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A DESCRIPTION OF CERTAIN INDIGENOUS FISHING METHODS FROM SOUTHERN DAHOMEY

R. L. WELCOMME

A survey of certain Dahomean fishing methods showed them to be specifically adapted to the exploitation of floodplains and shallow water lagoons. Several types of fish-parks are described, ranging from small installations that function as refuge traps, to larger constructions that act as a form of fish culture. Ponds are also dug in the floodplains in order to conserve fish isolated during the dry season. These methods all give high yields and are worthy of consideration for use elsewhere on the African continent.

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In Africa the need to exploit the numerous kinds of fish and crustacean species found in a range of aquatic habitats has led to the development of a great diversity of fishing methods. The majority of these exploit the vulnerable species with little regard to the maintenance of the stocks from which they are drawn. In parts of West Africa, however, more sophisticated techniques have arisen that not only give high yields, but also safeguard the stocks to a greater or lesser extent. In the Ouémé valley and coastal lagoons of Southern Dahomey such methods have attained a high degree of development and together contribute a considerable proportion of the total catch of the inland fisheries. There are two basic types of installations, (1) ponds, which are dug into the floodplain and (2) fish parks, which are installed in the open waters of rivers and lakes.

The use of these methods dates back to at least a hundred years. According to local tradition the initial development arose from the gradual artificial modification and enlargement of natural floodplain pools by the construction of a network of channels. Some of these later came to be connected with the river, and the floating vegetation found in them was encouraged to spread along the river littoral in the form of discrete parks. Still later these clumps of floating vegetation were replaced with branches of terrestrial bushes. New types of installations could then be developed which spread into the more open waters of the coastal lagoons. Recently these types of fish-parks have spread from Lake Nokoue, where they originated, into other Dahomean lagoons and also into some lagoons in Togo.

All stages of this development sequence are still in existence and are available for study. The fish-parks, especially from the lakes,

have been described by BUFFE (1958) and CENTRE TECHNIQUE FORESTIER TROPICAL (1965). Unpublished studies on these and other types of installation have been carried out in Dahomey by the Service des Eaux, Forêts et Chasses. This paper describes the specialized fishing methods used among the various types of fish-parks and summarizes the existing data relating to their catches.

SURVEY OF METHODS

Fish-parks

The term fish-park is used here to describe several different types of installations that are constructed either of vegetation or branches in the shallow regions of the lakes and rivers. The use of such fish-parks is well known in many parts of the world (HORNELL 1950) and is widespread in West Africa from where it has been described particularly from the Niger-Benue system (RAIMBAULT 1960, STAUCH 1966, and REED 1967). Here clumps of floating vegetation or branches are introduced into the water to attract fish in search of food and refuge. Such installations are fished within a few days of their construction and act as refuge-traps that attract fish from waters surrounding them.

Fish-parks are constructed in shallow water in which a man can comfortably work (up to 1.5 m). The installations are fished by surrounding them with nets or with a type of fence made of woven palm stems. The branches or vegetation thus contained are removed from the interior of the enclosure, and when the bottom is clear of obstructions, the nets are moved slowly inward until the fish are confined in a small space from which they may easily be removed with hand-nets and baskets. This procedure may vary in detail with the type of installation to be fished and also from locality to locality, but the general principle remains the same. An undetermined amount of escapage occurs by fish leaping over the nets or by burying themselves in the mud during fishing. Juvenile fish also avoid capture by swimming through the meshes of the surrounding netting.

Fish-parks used in rivers

Aulas. Small fish-parks, known as aulas, are made from floating vegetation contained within a widely spaced circle of wooden stakes driven into the bottom (Fig. 1). Aulas are first installed immediately after the annual floods have subsided and are fished at intervals of about 20 days throughout the dry season (December-July). A wide range of fish and crustacean species is found in the aulas (Table 1).

A mean yield of 6.3 kg of fish and crustaceans per fishing operation was obtained from seven aulas with a mean area of 22.4 m^2 (5.3 m in diameter). The extrapolated yield per hectare of aula per fishing is 2.8 metric tons. At a fishing rate of once every 20

Table 1. Species composition by weight of the catch from two aulas.

