

IV NATIONAL MEETING ON CLIMATE, WATER AND LANDS

TOPIC 1: Data Collection

A PRACTICAL BOAT FOR HYDROLOGICAL MEASUREMENTS IN LARGE RIVERS

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The practical problems related to hydrological measurements in large rivers of the world are far from being solved completely and though there have been notable advances in the improvement of both equipment and instruments during recent years, there are still aspects related to the operation of the means of transportation that should be solved, especially when working in river reaches far from populated centers trying to make various measurements following the scheme of hydrological campaigns.

On the one hand the existing experiences, using boats and barges equipped with all the instruments for hydrological measurements, as well as for the preparation and the treatment of sediment and water quality samples (Duida in the Orinoco, Alpha helix in the Amazon) resulted in high operation costs and limitation of such boats when are operated in rivers with rapids and unpredictable fluvials like the ones in the upper Orinoco, which restrict navigation and more over require sophisticated and expensive systems of positioning.

On the other hand, light boats provided with conventional measuring systems do not have enough capacity and autonomy to be operated in large rivers, and due to their limited freight they are unstable in case of strong winds and furthermore, their positioning and stabilisation become harder to obtain in rivers with high velocities, all of which make it little operatives.

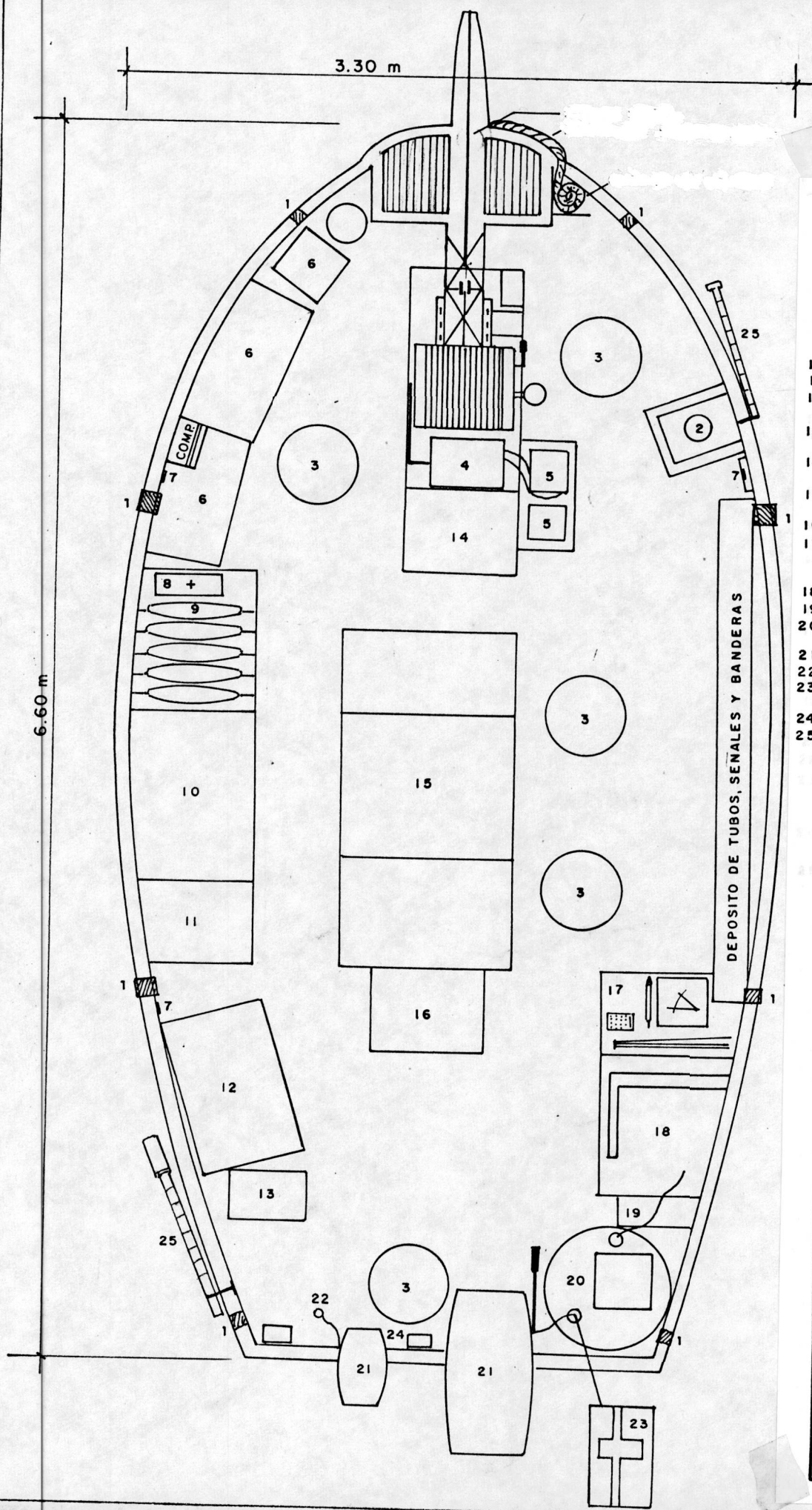
During the last years, the Direction of Hydrology and Meteorology of Venezuela has improved a boat to carry out measurements in the Orinoco whose characteristics and the proposed modification enable it to perform the measurement more efficiently than the existing ones, at relatively low costs.

