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## IMPROVING ARTISANAL AND SEMI-INDUSTRIAL FISHERIES DATA: A PILOT EXPERIENCE ON GILLNET FISHERY IN ABIDJAN

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### SUMMARY

*A low coast GPS was developed by a student in the framework of his engineer training to solve a common data acquisition problem faced by scientists, fishermen and fishery managers in the majority of African coastal countries. A pilot test was done on a single artisanal pirogue during five consecutive trips. The results obtained were clearly positives and can surely help for improving artisanal and semi-industrial fisheries data. The document point out some technical issues that were not considered during the first step of this work. However many positive perspectives were unlighted by the authors. Going forward in artisanal and semi-industrial spatial and temporal data improvement is now totally possible. The implication of coastal countries administrations and RFMOs can help for setting a simple geographical information system for the management of artisanal and semi-industrial fisheries.*

### RÉSUMÉ

*Un étudiant a développé un GPS de faible coût dans le cadre de sa formation d'ingénieur en vue de résoudre un problème commun d'acquisition de données rencontré par les scientifiques, les pêcheurs et les gestionnaires des pêcheries dans la plupart des pays côtiers d'Afrique. Un essai pilote a été réalisé sur une pirogue artisanale unique au cours de cinq sorties consécutives. Les résultats obtenus ont été clairement positifs et peuvent très certainement contribuer à l'amélioration des données sur les pêcheries artisanales et semi-industrielles. Le document a mis en lumière quelques problèmes techniques dont on n'avait pas tenu compte lors de la première étape de ce travail. Cependant, les auteurs ont mis en avant de nombreux points positifs. Il est désormais tout à fait possible d'aller de l'avant dans l'amélioration des données spatiales et temporelles des pêcheries artisanales et semi-industrielles. L'implication des administrations des pays côtiers et des ORGP peut aider à établir un système d'information géographique simple pour la gestion des pêcheries artisanales et semi-industrielles.*

### RESUMEN

*Un GPS de bajo coste fue desarrollado por un estudiante en el marco de su formación como ingeniero para resolver un problema común de adquisición de datos que se les plantea a científicos, pescadores y gestores pesqueros en la mayoría de los países costeros de África. Se realizó una prueba piloto en una piragua individual artesanal durante cinco mareas consecutivas. Los resultados fueron claramente positivos y, sin duda, pueden contribuir a mejorar los datos de la pesca artesanal y semi-industrial. El documento señalaba algunos problemas técnicos que no fueron considerados durante la primera etapa de este trabajo. Sin embargo, los autores desvelaron muchas perspectivas positivas. Ahora es totalmente posible avanzar en las mejoras de los datos espaciales y temporales de las flotas artesanales y semiindustriales. La implicación de las administraciones de países costeros y las OROP podría contribuir al establecimiento de un sistema sencillo de información geográfica para la ordenación de la pesca artesanal y semi-industrial.*

### KEYWORDS

*GPS; spatial and temporal data; coastal artisanal and semi-industrial fisheries management*

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## Introduction

Artisanal and semi-industrial fisheries in African coastal countries contribute highly to food security, employment and economic growth, particularly among the most vulnerable in developing countries (Sowman and Cardoso, 2010). Accurate management is a key and crucial objective for managers to ensure a sustainable exploitation of living resources and ecosystems (Sainsbury et al, 2000). That, suggest to collect reliable data on catches, efforts and others biological information to efficiently assess the fishery and stocks dynamics. However in many African countries, a complete of advanced data acquisition remains challenging for various reasons. In general, the majority of semi-industrial and artisanal fisheries are multispecifics, wide distributed and highly dynamic. So, in general cases, costal countries failed in getting continuous and completed data for better managing their fisheries. Out of the framework of some regional or international short terms project, many artisanal data consist in total landings and fishing effort (in terms of number of boats). Spatial and temporal data in artisanal fisheries is not a routine task among many African coastal fisheries. Artisanal boats are not generally equipped with GPS or instruments allowing these spatial and temporal data acquisition. Since today, spatial and temporal data in artisanal and semi-industrial fisheries were considered as a less priority. However some important management measures that can help managers to ensure a sustainable exploitation of the resources cannot be objectively setup without reliable scientific advises. For example, setting marine protected areas (MPAs) need some prior knowledge about the interactions between fishing activities and the marine ecosystems (e.g. area with high catches/effort, fishing impact on juveniles or spawning area, etc.). Also, the lake of spatial and temporal data impede costal countries to provide detailed or required information to RFMOs. For example, there is a huge lake of information from African artisanal fisheries, particularly gillnet fisheries, in the task 2 - catch and effort data in ICCAT database. In these databases, the available spatial information consists often in an estimation of the probable fishing area, done by fishery experts without any data. These basic artisanal or coastal data available are of course better than nothing and were considered enough some decades ago because associated cost for improving data was (may be) important compared to expected results. But today, African countries could take advantage in the huge progress of the technology to build cheaper instruments and/or technics for improving data collection.