Species	% *representation*
Macrobrachium spp. *	29.1
Tilapia melanotheron	15.0
Hemichromis fasciatus	10.0
Callienectes latimanus *	7.1
Hepsetus odoe	6.7
Polypterus senegalus	5.4
Hemichromis bimaculatus	4.7
Synodontis (2 species)	4.5
Parophiocephalus obscurus	4.5
Clarias lazera	3.7
Eleotris (3 species)	2.6
Schilbe mystus	2.4
Tilapia guineensis	1.7
Ctenopoma kingsleyae	1.2
Chromidotilapia guntheri	1.0
Batanga lebretonis	0.4
Acentrogrobius schlegelii	0.1

* Crustacean species.

Figure 1 Typical aula in the Sô river near the village of Ganvié.

Figure 2. Riverine acadjas installed in the Ouémé river.

Figure 3. Amedjerotins in the coastal lagoon of Dahomey.

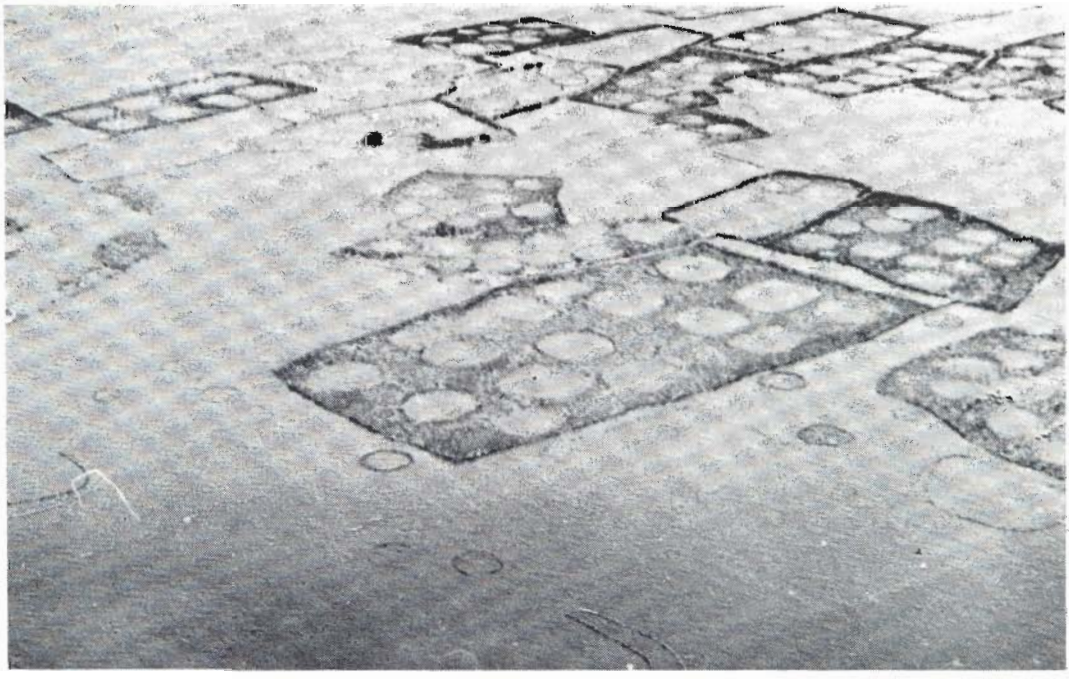

Figure 4. Avas forming part of the Ganvié acadja field (note small circular acadjavis grouped near the rectangular area).

Table 3. Observed and theoretical yield of avas fished after different elapsed times since construction.

Time elapsed since construction (months)	*1957/59*		*1969/70*	
	observed yield (t/ha)	*theoretical yield t/ha)*	*observed yield (t/ha)*	*theoretical yield (t/ha)*
2	1.46	1.35	1.16	1.06
3	1.50	1.62	1.06	1.24
4	2.30	1.93	1.52	1.44
5	2.46	2.31	1.72	1.68
6	2.25	2.76		1.96
7	3.06	3.30	2.19	2.29
8	3.67	3.95	2.68	2.67
9	4.53	4.72	3.19	3.11
10	6.10	5.74		3.63
11		6.86		4.23
12	8.82	8.20		4.94

yield probably results from the growth and reproduction of the fish populations within the acadjas. This is indicated by the presence of fish in breeding and brooding condition and by an increase in the mean weight of individual fish as the acadja ages. Furthermore, although many species have been recorded within the avas, approximately 70 per cent of the total population belong to the genus *Tilapia* (*T. melanotheron* and *T. guineensis*) in all lakes studied, and much of the remaining percentage is provided by one other species, *Chrysichthys nigrodigitatus*. Fishes of these genera are less common in other habitats within the lakes (Table 4) and it would appear that the populations of these installations are more or less distinct from those of the open waters, although obviously some interchange does occur.

