Catchability Estimates for Simple Fishing Gears in Small-Scale Fishponds*

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Introduction

Harvesting of fish has been a significant problem in small-scale fish farming in Malawi from as far back as 1962 (MNRS 1962). Farmers harvest fish with seine nets borrowed from the Fisheries Department. They cannot afford to buy nets. This is one of the factors which have led to overdependence of farmers on the government (Banda 1987). Some ponds cannot be drained and many farmers do not wish to drain ponds where problems of water supply exist. Cheap and locally available alternative harvesting tools are therefore an important prerequisite to the success of small-scale fish farming in Malawi.

Traditional fishing gears used in lake and river capture fisheries utilize local construction materials, are easy to make and require little training to operate. ICLARM, in cooperation with the Fisheries Department and the University of Malawi, with funding from the German Agency for Technical Cooperation (GTZ), is exploring the possibility to adapt some traditional fishing gears for use in ponds: hook-and-line and cover pots.

Materials and Methods

Ten experiments were conducted in 200-m² earthen ponds at the Domasi Experimental Fish Farm in Zomba, Malawi. *Oreochromis shiranus* and *Tilapia rendalli* of 34-44 g were stocked at 1 fish/m² at a 1:1 species ratio. Table 1 shows the experimental setup. The catchability of hook-and-line and cover pot techniques were preliminarily evaluated.

Fishing rods were made of 250-cm long reeds (*Phragmites* spp.). A single no. 15 steel hook and a 10-cm long 0.5-cm thick grass float were tied to an 8-lb test monofilament line. Hooks were baited with common earthworms (*Lumbricus* spp.). Two anglers fished. One hook with one line was fished by a single angler in a 200-m² pond between 0600 and 1700 hours for five to six consecutive days. Each experiment was replicated twice in time (Table 1).

A cover pot or plunge basket displayed on the bank of one of the 200-m² experimental ponds at the Domasi Experimental Fish Farm, near Zomba, Malawi. (Photo by Aggrey Ambali)
Une nasse à main sur le bord d'un des étangs expérimentaux de Domasi près de Zomba, Malawi. (Cliché: Aggrey Ambali)

Cover pots, also known as plunge baskets (Ratcliffe 1972), were made of split reeds, cone-shaped, 110 cm high and tapered at the top with base diameter of 45 cm. They were tried at two water depths (0.3 and 0.4 m). One individual operated one pot between 0600 and 1700 hours for five to six consecutive days. Operation at 0.4-m depth was replicated twice in time (Table 1).

Estimates of Catchability

Data collected on both gears included number and species caught per hour. Catchability was estimated by Leslie's method (Ricker 1975). A regression equation of the form:

$$C/f_t = a - q \cdot \Sigma C_t$$

was used, where

: C/f_t is the catch (C) per fishing effort (f) during interval t (here, f refers to the application of a given gear for one hour);
: a is the intercept of the

Table 1: Experimental design and estimated characteristics of hook-and-line (HL) and cover pots (CP) in 200-m² tilapia ponds in Malawi.

Date in 1989	Pond number	Water depth (m)	Number of fish	Fishing gear	Operator	Fishing effort[a] (f_t)	q[b]	Residual SS	Residual DF
3 Aug	1	1.0	200	HL1	A	33	0.007	430.748	31
3 Aug	2	1.0	200	HL2	B	33	0.061	413.385	31
3 Aug	3	0.4	200	CP1	C	33	0.104	247.259	31
3 Aug	4	0.4	200	CP2	D	33	0.127	228.011	31
23 Aug	5	1.0	200	HL3	E	29	0.077	341.413	27
23 Aug	6	1.0	200	HL4	A	29	0.277	310.911	27
23 Aug	7	0.4	200	CP3	B	29	0.099	465.276	27
23 Aug	8	0.4	200	CP4	C	29	0.205	307.068	27
23 Aug	9	0.3	200	CP5	E	29	0.391	266.363	20
23 Aug	10	0.3	200	CP6	F	29	0.280	636.051	27
					Pooled regression:			3,646.485	279
					Common regression:		0.163	24,195.420	208

[a]Hours for which the gear was operated.
[b]q = Catchability.

critical F value = 174.7
$F_{0.05,9,279} = 1.92$
($P<0.0005$)

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regression;
: q is the slope (equal to the catchability coefficient - the fraction of the population taken by one unit of effort); and
: ΣC_t is the cumulative catch of the gear in question to the start of the interval (t) plus half of that taken during interval (t).

Note that $a = q \cdot N_o$; thus the initial population (N_o) can be obtained from $N_o = a/q$.

Analysis of covariance (Zar 1984) was used to compare q values and a Tukey test (Zar 1984) was used to compare pairs of q values.

