Shielded-needle Technique for Surgically Implanting Radio-frequency Transmitters in Fish

Surgically implanted radio-frequency transmitters are preferable to external transmitters for experiments on fish in dense aquatic vegetation (Stasko and Pincock 1977). The performance of the implanted transmitter is improved by adding a protruding whip antenna, which results in (1) reducing the size of the transmitter; (2) providing a longer range for a given power output, and (3) requiring less critical tuning. Provision of an outlet for the antenna through the body wall has presented some problems, but Winter et al. (1978) described a technique in which a knitting needle was used to tunnel a cavity under the skin. However, we found this method somewhat difficult to use on fish with abdominal pelvic fins because of difficulty in tunneling past the pelvic girdle without piercing vital organs or the skin. To overcome this problem, we developed a shielded-needle technique to guide an antenna made of 24- or 26-gauge Teflon-coated conductor wire along the intestine under the pelvic girdle (Fig. 1).

A 3-cm incision was made along the linea alba anterior to the pelvic girdle on an anesthetized fish (Hart and Summerfelt 1975). A half-curved veterinary needle (Miltex No. 1291, size 0), shielded (to protect

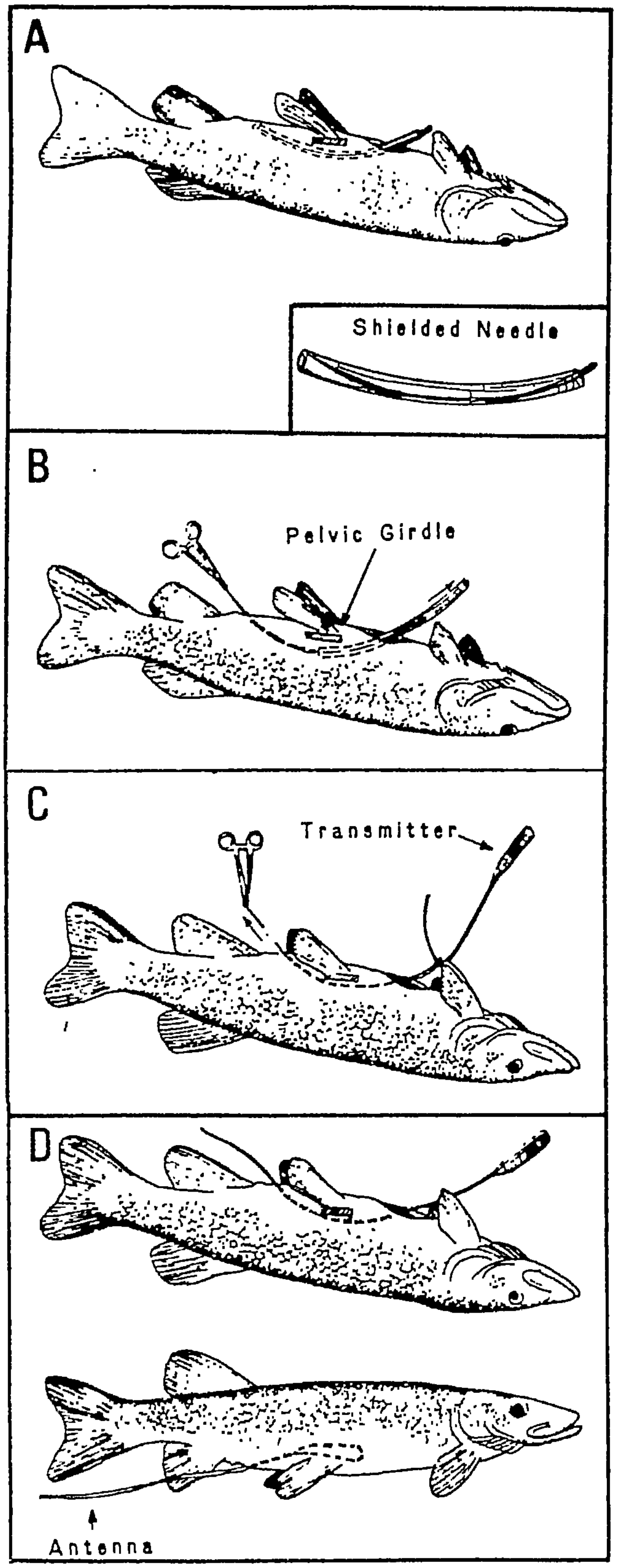

Fig. 1. A shielded-needle technique for surgically implanting radio transmitters with whip antennas in fish.