Table 4 Composition of the fish population of acadja avas as compared with that of the open waters of Lake Nokoue.

Species	% *representation by weight*	
	ava	*open water*
Tilapia melanotheron	76.6	0.7
Chrysichthys nigrodigitatus	23.8	1.4
Other species	3.6	97.9

Hanou. The hanou is a composite type of acadja that consists of a central ava surrounded by several acadjavis which are of the same size and form as the godokponos. The central ava is rarely fished and serves as a reserve from which the associated acadjavis are stocked by migration. These are fished once every two months in a cycle similar to that of the godokponos. These installations are said to give high yields, and this is confirmed to a certain extent by the mean of 2.84 t/ha/fishing obtained from godokponos of equivalent area at the same period.

Hanoumecadja. In the hanoumecadja the acadajavis are set within a hollow rectangular or horseshoe-shaped reserve. Here the acadjavis are fished only two or three times per year and the reserve generally remains unfished. High yields may be obtained by this method and one hanoumecadja consisting of 19 acadjavis of mean area 143 m^2 gave a mean yield of 4.02 t/ha of acadjavi when fished after five months and 1.85 t/ha when fished after three months. This indicates a total annual yield of about 8 t/ha when calculated from the surface area of the acadjavis alone. When the total planted area of the installations is taken into account this figure is obviously somewhat diminished (about 6 t/ha).

Ponds

Ponds, known locally as whedos, are cut into most of the low-lying areas of the Ouémé floodplain (Fig. 5). These generally take the form of channels often exceeding a kilometre in length, but seldom more than 4 m wide and 1.5 m deep. Also classified as whedos are the numerous permanent pools and swamps that are left naturally on the floodplain and which are often artificially extended. The whedos, which are submerged together with the rest of the floodplain during the floods (July-November), remain full when the waters retreat in December, and are fished toward the end of the dry season (May-June).

Whedos tend to be overgrown with floating vegetation during the dry season and the water is usually de-oxygenated below this cover; in eight whedos sampled no dissolved oxygen was detectable using Winkler's method. The species composition of the population, shown in Table 5, consists mainly of those forms possessing auxiliary air-breathing organs. Fishing is carried out by isolating a segment of the whedo with

Table 5. Percentage composition by weight of the catch from 14 whedos in 1955–1958.

Species	% *representation*
Clarias lazera	46.8
Parophiocephalus obscurus	27.9
Heterotis niloticus	6.2
Ctenopoma kingsleyae	5.5
Clarias dahomeyensis	4.5
Gymnarchus niloticus	3.7
Polypterus senegalus	2.5
Protopterus annectens	2.0
Xenomystus nigri	0.8
Tilapia spp.	0.1

