Preliminary observations on the use of a frame trawl in hydroacoustic surveys

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Abstract: Fish echo traces identified using a Simrad EY 500 scientific echosounder were sampled with a 3.5 x 3.5 m opening frame trawl. Approximately equal weights of haplochromine cichlids and *Rastrineobola argentea* (Pellegrin) were caught. Haplochromines dominated in midwater and *R. argentea* near the surface. At the oxycline, the shrimp, *Caridina nilotica* (Roux) was abundant. Barbus profundus Greenwood was also abundant in one haul at the oxycline but was absent from all other samples.

Introduction

Hydroacoustic surveys are a valuable method for assessing fish stocks in a given area (MacLennan & Simmonds 1992). Fish swimming in the water column below the echosounder transducer reflect some of the sound energy from the transducer back to the transducer, where the reflected energy is measured. The volume of water sampled forms a cone beneath the transducer as the sound pulses spread out at a narrow angle from the point source at the transducer. The degree of reflection is determined largely by the size of the fish, with the volume of the air-filled swim bladder an additional important factor in determining the strength of the echo. By a process of echo-integration, the hydroacoustic equipment (in the Lake Victoria Fisheries Research Project (LVFRP) this is a Simrad EY500) provides an estimate of the biomass and/or density of fish in the sampled cone of water beneath the transducer from the combined echoes received from that cone. The echosounder cannot, however, distinguish between different species and therefore experimental fishing has to be carried out in conjunction with hydroacoustic surveys to assess the species composition and confirm sizes of the fish recorded.

In the LVFRP, two main methods of sampling these fishes are being developed, multi-meshed, multi-depth gillnetting and frame trawling. The latter was used during the hydroacoustic survey conducted in Ugandan waters in February 1999.

Earlier work on *Rastrineobola argentea* (Pellegrin) used a 3 x 3 m opening frame trawl for sampling, using the research vessel RV Ibis (S.B. Wandera, unpublished data). During the first visit to the project of the STTA Gear Technologist, Mr S. Ridgway, the effectiveness of this net was investigated. Fishing with the gear was found to be simple and effective, but it was determined that a much larger frame could be fished from the vessel without difficulty. A larger frame trawl would prove effective for the smaller pelagic species and juveniles of the larger species. The shape of the net fitted to the 3 x 3 m frame was unsatisfactory and needed major modification for the proposed new, larger frame. Also, depth setting without netsounding equipment was suspected to be too inaccurate for targeting fish layers identified in hydroacoustic surveys and thus a netsounder was obtained for the new frame trawl.

Materials and methods

Measurements of deck area on the RV Ibis and RV Victoria Explorer suggested that a 3.5 x 3.5 m frame would be suitable, giving 36% greater fishing area than the original 3 x 3 m frame. A new 4-panel net design was prepared to give a better shape and more gentle taper to the net (Figure 1). The new frame was constructed in two halves to make it easier to transfer the net between the vessel and shore.

During the hydroacoustic survey, layering of echoes in the water column was observed. The frame trawl was deployed to investigate these layers. The net was hauled for up to 30 minutes per pull with exact time being recorded.

A Furuno netsounder was used to accurately determine the depth at which the net fished. The equipment consists of a transducer/transmitter unit which is attached to the top of the frame. This sends pulses of sound up to the surface of the lake and down to the lakebed, transmitting return echoes to a towed paravane receiver alongside the vessel (Fig. 2). The signals are displayed on a monitor in the wheelhouse, showing the actual depth of the net in relation to both water surface and lake bottom. The required fishing depth for the net was achieved, initially by trial and error, using a combination of: (a) weights and floats on the frame of the trawl; (b) amount of wire warp paid out from the winch; and (c) slight adjustments to vessel speed while observing the position of the net in the water column on the netsounder monitor.

Catches were divided into species. Total weight of each species (kg) was recorded. Lengths (TL, mm) and weights (g) of individual fish were recorded; sub-sampling was used when appropriate. Each haul was linked to the Simrad EY 500 echo trace taken at the time, to assist in interpretation of the echo traces.