1. DESCRIPTION OF THE MARNR-BOAT

The boat used by the Direction of Hydrology and Meteorology is a conventional model with a flat bottom and a triangular keel made of fiberglass with dimensions: 6,6 m length, 2 m width, powered by an outboard motor. It is used for transportation as well as a base for installing the equipment which consists of an hydraulic or electric winch (the latter, which is used more frequently, uses a 24 V- battery as energy supply), a cylinder drum and a cable to do sounding until 50 m depth. The cable of 4 mm diameter allows the suspension of a 500 lbs weight, which consists of the weight itself, the current-meter and the collapsible bottle. Also echosounding, topographical equipment, sextant for positioning and sampling storage, are available.

The following advantages of the boat can be mentioned:

1. It can be easily moved and transported on ordinary roads using a trailer and also be placed in the reaches of interest, which permits us to avoid obstacles and rapids like the ones of Ature-Maipures which represents a serious problem for boats of major fretwork.



- 1 HOOK (ROOF FIXING)
- 2 ECHOSOUND
- 3 ROTATING CHAIRS
- 4 MOTOR WINCH
- 5 12 V BATTERIES
- 6 LABORATORY COMPUTER
- 7 PLUGS
- 8 FIRST AIDS BOX
- 9 LIFE PRESERVERS
- 10 MATTRES
- 11 BAGGAGE, HAMACAS
- 12 COOK AND FOOD DEPOSITS
- 13 ROOF AND AIR BOAT DEPOSITS
- 14 MOTOR AND CLEANERS
- 15 ACCESORIES
- 16 TOOLS AND REPAIR EQUIPMENTS
- 17 TABLEWORK, UNDER WATER AND FOOD DEPOSITS
- 18 RADIO AND ANTENNA
- 19 OPTICAL EQUIPMENTS, SEXTANT, MACHETES AND THEODOLITES
- 20 ELECTRICAL GENERATOR
- 21 OIL DEPOSITS
- 22 GASOLINE DEPOSITS (100 LIT.)
- 23 OUTBOARD MOTORS
- 24 SMALL TANK
- 25 SECURITY SISTEM FOR OIL TANK
- 26 HEADLIGHT
- 27 TRANSDUCER (ALTERNATE LOCATION)

GRAPHIC Nº 1
EQUIPMENT DISTRIBUTION
IN THE SUGGESTED FLUVIAL BOAT
FOR MEASUREMENT IN LARGE RIVERS

2. It permits efficient mobility in the water with a crew of five operators at relatively low cost, provided the consumption of fuel oil and the use of conventional outboard motors.
3. It makes easier to go into minor tributaries which would not be navigables in a boat with high draught.
4. It is stable, resistant, easy to manipulate and safe when compared to the boat used during the first measurements of large Venezuelan rivers. It can be adapted in order to permit the crew to stay in the open field during measuring programs.

Nevertheless, some modifications should be carried out to improve operation in campus, concerning the distribution of the equipment, the supply of energy and mainly some modifications of the arm-support for the installation of the instruments.

