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Commentary

Modifications of Traps to Reduce Bycatch of Freshwater Turtles

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ABSTRACT Mortality of freshwater turtles varies among types and deployments of traps. There are few or no losses in hoop or fyke traps set where turtles may reach air, including placement in shallows, addition of floats on traps, and tying traps securely to a stake or to shore. Turtle mortality occurs when traps are set deep, traps are checked at intervals >1 day, and when turtles are captured as bycatch. Devices are available that exclude turtles from traps set for crab or game fish harvest. Slotted gates in front of the trap mouth reduce turtle entry, but small individuals still may be trapped. Incidental take of turtles is preventable by integrating several designs into aquatic traps, such as adding floats to the top of traps so turtles may reach air or an extension tube (chimney, ramp) that creates an escape route. © 2011 The Wildlife Society.[†]

KEY WORDS bycatch, flotation devices, fyke traps, hoop traps, mortality, turtles.

Freshwater turtles are important components of many aquatic ecosystems in North America due to their abundance, large biomass, and longevity (Bury 1979, Congdon et al. 1986, Moll and Moll 2004). Turtles cannot withstand heavy losses and maintain their numbers given their slow rates of maturation and reproduction (Ernst and Lovich 2009). Many turtle species are threatened with extinction or declining in numbers around the globe, and there is increasing concern over their continued persistence (Gibbons et al. 2000, Klemens 2000). In North America, several species of turtles are harvested with little knowledge of their population status and trends (e.g., Moll and Moll 2004, Schlaepfer et al. 2005).

Traps and nets set to harvest fish in large rivers or reservoirs may incidentally catch and drown turtles (Fratto et al. 2008*a*). In the Upper Mississippi River of Missouri and Illinois, 10.3% of 2,584 captured turtles died in passive fishing traps submerged for ≥1 day (Barko et al. 2004). Hundreds of freshwater turtles died in traps set in deep waters in Missouri until a metal grate added to the trap reduced the catch of large-sized turtles (Fratto et al. 2008*a*).

Several modifications to small, baited hoop traps set in deep waters will exclude turtles (Fratto et al. 2008*b*). A chimney design (i.e., a chute made of netting) allowed turtles to surface for air and escape, reducing mortality by 83% compared to traps lacking this modification. This design is one of the first attempts to create turtle exclusion or bycatch reduction devices for hoop-nets deployed in freshwater systems.

I reviewed literature describing freshwater turtle capture in traps, exclusive of papers published before the 1940s and non-published theses. My objectives were to: 1) summarize the literature on sampling freshwater turtles with different trap designs, 2) identify those practices causing mortality of turtles in traps, and 3) suggest several trapping modifications to prevent drowning of turtles in traps.

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TRAPS DESIGNS WITH LITTLE OR NO MORTALITY

Thousands of turtles have been trapped for mark and release studies (e.g., Gibbons 1968, Ernst 1971, Vogt 1980, Trauth et al. 2004, Dorcas 2005), including several long-term monitoring projects (e.g., Plummer 1977, Congdon and Gibbons 1996, Pappas et al. 2000) with no or few turtle mortalities. I found >30 studies using techniques and protocols to prevent mortality of freshwater turtles caught in traps, mostly extruding part of the trap above the water to allow turtles to breathe. The best trap results are obtained when turtle traps are anchored to the bottom with iron bars or wood stakes driven down through the ends of the trap and into the mud, are set so that the tops of the hoops are just out of water, and sealed plastic pipe or boards are tied along the sides of the hoops to keep the trap rigid and afloat (Lagler 1943, Conant 1975). Other investigators set baited traps secured to stakes in shallow waters where turtles can surface for air inside traps (e.g., Legler 1960, Iverson 1979, Zweifel 1989, Spencer 2002, Boundy and Kennedy 2006). Plastic pool floats or a column placed inside the trap provides access to airspace at the top of the trap (Bury and Germano 2003, Georges et al. 2006, Outerbridge 2008). Submerged traps should be checked every 8–12 hr to prevent captives from drowning (Mount 1975, Kuchling 2003).

Airspace can be ensured in large turtle traps with floats (e.g., air-filled plastic bottles) placed inside or side floats constructed of wood and folded Styrofoam and, for dome-shaped collapsible traps, bicycle inner tubes secured around the outside of traps to serve as floats (Fig. 1). Traps tied to a vertical stake or solid objects on shore keep the trap in place. Collapsible traps may be set in shallow water without floats, with the "dome" above the water line and tied to shore objects to prevent movement into deeper water. To date, we have captured >5,000 turtles in the last 3 decades with 2 fatalities attributed to turtle entanglement in the mesh (R. B. Bury, U.S. Geological Survey, unpublished data). Although mortalities are infrequent, they should be reported to increase knowledge about survival rates in the various trapping methods.

