A Modified Floating-Fish Snare for Capture of Inland Bald Eagles

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In our studies of the foraging ecology of Bald Eagles (*Haliaeetus leucocephalus*) in California and Arizona (Hunt et al. 1992a, 1992b, Jenkins 1992), we used various floating-fish snares to capture 30 adult Bald Eagles for transmitter attachment and color banding. Problems with approaching wary eagles by boat without flushing or alerting them, combined with their aversion to monofilament nooses on inland reservoirs, led us to modify previously reported techniques. Cain and Hodges (1989) described a 4-noose, floating-fish snare modified from the original single noose floating fish used by Robards (1966) in Alaska and a bi-lateral, 2-noose system used by Frenzel and Anthony (1982) in Oregon to capture Bald Eagles on open water. We experimented with these designs, but were unable to achieve reported success rates (≥50%; see Cain and Hodges (1989) for review of reported success rates).

During efforts to construct a reliable floating-fish snare, we tried many other designs (n>30) by varying the following: size of bait fish (10 cm to over 500 cm total length), bait fish shape (deep-bodied, cylindrical, flat-bottomed), number of nooses (1-6), noose position on the fish (both in and out of the water and at various angles to the longitudinal axis of the fish and to the surface of the water), noose size (approx. 8 cm to 15 cm), monofilament breaking strength (14-27 kg test), and monofilament color (clear, green, brown). Noose position and number seemed particularly important since the eagles were apparently trying to avoid the monofilament (see below), regardless of color.

We occasionally captured eagles with certain configurations, including those described by previous authors; however, we abandoned a particular design after multiple failures or refusals. A single-noose design, similar to Robards' (1966) method, was rarely successful for us (n=35 attempts, 9% capture rate). We had moderate success (n=10 attempts, 20% capture rate) with another design: a single-noose attached to the side of a small (10 cm) sunfish (Centrarchidae). The configuration described in this paper attracted and captured eagles most consistently.

We prepared floating fish with carved styrofoam plugs using methods described by Frenzel and Anthony (1982) and Cain and Hodges (1989); however, we inserted the floatation plug mostly into the anterior portion, rather than the entire body cavity, allowing the tail of the fish to droop more deeply below the surface of the water (Figure 1). For each noose we tied a slip knot, shown in Figure 1a (R. Frenzel, pers. comm.), at one end of approximately 1.5 m of 18 kg (40 lb) test light green monofilament, leaving a 2 cm end tab. The end tab provided enough line for this knot to tighten completely, after the eagle was snared. When tied correctly, slip knots held the noose shape, but slid along the monofilament with minimum friction, and completely unraveled if pulled through. Thus, unsnared eagles could more easily separate the fish from the nooses than with previously described knots (Cain and Hodges 1989). This allowed uncaptured, monofilament-wary eagles to be rewarded with the fish making them more inclined to seize another bait fish.

We placed two nooses in an alternate/lateral position (Figure 1b) that allowed maximum coverage of the exposed fish surface with the fewest nooses. Noose diameters were similar to those used by previous authors (10 - 12 cm). We used a large upholstery needle to feed the free end of each noose into the ventral surface of fish and through the styrofoam plug to exit dorsally. A slight bending of the monofilament near the slip knot and placement of small staples (one per noose, see Cain and Hodges 1989) kept the nooses flat on the fish's ventral surface. Slight bending did not noticeably weaken monofilament during our informal tests of breaking strength; the monofilament invariably broke at a knot, characteristically the weakest point. Risking entanglement, we left all fins intact for a more natural presentation of the bait; however, we sewed the left pectoral fin to the body with light monofilament to help prevent it from entangling the anterior noose (Figure 1b). Bait fish were stored in a small cooler and positioned to allow nooses to remain flat against the ventral surface.

We used large (approx. 40 cm total length), suckers (*Catostomus* spp.) or catfish (*Ictalurus* spp.) as our preferred bait. We believe that covering a large amount of the fishes' flat ventral surface laterally with the nooses (distance "x" in Figure 1b) and presenting only the noosed portion of the fish at the surface (tail drooped) contributed to our success with this design. In our experience, the use of larger fish forced eagles to grasp baits more deeply; small fish appeared to be taken just with talons, not fully grasped by the eagles. These factors seemed to allow the noose to fully snare the distal phalanx. In addition, we observed that large fish were usually ignored by common non-target bird species (e.g., Osprey *Pandion haliaetus*, gulls *Larus spp.*, Common Mergansers *Mergus merganser*) known to foul floating-fish snares (Frenzel and Anthony 1982, Cain and Hodges 1989, A. Harmata pers. comm.).

