Telephone, Micro-electronic, and Generator-powered Electrofishing Gear for Collecting Flathead Catfish[1]

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Abstract: Flathead catfish (*Pylodictis olivaris*) in Oklahoma lakes and rivers were sampled using gasoline-powered generators with variable voltage pulsators (VVP), magneto "telephone" generators, and micro-electronic "pacemaker" electrofishing devices. VVP gear produced the highest numbers of flathead observed surfacing (O/f) and collected (C/f) per electrofishing attempt. Telephones and pacemakers produced somewhat lower O/f and C/f values but length frequencies were similar to VVP samples. Pulse frequencies of 20 Hz appeared to be the most critical electrical output parameter influencing catch rates, with electrode configuration, site selection, and water temperature also being contributing factors. Assistance of a "chase" boat to aid picking up surfacing catfish is recommended for all gear.

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Oklahoma anglers have recently shown increased interest and concern regarding flathead catfish (*Pylodictis olivaris*) sport fisheries throughout the state (Summers 1986). Current Oklahoma Department of Wildlife Conservation (ODWC) standardized sampling procedures (Erickson 1978) have been found to be inadequate for assessing flathead populations. Historical data have been collected primarily because of the value of this species in commercial fisheries (Jenkins 1952, McCoy 1953, Turner and Summerfelt 1971, Weeks and Combs 1981). These data were often biased by gear selectivity. Biologists felt that more efficient and non-size selective sampling methods were needed to better manage this species.

Magneto telephone generators have been used for collecting various species of catfish (Brown and Dendy 1961, Morris and Novak 1968, Bamberg 1973, Guier et al. 1981, Hale et al. 1984). These "telephones" generate high AC voltage with low pulse frequencies (Corcoran 1979). Weeks and Combs (1981) found gasoline generator-powered variable voltage pulsators (VVP) units to be highly successful in

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collecting catfish, as have Nelson and Little (in press), J. Robinson (pers. commun., Mo. Dep. Conserv.), and G. Zuerlein (pers. commun., Neb. Game and Parks Comm.). Micro-electronic fish-shocking devices confiscated by wildlife law enforcement personnel in Texas (Hensley 1981) and Oklahoma (D. Musgrove, pers. commun., ODWC) have not been tested as sampling tools. These "pacemakers" are small, effective, inexpensive (components cost <$5.00), and easy to make. Quinn (1986) tested sophisticated custom-made solid state units with variable output control. Our study was developed to evaluate pacemakers and telephones and compare them with VVP gear to determine their value for sampling flathead catfish.

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Methods

Lakes Ellsworth, Ft. Gibson, Overholser, Thunderbird, Texoma, Waurika, and Wister, and sections of the Arkansas and Washita rivers were electrofished for flathead catfish from June through August 1985 and May through September 1986 using VVP, telephone, and pacemaker gear.

VVP electrofishing was conducted using a Coffelt VVP-15 with 125 V pulsed-DC output (Table 1). The electrode array for the VVP-equipped boat was similar to that described by Novotny and Priegel (1974) with 6 2-m long ring-mounted anode cables and 8 1-m long cathode cables suspended from the gunwales.

Table 1. Electrical output characteristics of electrofishing devices used for sampling flathead catfish during 1985 and 1986 showing output voltage (V), current (A), pulse frequency (Hz), and pulse width (%).

Variable Voltage pulsator:
Coffelt Model VVP-15[a]—125 V pulsed DC, 5 A, 20 Hz, 20% pulse width
Magneto Telephone generators:
Motor-driven telephone—51 V AC, 90 mA, 14 Hz
Motor-driven tractor magneto—24 V AC, 80 mA, 16 Hz
Hand-cranked telephone—63 V AC, 200 mA, 14 Hz
Micro-electronic pacemakers:
10 S – 14 V pulsed DC, 100 mA, 10 Hz, 50% pulse width
10 L – 14 V pulsed DC, 125 mA, 18 Hz, 66% pulse width
20 S – 17 V pulsed DC, 100 mA, 20 Hz, 50% pulse width
20 L – 17 V pulsed DC, 125 mA, 40 Hz, 66% pulse width
60 S – 18 V pulsed DC, 125 mA, 60 Hz, 50% pulse width
60 L – 18 V pulsed DC, 200 mA, 80 Hz, 66% pulse width

[a]Does not imply endorsement of any manufacturer's product.
S = short pulse width.
L = long pulse width.