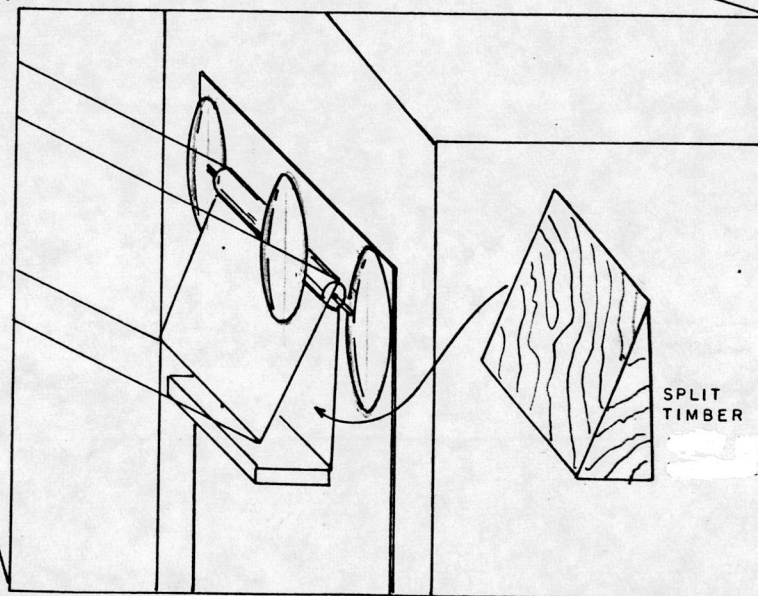
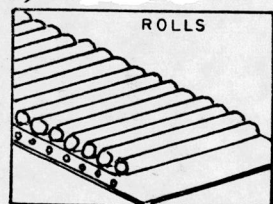
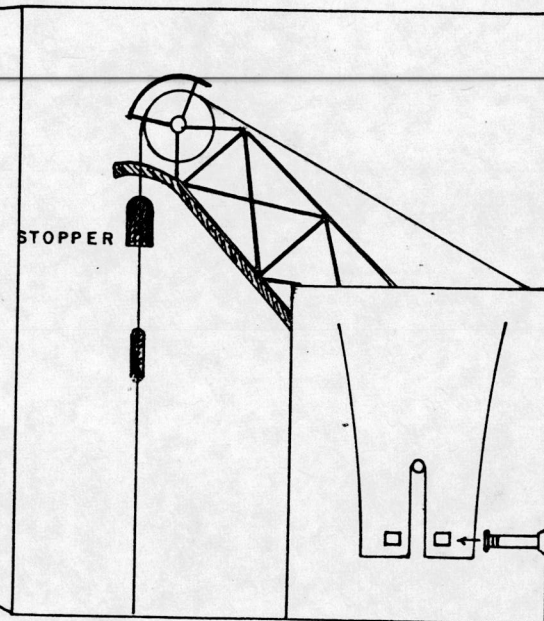
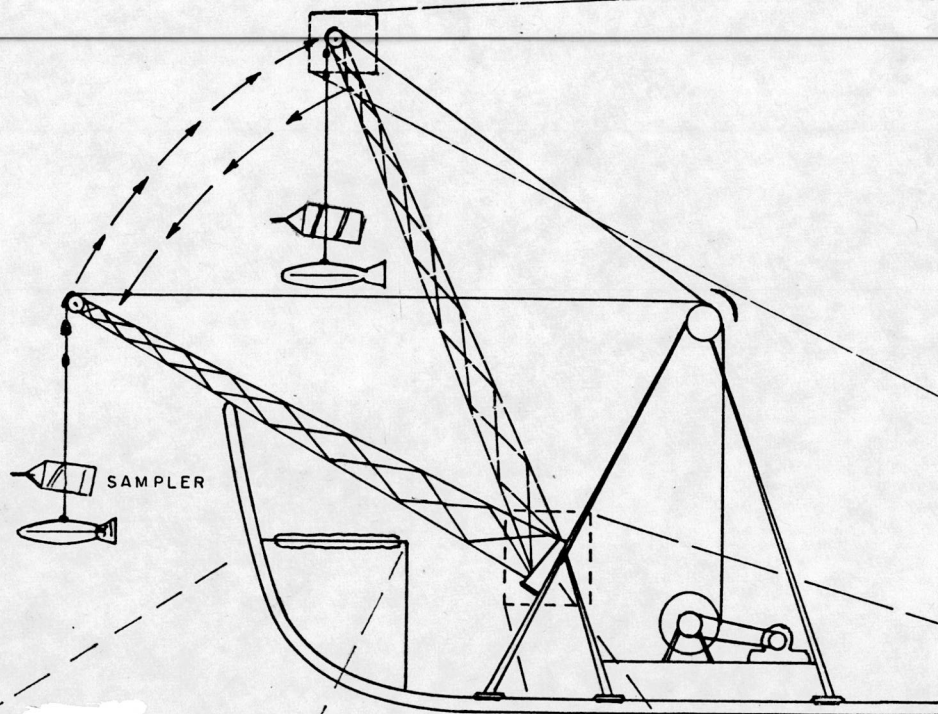
2. SUGGESTED CHANGES AND A NEW DESIGN

Graphic N° 1 shows the recommended distribution of the equipments, dimensions, source of energy, storage space and the localization of the elements that make measurements easier. The modifications related to the fixed-arm which is responsible for the measurement instrument's suspension is considered the most important one and presently the least safe and practicable part when working with the measuring equipment or when installing it. This is basically caused by the fixed construction of the arm, which determines that both the placing of the instruments as well as the collecting sampling and utilization of the equipment have to be done by the operators outside the boat, which makes it difficult for the user to work with the arm and to maintain the security of the operation. Using an angularly arm moving in a vertical sense, operated through an appropriate double poled winch, like it is shown in graphic N° 2 the process of work with a configuration currentmeter-weight-sampler, can be done inside of the boat with higher security, stability and efficiency. Basically it makes easier to install the equipment, especially when the river's banks are covered by dense vegetations or when they are vertical these are common situations during the highwater periods when usually weights of 300 pounds have to be used.