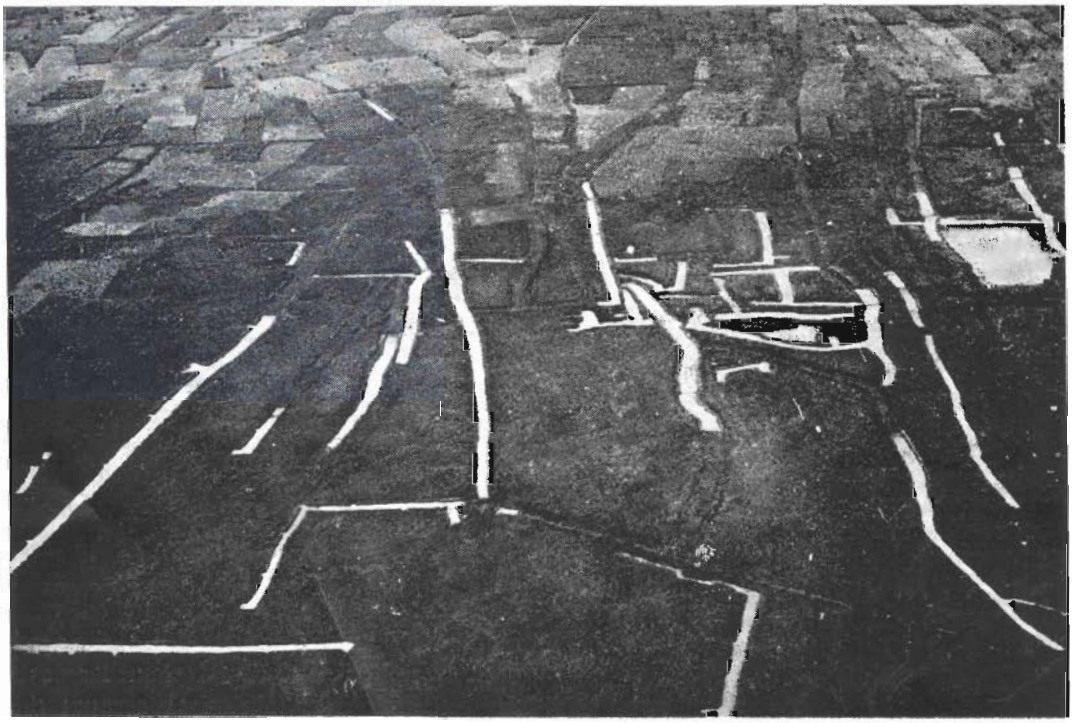

Figure 5. Whedos in the Ouémé floodplain. The light areas are whedos that have been recently fished. Other unfinished areas that are still filled with vegetation may be distinguished as continuations of them.

fences made of split palm stems. The vegetation is then removed from the portion and one fence is advanced until the fish are contained within a small area from which they may conveniently be removed.

The same species complex was present in the samples examined in 1968/1970, but the order of dominance of the *Clarias* species was reversed; *C. dahomeyensis* comprising 71 per cent of the combined *Clarias* catch and *C. lazera* the remaining 29 per cent. Furthermore, at this time *Clarias* generally appeared to contribute a greater percentage of the catch than hitherto. A more detailed analysis of the 1968/1970 catch was not possible due to the inaccuracy of the identification of other species. The mean yields calculated for the whedos are shown in Table 6.

Table 6. Mean yields of whedos in different years.

Year	*No. in sample*	*Yield (t/ha/yr) and standard deviation*
1955	17	2,06±1.14
1956	14	2,14±1.39
1958	3	2,13
1968	2	1,59
1970	32	1,57±0,41

There was no significant difference between the results obtained for 1955, 1956, and 1958. The means for those years may be grouped to give a single sample of 34 observations with a mean of 2.12 ± 1.18 t/ha. Similarly the means for 1968 and 1970 may be grouped into one sample also of 34 observations with a mean of 1.57 × 0.40 t/ha. The 1968/1970 mean was significantly lower than that of 1955/1958, and the loss in production is attributed to a general overfishing of the Ouémé valley area by other fishing methods (FOOD AND AGRICULTURAL ORGANIZATION, in press).

DISCUSSION

The management of floodplains and shallow water ponds and lagoons to obtain maximum fish production is of great interest in Africa where this type of habitat is widespread. The fishing methods that have been developed in Dahomey are specifically adapted to exploit these environments and appear suitable for introduction into similar areas elsewhere in the continent.

Ecologically these fishing methods are related in that they represent a type of developmental sequence that passes through three recognizable stages. These may be considered as operating by (i) the drain-in principle, (ii) the refuge-trap principle and (iii) the acadja principle.

The drain-in principle

One of the greatest problems of floodplain fisheries is posed by the seeming overproduction of young fish during the flood phase, with the resulting heavy mortality as the water level drops and fish become concentrated into a progressively smaller area. In these instances, it is known that the natural mortality far exceeds the mortality due to fishing and there is, therefore, a considerable potential for increased production. One way in which this may be achieved is by increasing the area of water available to the fish during the low water phase, and this is the main contribution of the whedo-type fish ponds. An estimated 3 per cent of the Ouémé floodplain is occupied by these ponds and the resulting 1,100 hectares roughly doubles the surface area of water that is available to the fish during low water. The present form of the whedos, however, results in the survival of only those species with auxiliary air-breathing apparatus. Thus, there is room for experiments with other types of ponds which retain less vegetation cover and could, therefore, harbour a greater variety of species.