Results

Thirteen hauls were made during the hydroacoustic survey of the Ugandan waters of Lake Victoria from 7-19 February 1999. The sampling sites are shown in the report of the survey (Tumwebaze & Getabu 1999). Ten of the hauls were made above the oxycline which was clearly visible as a strong echo on the echogram at between 25 and 35 m depth in most of the sampled areas (Table 1). The remaining three hauls targeted the oxycline.

Approximately equal weights of *R. argentea* and haplochromine cichlids were caught in total, but with marked differences between hauls. Near the surface, i.e. hauls 5 and 13 (Table 2, Fig. 3), *R. argentea* dominated the catches. In midwater, haplochromines were dominant, i.e. hauls 4, 1, 10, 11 and 3, with *Lates niloticus* (L.) *and R. argentea* appearing in variable quantities. At the oxycline (hauls 12 and 2) the shrimp *Caridina nilotica* (Roux) was abundant. The shrimp was also common in haul 9. In haul 2, several hundred *Barbus profundus* Greenwood were caught, but the species was not recorded in any other hauls.

Discussion

The frame trawl was shown to be an effective method for sampling concentrations of organisms identified on echo traces. It can be targeted to fish very accurately at the right depth. These preliminary observations suggest that, with practice, it will be possible to identify echo traces effectively in the hydroacoustic surveys.

During surveys, the inshore/offshore, depth, and temporal distribution of *R. argentea* should be investigated in more detail to test the hypotheses presented in the papers compiled by Wanink (1998), which relate the distribution of the species to various factors such as Nile perch predation, competition for food and parasitisation.

The presence of the normally benthic species *B. profundus* at the oxycline in midwater is the subject of a separate paper (Tweddle *et al.* in preparation).

In addition, *C. nilotica*, which was found to be abundant at the oxycline during the day, yielded high catches in the frame trawl, and is the cause of the reflecting layer seen in the echo traces. The intensity of the reflecting layer diminishes at night (M. Kenyanya, personal communication) when the shrimps disperse through the water column (Lehman *et al.* 1996). The ecology of the shrimp is the subject of detailed investigation under the LVFRP.

In future hydroacoustic surveys, following these successful net trials, the frame trawl will be used to systematically assess the species composition of the fish stocks registered by the hydroacoustic survey equipment in the pelagic zone of the lake.