Results

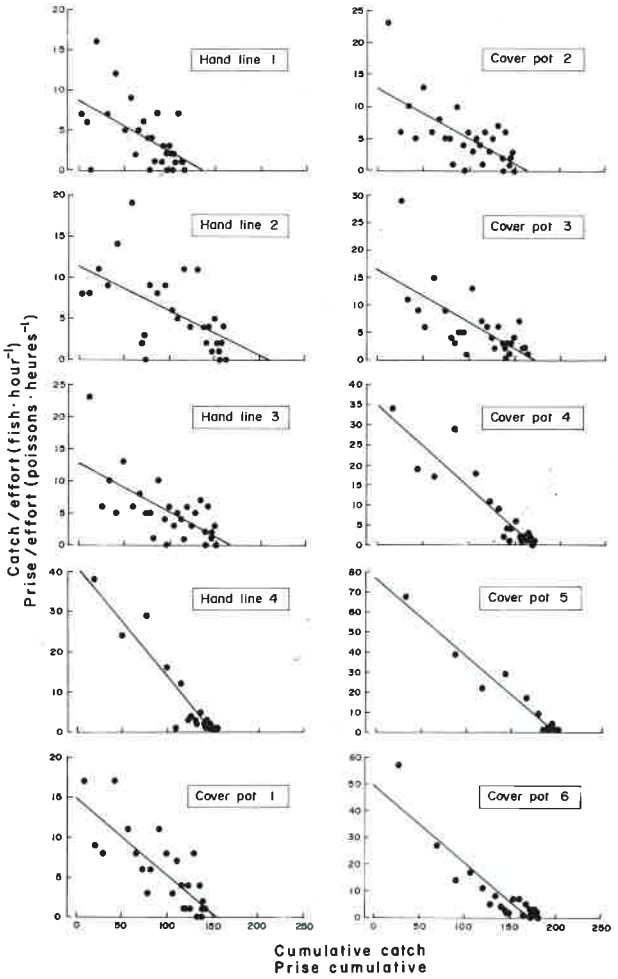
The values of q obtained from different gears, operators and dates ranged from 0.007 (hook-and-line, 1.0 m depth) to 0.391 (cover pot, 0.3 m) (Table 1). The q values were significantly different from each other ($P<0.005$). With two exceptions, q values were lower for hook-and-line operated at 1.0 m than cover pots operated at 0.3-0.4 m depths (Table 2). A cover pot operated at 0.3 m by operator E had the highest q value ($P<0.05$).

Table 2. Differences between pairs of catchabilities (q) of fishing gears (HL = hook-and-line; CP = cover pots) for 200-m² tilapia ponds in Malawi, by Tukey test[a].

Rank of q	1	2	3	4	5	6	7	8	9	10
Catchability	0.007	0.061	0.077	0.099	0.104	0.127	0.205	0.277	0.280	0.391
Gear	HL1	HL2	HL3	CP	CP1	CP2	CP4	HL4	CP6	CP5
Water depth(s) (m)	1.0	1.0	1.0	0.4	0.4	0.4	0.4	1.0	0.3	0.3
Operator	A	B	A	C	C	D	D	B	F	E
Date	3 Aug	3 Aug	3 Aug	3 Aug	23 Aug	23 Aug	23 Aug	23 Aug	23 Aug	23 Aug

[a]Catchabilities underlined by the same line are not significantly different ($P>0.05$).

With hook-and-line, significant differences in q values by angler and by experimental day were observed (Table 2). Operator A was less efficient than B on both days. The q values by both anglers were lower on 3 August than on 23 August. Variations in q due to operator and experimental day were not significantly different in three of the four comparisons with cover pots operated at 0.4 m. However, q values by different operators of cover pots operated at 0.3 m were significantly different ($P<0.05$).



Leslie plots showing impact of various gears on fish stocks in 200-m² ponds in Malawi (see text for details).
Tracé de Leslie montrant l'impact de divers instruments sur les stocks de poissons dans des étangs de 200 m² au Malawi (voir le texte).

Implications for Future Research

Hook-and-line q values showed wide variabilities during the experiment, with instantaneous rates of fish removal ranging from 0.7 to 27.7% per hour. It seems that hook-and-line cannot be relied upon to catch a predictable amount of fish each day.

Cover pots operated at 0.3 m had instantaneous rates of fish removal ranging from 28 to 39% per hour; an effective removal rate for small-scale ponds. The requirement of partial draining as a prerequisite to such high q values however, renders cover pots of limited use for undrainable ponds. Further investigations with an encircling reed fence which harvests fish like a seine net without draining are underway and the results will be reported in a future article.

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