Telephones, which were used both years, and pacemakers, used in 1985, had been confiscated by ODWC Law Enforcement Division. Hand-cranked and motor-driven magneto telephone generators had outputs of 24 to 63 V AC (Table 1). Because confiscated pacemakers failed frequently in 1985, the device used in 1986 was constructed by ODWC Radio Division personnel based on schematic diagrams obtained from Texas Parks and Wildlife Department (E. Simmons, pers. commun.). This single device, powered by a 12-V marine deep-cycle battery, had variable output control simulating 6 pacemakers with outputs of 14 to 18 V DC, 10 to 80 Hz (Table 1). Electrodes for telephones and pacemakers consisted of 2 7.6-m lengths of 16 gauge insulated wire thrown out on opposite sides of the boat (short lengths of chain were added for weight). These electrodes were later replaced with 2 1-m long uninsulated cables hung over the boat's bow and gunwale.

Electrofishing methods consisted of a series of 3-minute attempts (units of effort) per gear type at sites located in likely flathead catfish habitat (rock riprap along dams and bridge right-of-ways; bends along timbered creek channels; steep, rocky or clay banks; and points). The electrofishing boat was held stationary 2 to 10 m offshore during each attempt as suggested by Weeks and Combs (1981) and J. Robinson (pers. commun., Mo. Dep. Conserv.). Each site was electrofished with each gear on different dates. When additional personnel were available, a pick-up or "chase" boat assisted in spotting and netting surfacing catfish.

Data recorded included number of flathead observed (O), and collected (C) per unit of effort (f) and total length (mm) for all catfish captured. Percent collected, O/f, C/f, and length frequencies for each gear type and body of water were calculated. Statistical analyses included *t*-tests (Steele and Torrie 1960) for comparisons of O/f and C/f and Chi-square tests of homogeneity (Snedecor and Cochran 1976) for length frequency comparisons a significance level of $P \leq 0.05$ was assumed for all tests.

Results

Catfish would usually surface within 45 seconds after we began electrofishing and often remained on the surface for 60 to 90 seconds, either stunned and floating motionless or swimming erratically.

The 10 L (18 Hz) and 20 S (20 Hz) settings on our pacemaker had the longest pulse durations and slightly higher O/f and C/f. No significant differences were found, however, among O/f and C/f with the 4 low pulse frequency pacemaker settings. Therefore, results for all pacemaker trials for a given lake or year were pooled for comparisons. No catfish were collected with the high pulse frequencies (60 S and 60 L) as is often the case with VVP gear set up for collecting scaled fishes.

Sampling was most extensive on lakes Thunderbird and Overholser, making these results most meaningful. Electrofishing on Lake Thunderbird (Table 2) with VVP gear produced significantly higher mean O/f in 1986 (3.0) and mean C/f both years (0.7 and 1.4 in 1985 and 1986, respectively) than did telephones or pace-

Table 2. Flathead catfish collected from lakes Thunderbird and Overholser during 1985 and 1986, using various electrofishing gear; attempts made (f), number (and mean per attempt) of fish observed surfacing (O), number (and mean per attempt) collected (C), and the collection percentage (%).

Year and gear	Attempts	*N* observed (mean O/f)	*N* collected (mean C/f)	Percent collected
Thunderbird 1985 (260 umhos/cm)[a]				
VVP	50	67 (1.3)	36 (0.7)*	53
Pacemaker	16	11 (0.7)	2 (0.1)	18
Telephone	64	49 (0.8)	19 (0.3)	30
Thunderbird 1986				
VVP	7	21 (3.0)*	10 (1.4)*	48
Pacemaker	70	66 (0.9)	14 (0.2)	21
Telephone	39	71 (1.8)	25 (0.6)	35
Overholser 1985 (900 umhos/cm)[a]				
VVP	53	104 (3.0)	73 (1.8)*	70
Pacemaker	43	25 (0.6)	9 (0.2)	36
Telephone	51	112 (1.9)	46 (0.9)	41
Overholser 1986				
VVP	6	49 (8.2)*	23 (3.8)*	47
Pacemaker	75	267 (3.6)	121 (1.6)	44
Telephone	59	109 (1.8)	37 (0.6)	34

*Significantly different from other values at $P \leq 0.05$.
[a]Mean water conductivity.

makers. Ranked by collection percentage, VVP gear was the most efficient (53 and 48% for 1985 and 1986, respectively), followed by telephones and pacemakers, respectively.