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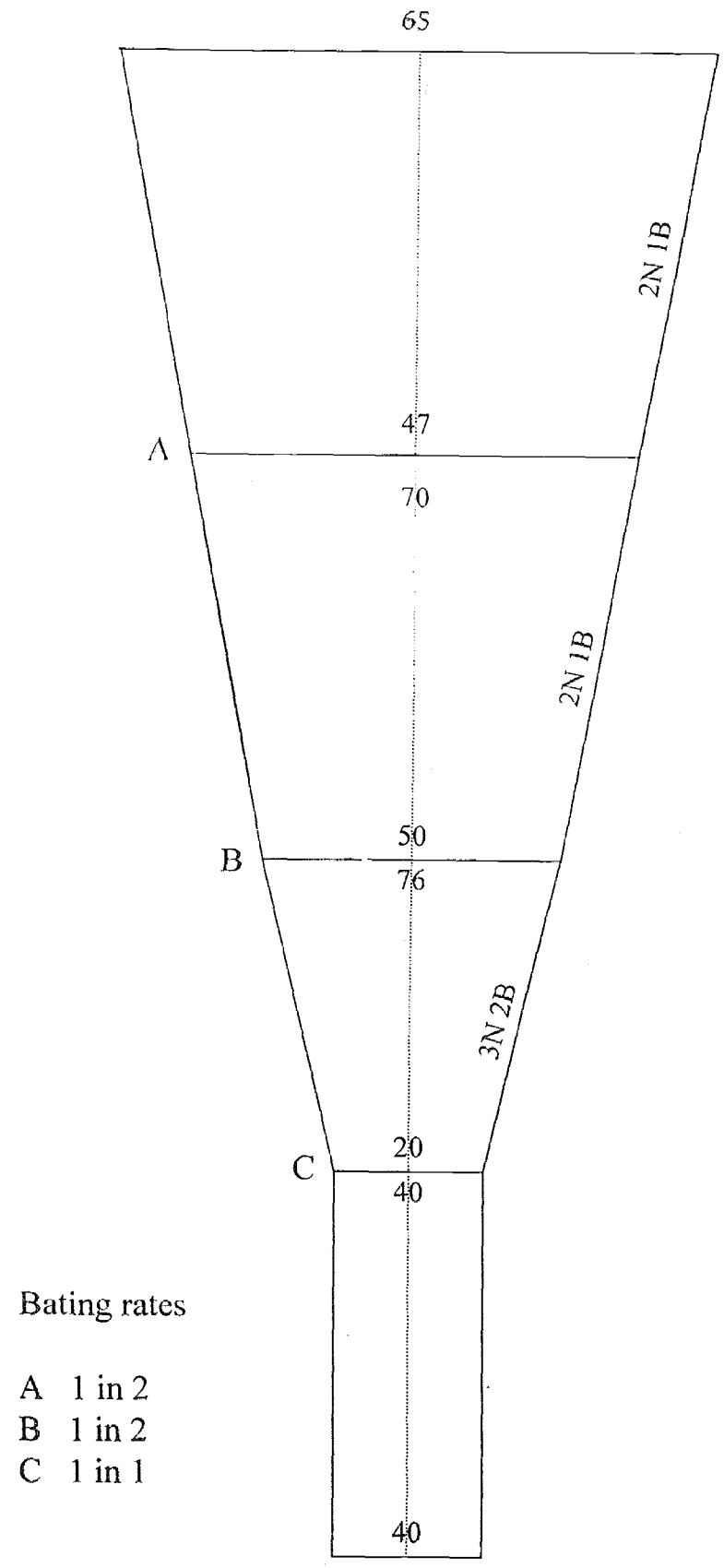
Table 1. Location and time of the 13 frame trawl hauls made during the February 1999 hydroacoustic survey of Ugandan waters.

Haul no.	Location	Date	Depth of lake (m)	Depth of set (m)		Time	Latitude	Longitude
1	Rwamafuta - Kirongo	7.02.99	26 - 26.5	15	Start	12:20	00°19'56"N	33°15'33"E
					Finish	12:56	00°18'20"N	33°13'41"E
2	Nsetwa – off Lukalu	9.02.99	45 - 48	29	Start	10:34	00°00'38"N	32°50'58"E
					Finish	11:04	00°00'39"S	32°59'45"E
3	Rumfua - Namba	9.02.99	40 - 43	20	Start	16:23	00°08'45"S	32°39'38"E
					Finish	16:53	00°07'41"S	32°38'00"E
4	Mu - Sadzi	10.02.99	30 - 31	10	Start	09:49	00°05'07"S	32°27'35"E
					Finish	10:19	00°05'10"S	32°30'05"E
5	Goru - Light House	10.02.99	13 - 13	5	Start	15:19	00°09'16"S	32°04'08"E
					Finish	15:39	00°09'51"S	32°02'57"E
6	Bukasa Channel	11.02.99	33 - 33	22	Start	14:39	00°27'22"S	32°25'12"E
					Finish	15:11	00°25'24"S	32°25'45"E
7	Bukasa Channel	11.02.99	33 - 33	12	Start	17:00	00°24'55"S	32°26'03"E
					Finish	17:25	00°26'24"S	32°26'19"E
8	Kirongo - Kiyindi	17.02.99	27 - 28	12	Start	15:17	00°17'29"N	33°12'45"E
					Finish	15:47	00°16'49"N	33°11'03"E
9	Bugaia	17.02.99	41 - 41	33	Start	15:49	00°05'07"N	33°17'58"E
					Finish	16:12	00°04'12"N	33°18'54"E
10	Bugaia	18.02.99	41 - 41	15	Start	16:56	00°04'23"N	33°18'29"E
					Finish	17:26	00°05'37"N	33°17'11"E
11	Buziri - Bugaia	19.02.99	29 - 29	17	Start	12:34	00°10'16"N	33°12'16"E
					Finish	13:03	00°08'45"N	33°12'51"E
12	Kirongo - Buvuma	19.02.99	28 - 28	26	Start	15:09	00°18'30"N	33°13'15"E
					Finish	15:30	00°17'47"N	33°12'32"E
13	Kirongo - Buvuma	19.02.99	27 - 27	1	Start	16:03	00°17'56"N	32°12'31"E
					Finish	16:31	00°19'03"N	33°13'34"E