To increase our chances of an early strike and reduce the potential for interference by non-target species, we typically set out two or three fish snares just before dawn at habitual foraging sites, observable from one location in a boat. We used fixed anchors to avoid drifting sets or trapped eagles swimming to shore on the narrow reservoirs. The anchor system consisted of a 4.5 kg barbell weight connected to a 1.5 m length of heavy (1.1 cm dia.) nylon-jacketed shock cord with an overhand knot tied at the free end (Figure 1c). The large shock cord helped alleviate problems with eagles breaking nooses in shallow water (.5 to 3 m deep). Also connected to the anchor weight was about 25 m of brown nylon cord tied to a section of monofilament (approximately 5 m of 11 kg (25 lb) test) attached to a large cork (Figure 1c). The cork and cord allowed us to retrieve anchors if the eagle escaped with the bait fish, and facilitated anchor placement in deep water. We stacked anchor and lines, cork end first, into large (approx. 14 cm x 18 cm x 30 cm) army surplus ammo boxes to transport sets and facilitate bait placement.

During bait placement, we tied 27 kg (60 lb) test monofilament from a large spool to the free end of the shock cord below the knot using an improved clinch knot with 3.5 twists (a common fishing knot; Kreh and Sosin 1972). Holding the nylon cord, we lowered the anchor weight out of the boat to the lake bottom. We achieved a stable anchor position by sounding with the anchor line to find a relatively flat bottom profile and allowed the anchor to settle into mud or sand without contacting rocks (the sound of the iron anchor contacting rocks is audible even through deep water). Because of the possibility of an eagle dislodging the anchor and sinking into deeper water when captured, we avoided areas with steep or uneven bottom profiles. We next tied a double surgeon's loop (double the line, make an overhand knot, pass the loop through the knot again and tighten; Kreh and Sosin 1972) to the end of the 27 kg test monofilament and tied the two noose ends from the bait fish to this loop using improved clinch knots with five twists. To avoid abrasion, all knots were moistened before tightening. Knot type and quality are important when working with monofilament; see Kreh and Sosin (1972) or consult a fishing guide or expert for more information.

In deep water, we left about 1 m of slack in the shock system to allow for wave action and water level fluctuations on reservoirs. In shallow water the shock cord itself was also lightly weighted or covered by the bottom substrate (i.e., sand or mud) to reduce visibility. We placed the retrieval cork as

far from the bait as possible. Once captured, we used a large salmon landing net to carefully scoop the eagle into the boat.

The alternate/lateral floating-fish snare was successful in capturing Bald Eagles in 17 of 43 events where eagles tried to grasp this bait (40% capture success). We eliminated nine additional events from the success rate calculations where eagles purposely struck the fish, apparently attempting to dislodge the monofilament nooses. When exhibiting this behavior, eagles hit the bait fish with their talons without grasping it, often ripping portions of the flesh and sometimes flipping the fish out of the water. Eagles seizing the fish but not caught in the nooses were rewarded with the fish (n=9); snapped nooses when grasping the bait (n=4, usually in shallow water); could not separate the fish from the nooses (n=7, e.g., due to snared fin); were caught briefly but escaped (n=2, noose probably closed on talon only); or the bait disappeared (n=4, probably unseen forages by eagles or interference by other species).

The modifications we described to the floating-fish snare were designed as a compromise between circumventing the aversion that certain resident adult Bald Eagles have toward monofilament and achieving a reasonable capture rate. Shyness toward monofilament possibly derives from previous encounters with fishing line attached to fish or entangled on shoreline perches. Eagles also became wary of noosed fish from previous captures and near captures, or when they had difficulty pulling fish off the snare line. In addition to attempts to dislodge monofilament, some monofilament-wary eagles apparently tried to avoid the nooses when taking the bait fish, as evidenced by their flight patterns around the bait set prior to grasping it. Other birds avoided floating-fish snares entirely. To limit visibility of monofilament, yet maximize coverage of exposed surfaces, we used only two nooses, configured alternate/laterally. By drooping the posterior section of a large fish, we reduced the eagle's access to the only portion of the fish not covered by nooses. We set baits in shaded areas when possible; trapping was most effective during early morning hours before sunlight illuminated the monofilament.

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Figure 1.

a) slip knot
b) alternate/lateral noose configuration
c) anchored floating-fish snare