On Lake Overholser, mean VVP O/f (8.2 in 1986) and C/f (1.4 and 3.8 in 1985 and 1986, respectively) were significantly higher than for other gear types (Table 2). Telephones produced significantly higher mean O/f and C/f than pacemakers in 1985; however, 1986 results were reversed. VVP electrofishing ranked first in collection efficiency (70% in 1985 and 47% in 1986), followed by telephones in 1985 (41%) and pacemakers in 1986 (44%).

Further testing of telephones and pacemakers on lakes Ellsworth, Ft. Gibson, Texoma, Waurika, and Wister, and the Arkansas and Washita rivers confirmed results from lakes Thunderbird and Overholser. VVP electrofishing was not included in these tests because the gear had proven itself in our previous tests and in work done by Weeks and Combs (1981). Combined results showed telephones produced higher overall O/f and C/f than did pacemakers (0.8 and 0.2, respectively for telephones and 0.4 and 0.1, respectively for pacemakers; Table 3). Ranked by collection percentage, telephones had a slightly higher overall efficiency than pacemakers (means of 28 and 20%, respectively).

Total lengths of flathead catfish collected ranged from 60 mm to over 700 mm. While sample sizes between gear were different, with VVP gear providing higher catch rates, length frequencies by gear from lakes Thunderbird and Overholser dur-

Table 3. Flathead catfish collected from all other study lakes and rivers during 1986 using various electrofishing gear; attempts made (f), number (and mean per attempt) of fish observed surfacing (O), number (and mean per attempt) collected (C), and the percent collected.

Year and gear	Attempts	*N* observed (mean O/f)	*N* collected (mean C/f)	Percent collected
Ellsworth (400 umhos/cm)[a]				
Telephone	23	29 (1.3)	8 (0.3)	28
Ft. Gibson (175 umhos/cm)[a]				
Telephone	12	9 (0.8)	3 (0.3)	33
Texoma (1150 umhos/cm)[a]				
Pacemaker	36	15 (0.4)*	1 (0.1)	7
Telephone	17	1 (0.1)	0 (0.0)	0
Waurika (450 umhos/cm)[a]				
Pacemaker	48	27 (0.6)	7 (0.2)	26
Telephone	18	15 (1.2)	3 (0.2)	20
Wister (50 umhos/cm)[a]				
Pacemaker	7	1 (0.1)	0 (0.0)	0
Telephone	10	14 (1.4)	4 (0.4)	29
Arkansas and Washita rivers (1750 and 900 umhos/cm)[a]				
Pacemaker	14	2 (0.1)	1 (0.1)	50
Telephone	47	31 (0.7)	10 (0.2)	31
Telephone total	127	99 (0.8)*	28 (0.2)	29
Pacemaker total	105	45 (0.4)	9 (0.1)	20

*Significantly different from other values at $P \leq 0.05$.
[a]Mean water conductivity.

ing 1985 and 1986 showed no statistical differences (see example length frequencies in Fig. 1).

Mean catch per month by gear for all lakes pooled for both years showed an increase in C/f through September (Fig. 2). When catch rates were compared to temperature, peaks were recorded at 24° C for pacemakers and telephones, and at 27° C for VVP gear.

Conductivities of 50 to 1,750 umhos/cm were encountered in this study (Tables 2, 3) with no apparent trend in effectiveness for any gear. Catfish were successfully collected in lakes with relatively low conductivity (260 umhos/cm at Thunderbird) and high conductivity (1750 umhos/cm on the Arkansas River) by each gear type. We observed a decrease in apparent electrical field size of pacemakers and telephones with high conductivity but shocking effectiveness within that field appeared undiminished. VVP gear produced a much larger field size with fish often surfacing up to 50 m away.