The transducer of the echosounding system can be located in an alternating positioning; in front of the boat or in the back side, guaranteeing a high security when it's being used in rocky or shallow waters. A diagram (Graphic N° 3) shows the support and location of itself at the boat from different views and cross sections.

We consider the possibility to displace the arm in a horizontal plane (180°), but this have a tendency to produce a lower stability in the vessel, due to the action of rotating forces producing a moment respect to the longitudinal axis, so that the former option was considered the appropriated one.

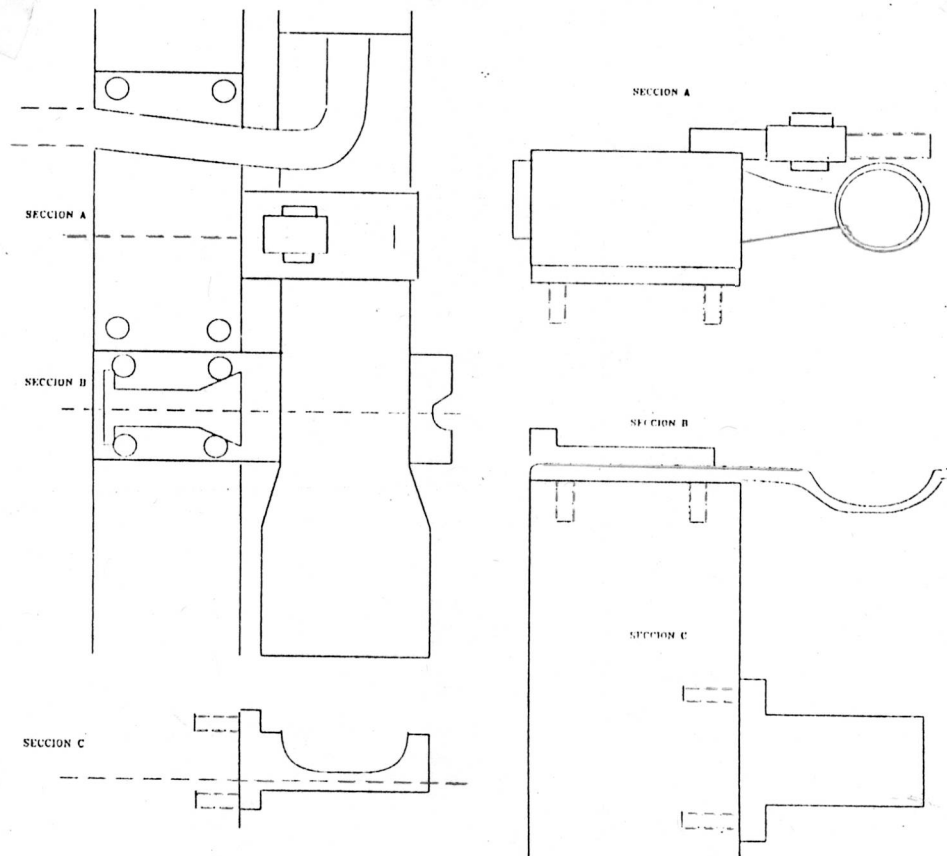
In order to improve the positioning and the stability of the boat by reducing the movement which is produced by lateral currents, it is



Graphic № 2
WINCH AND ARM DETAILS

0 cm. 30 60 90 120 cm
0 Ft. 1 2 3 4 Ft.

Graphic Nº 3 DIFFERENT TRANSDUCER VIEWS AND LOCATION ON THE BOAT



suggested to install hydrodynamic lateral catamarans at both sides of the boat. They will be put in place only during measurements and will be retracted when the boat is sailing.

AUTONOMY AND MOVILIZATION OF THE BOAT

Provided with the suggested modifications and an sufficient amount of gasoline the boat will have enough autonomy to make large trips allowing measurements in remote rivers and overnight staying in field and therefore, it accelerates the measurements and reduces the expenses of the operation saving time. This is particularly important in regions without camps or base stations, a situation like remote areas of the upper Orinoco and its tributaries. Recently, the experiences gained throught campaingns in the Orinoco, have proved that a boat like the one of MARNR, but with a larger surface areas and apropiate equipment as suggested, would simplify field work considerably.

COSTS AND FACILITIES OF CONSTRUCTION

A boat as the one suggested, would solve the problems of high expenses and the unadjusted type of the boats for measurements in large rivers that already exist in the market, and could be built in Venezuela and even exported to other countries of the South American-region. The current cost of a boat with the suggested characteristics would be about 3000 \$ (March '92) excluding the instruments and equipment which represent the most important investment.