This paper related some preliminary results obtained in the framework of a pilot test on artisanal gillnet fisheries in Ivory Coast using a low cost GPS built under an Open source and free access consideration to improve spatial and temporal data collection in artisanal and semi-industrial fisheries, particularly in developing countries.

## Material and methods

A low cost GPS was developed by Nicolas Champauzas in the framework of his engineer training (see for more detail). The objective of this GPS was to help scientists, managers and/or fishermen involved in artisanal and semi-industrial fisheries in their different tasks particularly in African coastal countries.

One GPS was deployed during five consecutive trips on a single pirogue (artisanal boat) from the artisanal landing port of Abobodoumé (in Abidjan, Côte d'Ivoire) during five consecutive trips.

The first prototype available now is working as a data logger with a sim card for storage. Data collected is directly stored in a .CSV file automatically created on the sim card. One new row data is added in the Excel file each five or ten minutes according to the setting choose by the user. For our pilot experience, we choose the default setting that is five minutes between two acquisitions. The GPS is supported by 12 small AAA batteries that allow a 7 full days data collection with the defaults time of data acquisition. Each row data is comprising of several information (see table 1 for details). Because fishermen are moving earlier in the morning, the GPS was deployed on the pirogue the night before the starting day of the fishing trip. It is removed from the boat after the end of the fishing trip, when the board arrived for at the artisanal landings port of Abobodoumé (Abidjan, Côte d'Ivoire). The GPS is then plugged to a computer to copy the data collected during the fishing trip. The GPS is implanted again on the boat following the same protocol.

## Results

A total of 4569 positions were collected during five trips. A fishing trip consisting in 4 continuous days at sea, starting at Monday and ending at Thursday.

The itineraries of the trips showed that the fishing area is delimited by longitude between 4°28'01''W and 3°42'08''W and latitude between 4°20'37''N and 5°18'29''N (**Figure 1**) for the observed boat. The distance between the ranges of latitude is equal to 58.7 nautical miles meaning that the boat reached a maximum distance of 108.7 km corresponding to 0.964 degree from the coast. Longitudinally, the distance between ranges was equal to 53.6 nautical miles corresponding to 99.2 km and about 0.766 degree.

Figure 3 shows the distribution of the boat speeds as a function of hours of the days for the overall dataset. The highest speeds are observed during the day i.e between seven o'clock AM to five o'clock PM, corresponding to searching time of appropriate fishing zone. In contrast, the lowest speeds are observed during the night i.e between six o'clock PM to six o'clock AM, corresponding to the Gillnet setting time. So a four days trip comprised of three nets setting.

## Discussion and conclusion

Tracking boats is not a revolution as almost all industrial boats have GPS and/or AIS or similar geographical information system. However, tracking artisanal boats is not a common task, particularly in African coastal countries.

Interesting and important (preliminary) results are obtained from this pilot experience whatever. Sure, it is not possible to extrapolate or given any conclusion about the spatial dynamic of the artisanal gillnet fishery in Abidjan. However these preliminary results are the proof that African costal countries are able to improve their spatial and temporal data in artisanal and semi-industrial fisheries. Instead of declaring general (and sometimes "supposed") fishing area to RMFOs like ICCAT, African coastal countries can highly improve their data declaration with more precision on fishing area, using updated and accurate data. Spatial and temporal data in artisanal fishery can highly be a big help for example in the framework of the Atlantic Ocean Tuna Tagging Program (AOTTP) as today there is no possibility to estimate the position of any tag recovered by artisanal gillnet fisheries in the gulf of Guinea. Spatial data can also help artisanal fishermen to defend their right of justify their previous fishing positions.