Discussion

Number of flathead catfish observed per attempt with each gear may give a more accurate representation of the effectiveness of the gear since a chase boat was

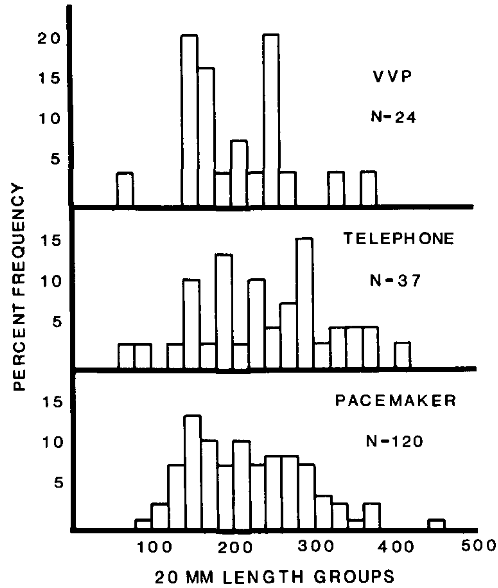

Figure 1. Length frequency relationships of flathead catfish collected from Lake Overholser during 1986 using VVP, pacemaker, and telephone electrofishing gear.

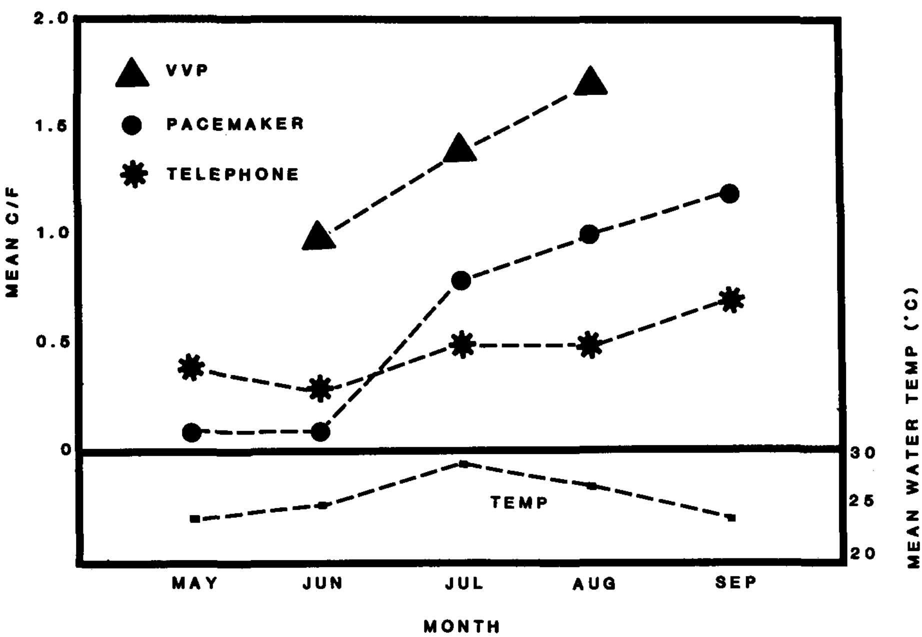

Figure 2. Mean monthly catch of flathead catfish per electrofishing attempt (C/f) by various gear (all lakes combined) during 1985 and 1986 and mean monthly water temperatures.

not always available. The second boat increased the collection percentage and the C/f but had no influence on the O/f values. Assistance of a chase boat would be needed for management sampling purposes because excessive shocker boat movement (either intentional or wind drift) reduced electrofishing effectiveness. However, the gear comparisons and methods developed in this study would still be applicable in more extensive population studies.

All 3 types of electrofishing gear tested provided statistically similar length frequencies with little apparent selectivity towards or against particular length groups. Weeks and Combs (1981) also found little size or age selectivity with VVP gear. Unlike Morris and Novak (1968), Bamberg (1975), and Quinn (1986), no reduction in efficiency of stunning small flathead (<150 mm TL) was seen. Perhaps this was due to sampling primarily in lakes where currents were not a factor.