Table 2. CPUE, in g hr^{-1}, by species for the catches in each of the 13 frame trawl hauls. Hauls are numbered as in Table 1. The three hauls where the oxycline was targeted are shown below the ten hauls made above the thermocline. (*L. n.* - *Lates niloticus; R. a.* - *Rastrineobola argentea*; H. spp. – haplochromine species; *O. n.* – *Oreochromis niloticus; B. p.* - *Barbus profundus; S. a.* – *Synodontis afrofischeri; C. n.* – *Caridina nilotica*).

	CPUE (g hr^{-1})							Total CPUE (kg hr^{-1})
Haul no.	*L. n.*	*R. a.*	H. spp.	*O. n.*	*B. p.*	S. a	*C. n.*	
1	636	418	3545	18	0	0	0	5
3	272	340	20388	0	0	0	0	21
4	10	1400	2400	0	0	0	0	4
5	2550	94320	5100	0	0	0	0	102
6	6068	6205	1364	0	0	0	0	14
7	7481	2244	4675	0	0	0	0	14
8	50	2750	3000	0	0	0	0	6
10	42	250	47916	0	0	0	0	48
11	50	9792	52227	0	0	0	0	62
13	21	31607	321	193	0	0	0	32
Mean	1718	14933	14094	21	0	0	0	31
SD	2794	29467	19805	61	0	0	0	32
2	6000	1000	880	0	4400	10	79720	92
9	3574	783	1304	0	0	0	52	6
12	557	2529	1257	0	0	0	121374	126
Mean	3377	1437	1147	0	1467	3	67049	74
SD	2727	952	233	0	2540	6	61646	62



Meshes	mm	Length (m) approx.
45	114	4.41
50	75	3.24
112	50	4.85
80	25	1.73

Figure 1. The frame trawl consists of four identical panels (constructed as shown in this diagram) sewn together and held open by a 3.5 x 3.5 m square steel frame.