The prototype available today is quit constraining as you need to deploy and collect it before and after each trip. It is also battery consuming as we need to replace all the batteries (12) at each trip. However this prototype is for instance a first step product. The next step will consist in solving the problems mentioned by using solar rechargeable batteries instead of alkaline ones. Data collected will be sent on a mobile phone when the pirogues approach the coast. Then we will be able to track all artisanal or semi-industrial boats once the get near the coast without repetitive deployment and removing of the GPS.

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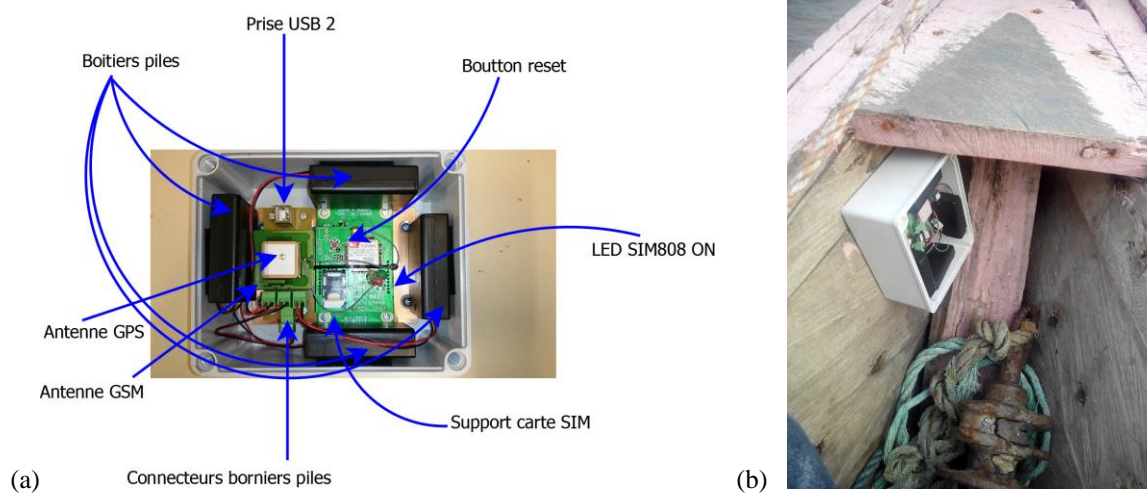
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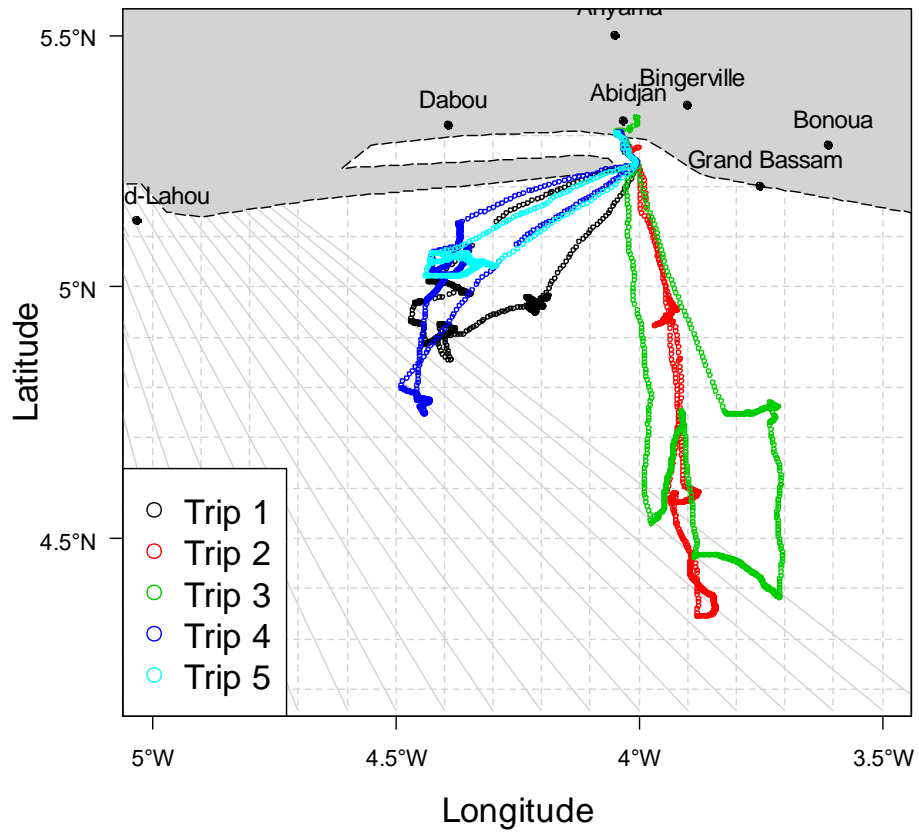
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**Table 1.** Description of data collected by the GPS BOATTLE.