Successful use of VVP gear with outputs similar to those used in this study were reported by Corcoran (1979), J. Robinson (pers. commun., Mo. Dep. Conserv.) and G. Zuerlein (pers. commun., Neb. Game and Parks). Magneto telephone generators were useful for collecting flathead catfish and although no size selectivity relative to other gear was seen, catch rates and collection percentages were lower than for VVP gear. Fish did not stay on the surface as long as with VVP gear making netting more difficult. We saw no apparent differences in mean O/f or C/f using the 63-V telephone or the 24-V tractor magneto. Morris and Novak (1968) recommended a 24- to 38-V telephone, but Hale et al. (1984) reported success with 16- to 18-V telephones, and Bamberg (1973) used a 55-V telephone similar to one used in this study.

Hensley (1981) reported that confiscated illegal micro-electronic shocking devices had 9- to 12-V output with frequencies of 18 to 20 Hz. Quinn (1986) reported peak effectiveness of custom-made battery-powered shockers to be at 20 Hz and 0.4 to 0.5 ms pulse width. Corcoran (1979) found longer pulse widths caused flathead to remain on the surface longer, while shorter pulses caused more thrashing (making them easier to see in turbulent water but not staying on the surface as long). Our 10 L (18 Hz) and 20 S (20 Hz) pacemaker settings and the tractor magneto "telephone" had the longest pulse durations of the gear tested and correspondingly higher mean O/f and C/f.

Morris and Novak (1968), Bamberg (1973), and J. Robinson (pers. commun., Mo. Dep. Conserv.) used 3- to 5-m long insulated electrodes. Quinn (1986) used a 12-m anode cable with the boat hull as a cathode. Our preliminary shocking with all gear employed 7.6-m long insulated cable or wire electrodes. Boat handling was difficult and did not allow pick-up of fish surfacing nearby and electrodes frequently snagged. Later conversion to shorter electrodes (1 to 2 m long) increased boat maneuverability and collection percentage increased with no apparent decrease in O/f. This arrangement proved as effective as long electrodes in waters up to 6 m deep and was especially important when a chase boat was unavailable.

As reported by Weeks and Combs (1981), Hale et al. (1984), Quinn (1986), J. Robinson (pers. commun., Mo. Dep. Conserv.) and G. Zuerlein (pers. commun., Neb. Game and Parks) electrofishing in suitable habitat was a key to sampling success. Knowledge of the lake or river to be sampled was helpful as was advice from local anglers and law enforcement personnel in locating likely catfish habitat on bodies of water not previously sampled.

Although seasonal effects were not investigated in this study, the data showed C/f increased with temperature. No conclusions can be made about minimum temperatures required for successful shocking as were noted by Weeks and Combs (1981) and Morris and Novak (1968). We did, however, see peaks in C/f similar to Morris and Novak (1968), Bamberg (1973), and Hale et al. (1984) at 24° C for telephones and pacemakers and 27° C for VVP gear.

Water conductivities had some effect on the size of the electrical fields and consequently the shocking efficiency of the various gear. In higher conductivities (>500 umhos), higher voltages available with VVP gear appeared more successful in stunning catfish at greater distances. Conductivities from 80 to 1,100 umhos/cm are reported by other authors (Hale et al. 1984, Quinn 1986) with little indication of its effect. Our varied results in both high and low conductivities seemed to indicate that many factors may influence gear effectiveness.

Summary

Generator-powered VVP, telephone, and pacemaker electrofishing equipment was suitable for collecting flathead catfish in the reservoirs and rivers sampled. Representative samples were obtained with each gear using the electrical outputs described. Stationary shocking for 3 minutes per attempt in suitable habitat with assistance of a chase boat is recommended for all gear.

Telephones and pacemakers proved successful in stunning fish but the collection efficiency was lower than with VVP gear because the fish did not remain on the surface as long making them more difficult to net. Satisfactory (albeit smaller) samples, portability, low cost, and easily modified output make pacemaker units practical sampling tools if access for VVP equipped boats is unavailable.

Pulse frequencies of 20 Hz are recommended for all gear when flathead catfish are the target species, but further experimentation with variable pulse widths may improve the ability of these devices to stun and hold fish on the surface longer for netting.

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