The refuge-trap principle

The presence of floating vegetation or branches in the water quickly attracts fish of many species in search of shade, shelter, breeding areas and/or the food organisms that grow on the submerged surfaces. By the construction of suitable enclosures or fish-parks this behaviour can be utilized to assemble fish within specific areas, where they may be easily captured. Such installations are usually fished within a short time of their initial construction, in which case they merely attract the fish from the surrounding waters, and in this way act in a similar manner to any other type of baited trap. In those installations that are left for longer periods, however, certain secondary effects tend to make them more beneficial to the fishery as a whole. Firstly, by providing increased shelter they permit the river to support a larger population of desirable littoral species than it would otherwise be able to. In this way they have the characteristics of the drain-in type of fishery. Secondly, by increasing the cover they offer greater shelter from both predators and other fishing methods practised in the open waters around them. Thirdly, by providing increased food they may make higher growth rates possible. Finally, they encourage the continuance of reproduction throughout the year; ripe adults of several cichlid species, notably *Tilapia melanotheron*, *Chromidotilapia guntheri* and *Hemichromis fasciatus*, are found in these habitats at all times.

The acadja principle

Observations show that after an enclosure has been in the water for a certain length of time, the population, as represented by the weight of catch per unit area, begins to increase exponentially, provided that the installation is maintained. It is assumed that this increase is due mainly to the growth and reproduction of the fish within the installation, rather than to continued immigration; an assumption which is supported by the abundance of fish in breeding and brooding condition and by an increase in the mean weight of the individuals within the population with time. Furthermore, only a very few species participate in this development, and it would appear that discrete populations, that are generally independent of those in the adjacent open waters, arise within such enclosures.

Obviously the exponential trend cannot continue indefinitely, although it is observed to hold good for up to at least 12 months. It is, therefore, supposed that after a certain population density is reached, the excess individuals emigrate either into other installations in the vicinity or into the open waters of the lake. This principle explains the success of the hanou and hanoumecadja types where small refuge-traps installed near to the main acadja presumably crop the excess population. The acadja may also serve as a stocking mechanism for the open waters of the lake or river in which they are installed.

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SUMMARY

Various fishing methods from Dahomey which exploit the fishes of the floodplains and shallow water lagoons are described. Their yields and essential characteristics are tabulated as follows:

Type of installation	*Construction material*	*Usual area (m²)*	*Frequency of fishing (times per year)*	*Mean yield per fishing (expressed in t/ha equivalents)*
Aula	Floating vegetation	22.4	10	2.80
Riverine acadjas	,,	440.0	2	1.90
Godokponos	branches	63.7	4–5	1.36
Amedjerotin	,,	286.0	2	2.79
Adokpo	,,	407.0	2	4.11
Ava	,,	3,076.0	2	2.00
Hanou	,,	Acadjas of mean area 63.7 m² only fished 4–5 times a year to give 2.84 t/ha/fishing		
Hanoumecadja	,,	Acadjas of mean area 143 m² only fished 2 times per year to give 3 t/ha/fishing		
Whedos	Ponds of variable area dug into the floodplain fished 1 per year to give 1.57 t/ha/yr			

Some of the principles whereby these methods operate are discussed.

RÉSUMÉ

Diverses méthodes de pêche en usage au Dahomey pour l'exploitation des plaines inondées et des lagunes en eau peu profondes sont décrites. Leur rendement et charactéristiques essentielles peuvent être présentées comme suit:

Type d'installation	*Matériau utilisé*	*Superficie exploitée en général (m²)*	*Fréquence des pêches (nombre de pêches par an)*	*Rendement moyen par pêche (exprimé en t/ha)*
Aula	végétation flottante	22.4	10	2.80
Acadjas fluviaux	,,	440.0	2	1.90
Godokponos	branches	63.7	4–5	1.36
Amedjerotin	,,	286.0	2	2.79
Adokpo	,,	407.0	2	4.11
Ava	,,	3,076.0	2	2.00
Hanou	,,	acadjas d'une superficie moyenne de 63.7 m², pêchés 4–5 fois l'an seulement rendant 2,84 t/ha/pêche		
Hanoumecadja	,,	acadjas d'une superficie moyenne de 143 m², pêchés deux fois l'an rendant 3 t/ha/pêche		
Whedos	Etangs de superficie variable creusés dans les plaines inondées et pêchés une fois l'an rendant 1.57 t/ha/an			

Quelques uns des principes selon lesquels ces méthodes fonctionnent sont discutés.

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