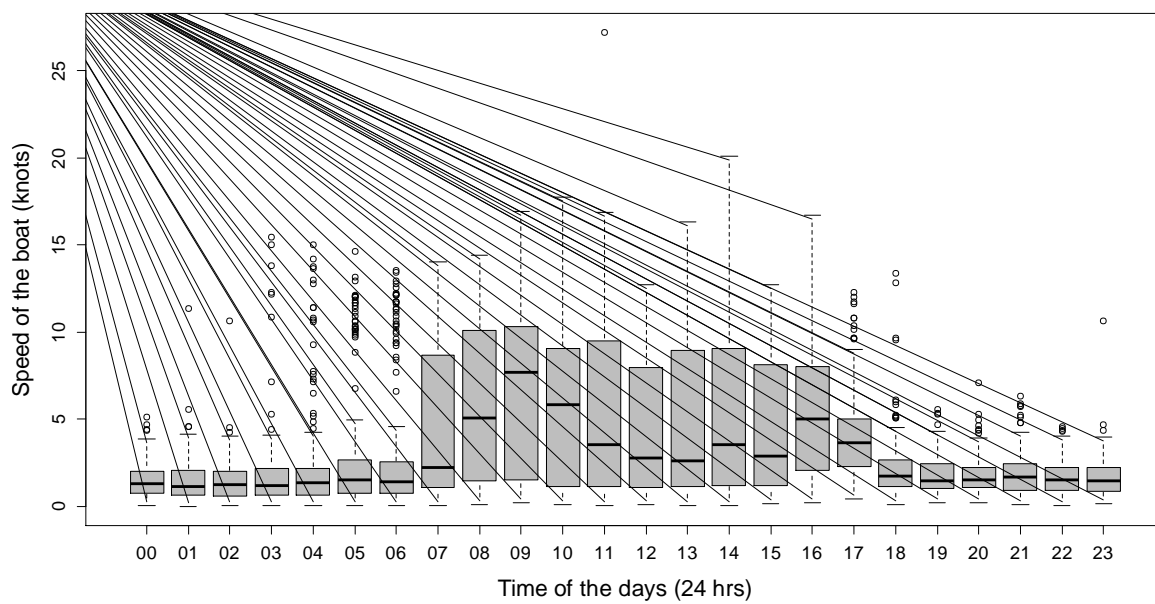
<i>Fields</i>	<i>Description</i>	<i>Units or precision</i>
Date	Date of data acquisition	YYYY / MM / DD
Hour	Hour of data acquisition	HH / MIN / SEC
Latitude	Latitude	Decimal degree
Longitude	Longitude	Decimal degree
Temperature	Outside temperature	Degree
Speed	Speed of the boat	knots



**Figure 1.** (a) Scheme of the GPS and (b) photo of its implantation before the first trip.



**Figure 2.** Itineraries of artisanal boats during their fishing trips.



**Figure 3.** Distribution of speeds of the pirogue according to hours of the days.