "Marimbondo" and "Cavivara" are not the worst type in relation to wildlife rescue, although expressive amount of material and human resources were necessary to save hundreds of animals.

In these regions, the draining waters overflow the river banks, spread and invade an enormous riverine area provoking in a few cases the formation of isolated terrain, great pockets which gradually become submersed.

At accumulation basins where, besides the normal inundation, exist also lateral refluxes invading at first the lower terrain with a consequent formation of pockets, bring most serious problems that become aggravated in timberland areas.

To the problem of poisonous animals, mainly snakes, was given special attention, in view of the type of flooded terrain, prevailing farms or pastures, where, in a general way, venomous snakes are found in great number. The ecological unbalance caused by man in cultivated regions, promotes in general an accumulation of rodents giving rise to an inversion of the ophidic fauna. Belluomini (3, 4) in 1976, actualizing the statistic data of 1968, confirms that 75% of the one million snakes received by the Instituto Butantan till 1975, were venomous.

This preoccupation is not exaggerated, for Rosenfeld (13) 1965, based on statistic data on accidented of the Hospital "Vital Brazil", Instituto Butantan, wrote:

"While the majority of the venomous snakes do not climb trees, they will do so, when the ground is very moist or inundated. All snakes can swim and even bite when in water. Contrary to the general point of view, the number of accidents near habitations is reasonable; 25,39% occurred in the vicinity of houses, and 12,96% of the cases happened to fisherman near riverbanks or lakes. This knowledge is helpful in accident prevention".

Data on geographical distribution of Brazilian venomous snakes studied by Hoge (8), the studies on envenomation by snakes, spiders and scorpions, by Rosenfeld et.al., 1966 (14), and Rosenfeld, 1971 (15), the survey in areas destined for hydroelectric power plants, the support given by extremely precise charts, types of vegetation and farm and grazelands, allowed the establishment of anti-ophidic stations well distributed according to the project at selected suitable places where accidented persons can receive assistance within a tolerable three hour period of time, with sufficient stock of anti-ophidic serum doses, and trained personnel actualized according to the experience of the "Hospital School Vital Brazil" of the Instituto Butantan.

Several urban zones of high demographic density caused serious preoccupations due to the proximity of the water.

Only one ophidic accident (promptly treated and recuperated) was registered in the region of "Chatão do Rio Grande", even so, outside the areas under consideration.

Fortunately, ophidic accidents did not occur as expected, according to the cases registered in the regions of the "Rio Grande" and "Rio Paranapanema".

Esta página tem uma errata. Para acessá-la, vá até o link do Sumário desta edição.

BELLUOMINI, H.E.; CEMBRANELLI E.L.; AUTUORI, M.P. — Wildlife rescue, capture of snakes and establishment of anti-ophidic stations in flooded areas destined for Brazilian hydroelectric power plants. *Mem. Inst. Butantan*, 40/41:129-154, 1976/77.

The high concentration of poisonous snakes expected in cultivated areas had been the reason for general preoccupation when visiting the region of "Capivara", however, the increased mechanization index in the culture of soja and wheat in this area requires periodical crop rotation where the farm machinery gives little chance to the installation of rodents and consequently to snakes which feed preferably rodents.

The collecting of snakes in the flooded areas was moderate. More or less 2.000 snakes were captured, only 5% of them poisonous. The type of the accumulation basin, the systematic clearing of the areas drove part of the snakes away, and the gradual inundation along the rivers dispersed the rest. It would be impracticable to maintain capturing teams along the two hundred kilometers of riverbanks.

A great part of the snakes were captured on treetops, and many were placed later in liberty, mainly boa constrictor (*Boa constrictor amarali*) at "Marimbondo". This is explained by the fact that boa constrictor are useful in the control of rodents: they are even used in certain Brazilian regions as "watchdogs" in barns or larders, in substitution of cats.

Accumulation basins, which cause problems as to the isolation of regions, thus forming pockets, may allow the capture of higher numbers of snakes, mainly when there is a more exuberant vegetation. At the Hydroelectric Power Plant of "Ilha Solteira", Hoge et.al. (7), 1974, sponsored by the CESP, captured during the development of the reservoir nearly 7.000 snakes, 95% of which on semi-submersed trees. This capture was done in determined regions of the reservoir, and the number of poisonous snakes there was also unimportant.

The nature of the terrain, and areas transforming themselves into pockets, gave similar aspects with respect to the monekys in "Promissão".

In "Coaracy Nunes" the possibility of rescuing animals eventually present on more distant islands, was solved reasonably by maintaining the water of the basin at the same level for the time being by means of the floodgates. In this paper the authors considered also data in literatura on fauna rescue during the construction of reservoirs destined for hydroelectric power plants by Dee, N. (6) — Oneida Narrows, and Leentvaar, P. (10) — Lake Brokopondo.

Finally, the training of the personnel is very important. Besides the coordination of the different groups, the work is better performed, mainly the dangerous task of capturing poisonous snakes by selected, apt, and alert persons.

The training of personnel gives greater consistency to the planning and execution of the project, gives fair results and reduces the accident rate during the capture of animals, to the rescuers as well as to the rescued.

CONCLUSIONS

1. The fewer the animals that had to be captured or rescued, the better the work prior to the closing of the floodgates.

2. Solicitations by the Hydroelectric Companies with respect to the preservation of wildlife in the flooded areas show the importance of the evolution with regard to this problem in Brazil.

3. The philosophy as well as the measures adopted by the Hydroelectric Companies as to the preservation of wildlife, diminished considerably the impact by the construction of the great barrages.

4. The aim of this work is to instruct, and point out to most of the riparian population, technicians of the hydroelectric companies, and a great number of their personnel, the problems related to ophidians, as well as the wildlife preservation in general.

5. Depending on the extension of the flooded areas, it is verified that the early, and whenever possible anticipated deforestation, prevents major problems related to eventually isolated animals, and at the same time furthers the progressive dislocation of the fauna existent in those regions.

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RESUMO: Na construção das grandes barragens para formação de reservatórios destinados às hidroelétricas, tornam-se necessárias extensas medidas para a conservação do equilíbrio ecológico e preservação da fauna. A convite das empresas hidroelétricas, cômicas da importância deste problema, a Fundação Parque Zoológico de São Paulo e o Instituto Butantan enviaram equipes às diversas regiões não só para instruir as populações ribeirinhas, os técnicos, e grande número de funcionários das empresas hidroelétricas nos problemas relativos ao ofidismo, mas também para instalar postos anti-ofídicos, permanentes e móveis, efetuar salvamento de animais ilhados e capturar serpentes.

Destaque especial foi dado ao salvamento de animais em perigo de extinção. Neste empreendimento foram utilizados expressivos recursos humanos apoiados por aviões, helicópteros, lanchas, barcos a motor e viaturas, todos equipados com rádio.

Especialistas do Hospital Vital Brazil instruíram médicos e enfermeiras a respeito do tratamento de acidentes ofídicos.

UNITERMOS: Salvamento de animais. Captura de ofídios. Instalação de postos anti-ofídicos.

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