internal organs) with 0.5-cm plastic tubing from the tip to 1 cm in front of the eye of the needle (Fig. 1A), was inserted posteriorly along the intestine, past the pelvic girdle. Slight anterior tension was then put on the needle to free the tip from the inside wall of the plastic tubing and the needle was pushed forward and upward, piercing the skin midway (about 1 cm) between the pelvic girdle and the anus (Fig. 1B). The needle was held in place with needle-holder forceps, and the tubing removed by pulling it anteriorly over the eye of the needle. The whip antenna on a radio transmitter was threaded through the eye and the needle pulled posteriorly, out through the flesh (Fig. 1C). The transmitter was inserted through the original incision and positioned lengthwise in the peritoneal cavity (Fig. 1D). The incision and antenna exit hole were then sutured with noncapillary, nonabsorbable suture material.

This technique has been used on several species (Table 1), including some with thoracic ventral fins, because of the flexibility afforded for transmitter placement. The data show that fish lived a minimum of 28 days, and one was observed more than 18 months after the transmitter was implanted, indicating that major damage to the internal organs had not occurred. Best results were obtained when fish were captured, tagged, and returned immediately to an open lake environment. Fish returned to a confined area did not survive as well as those in the open waters. Using a similar technique, Kuechle et al. (1981) also reported mortalities in both control and test groups of white suckers (*Catostomus commersoni*) in a confined area.

Problems commonly encountered with surgically implanting tags in small fish noted by Prince and Maughan (1978) included poor recovery, damage to organs, and slow healing. All of our fish recovered within 20–25 min from the MS-222 anesthetic and were swimming normally. In our studies, tissue damage was decreased when we used smaller transmitter-to-fish size ratios. Although conditions may vary among species, we believe the transmitter sizes used for the small muskellunge (*Esox masquinongy*) and northern pike (*E. lucius*) used in the present study (Table 1) are close to the upper limit of transmitter-to-fish size and weight ratios; the transmitter weight was about 1.7% of the fish weight. Three of four flathead catfish (*Pylodictis olivaris*) held in water at 4°C died before the incision healed. Similar problems were not, however, reported by Hart and Summerfelt (1975), who worked with this species. Walleyes (*Stizostedion vitreum vitreum*) and surviving white suckers were healed within 30 and 45 days, respectively (Kuechle et al. 1981).

Our technique enables the transmitter to be positioned anywhere in the peritoneal cavity, which reduces healing problems and the damage to vital organs that may occur when the transmitter is placed

Table 1. Summary of data on use of the shielded-needle technique for planting radio-frequency transmitters in fish.

Species	Fish: Range: Lengths (cm)	Fish: Range: Weights (kg)	Fish: No. tagged	Transmitter: Weight (g): Dry	Transmitter: Weight (g): In H_2O	Transmitter: Length (cm)	Transmitter: Diameter (cm)	Transmitter: Antenna length (cm)	Observation period (days)[a]	Mortalities (no.)	Environment[b]
Muskellunge (*Esox masquinongy*)	85–122	4.8–12.7	14	65	40	6.9	3.2	61	547	1	L
Flathead catfish (*Pylodictis olivaris*)	67–86	3.9–8.2	4	65[c]	40	6.9	3.2	46	65	3	HP
Walleye (*Stizostedion vitreum*)	63–73	3.2–4.5	3	21[c]	12	5.0	1.8	46	23	0	HP
Muskellunge	50–53	0.8–1.0	9	21	12	5.0	1.8	31	75	1	L
Northern pike (*Esox lucius*)	50–59	0.7–1.1	4	21	12	5.0	1.8	31	75	0	L
Walleye	41–49	0.5–0.9	11	9	4	3.5	1.1	23	28	4	ESC

[a] Observations of the larger muskellunge (85 – 122 cm) continued for 18 months; studies of the smaller muskellunge (50 – 53 cm) and northern pike are continuing.
[b] L = lake; HP = holding pond; ESC = experimental stream channels.
[c] Dummy transmitters.

at the incision or anterior to it. In contrast, the technique of Winter et al. (1978) does not permit transmitter placement posterior to the incision without a 180° bend in the antenna, since the tunnel begins at the posterior end of the incision. The shielded-needle technique also appears to be less traumatic than the Winter technique and requires substantially less force on the needle than tunneling between tissue layers, especially near the pelvic girdle.

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—Marvin Jon Ross, *University of Minnesota, Department of Ecology and Behavioral Biology, Minneapolis 55455;* and Charles F. Kleiner, *U.S. Environmental Protection Agency, Environmental Research Laboratory-Duluth, 6201 Congdon Boulevard, Duluth, Minn. 55804.*