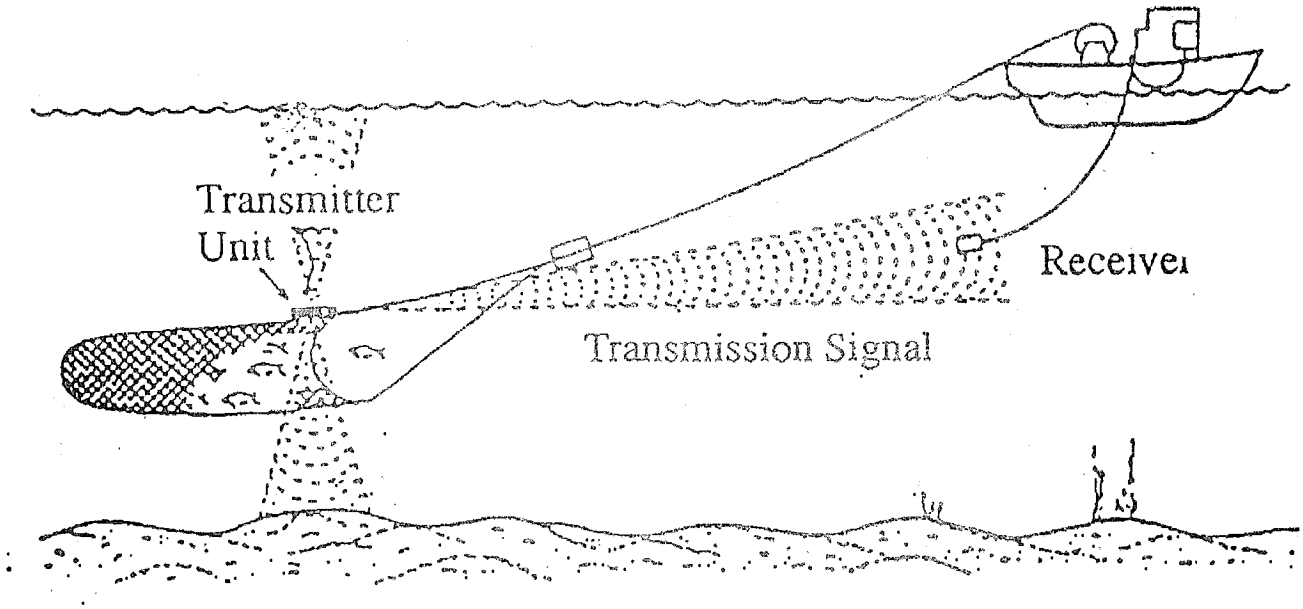


Figure 2. Sketch from Furuno netsounder manual showing how the netsounder and receiver work.

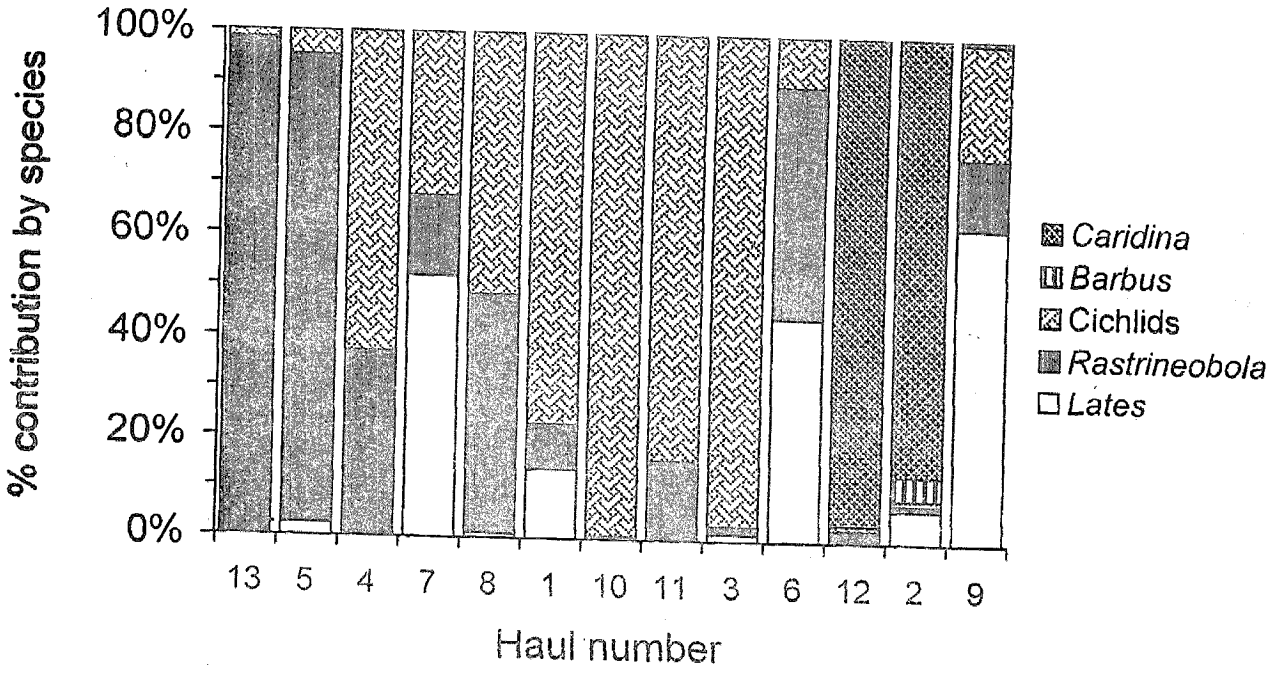


Figure 3. Percentage contribution by weight of the species caught in the frame trawl. The hauls are arranged in order of net fishing depth (see Table 1). The three hauls on the right hand of the figure targeted the oxycline.