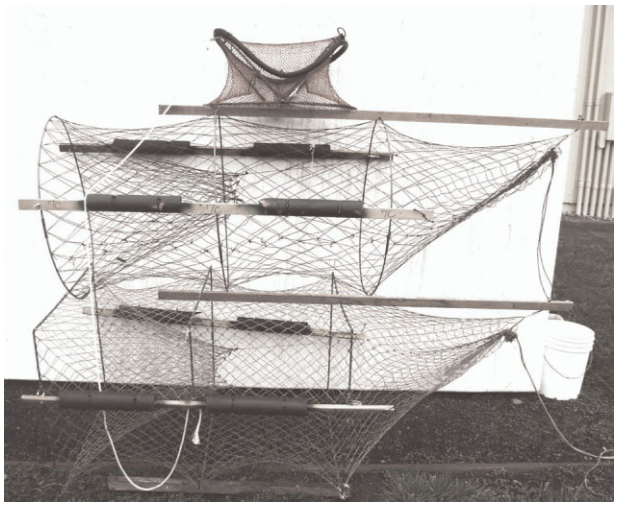

Figure 1. Top: Dome-shaped trap with outside float of attached bicycle inner tube. This crayfish and fish trap is collapsible and portable. Bottom: Two varieties (round and rectangular) hoop traps with stretchers and floats on outside sides. Both types of traps catch turtles and are available from several commercial netting-supply houses.

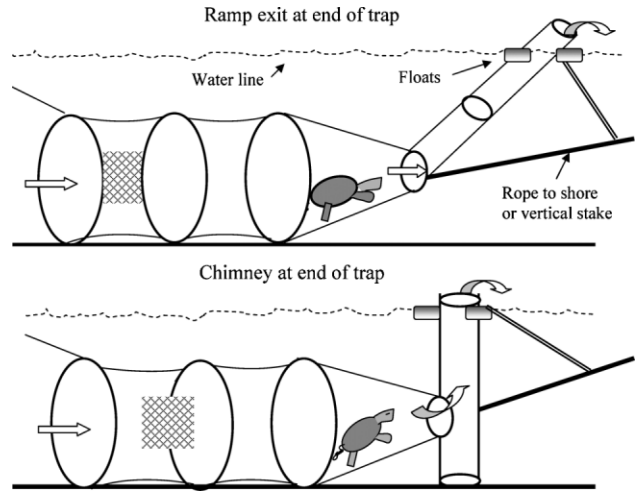

Figure 2. Proposed designs to reduce or eliminate catch of turtles in large-sized fyke traps. A tube of netting or metal mesh is attached to the rear opening of the trap to serve as a ramp (along incline) or a chimney (vertical) escape route for turtles. Attach floats to tube opening at surface.

Turtles can remain underwater for extended periods (Ultsch et al. 1984); however, survival decreases with increasing temperatures. Check traps more frequently in warmer weather. One of our traps slipped into deep water during trapping on a warm summer night in southern Oregon. We found 12 lethargic or non-responsive turtles in this trap the next morning. We drained water out of their mouths and throats and placed turtles on the shore in the shade. Most ($n = 10$) were revived after 1–6 hr and all the turtles appeared fully recovered after 18 hr (kept overnight). Further research is needed to determine if drowned turtles can be revived by placing them on shore in shaded, protected containers.

MODIFICATIONS TO FISH AND CRAB TRAPS TO DECREASE BYCATCH

Fyke traps used to capture fish contain a rectangular fore-trap with large metal supports (e.g., 1-m tall × 3-m wide mouth) and a smaller chamber (with second mouth) or cab to hold the catch. Side wings (e.g., 1-m tall × 20-m long) funnel fish or turtles into the trap. Fyke traps produce minimal mortality when captured turtles are provided access to air, either through the top of the cab suspended by rope above water or by floats in the rear chamber (Vogt 1980, Gibbons 1990, Dreslik et al. 2005).

Diamondback terrapins (*Malaclemys terrapin*) have drowned in commercial fish and crab traps set in bays and estuaries. Several designs reduce this catch. Metal panels (4.5 cm × 10 cm) installed in the mouth of crab traps exclude terrapins (Wood 1997), whereas taller crab traps provide turtles access to air (Roosenburg et al. 1997). A metal grate (4.5 cm × 12 cm) served as an effective bycatch-reduction device (Roosenburg and Green 2000, Cole and Helser 2001, Butler and Heinrich 2007). Vertical alignment of grates in the trap openings may effectively exclude terrapins without decreasing crab captures (Hoyle and Gibbons 2000, Dorcas et al. 2007).

Trapping with submerged fyke nets set for 1–3 days targets fish but may take turtles as bycatch. Resultant mortality may be reduced by installing chimneys to allow escape and excluder panels to reduce capture of turtles (Wood 1997, Barko et al. 2004, Lowry et al. 2004, Georges et al. 2006, Fratto et al. 2008*b*). Turtle mortality can be reduced by adopting the basic designs that employ floats either inside the cab or tied along the outside to lift part of the trap above water. Excluder devices reduce entry of turtles into fyke or hoop traps and securing the trap to a vertical stake or shore lifts the end of the trap and keeps the trap from sliding into deeper waters. Frequently checking traps, especially in warm water, also will reduce mortality of turtles.

Loss of freshwater turtles in bottom-deployed eel and carp traps was reduced in Australia with a net chimney or tube extending from the top of the trap to allow turtles access to the water's surface and a shelf opening to the outside at the top of the trap (Lowry et al. 2004). I recommend installing a tube of wire mesh or netting (with narrow metal hoops 0.5-m diam) to create a rear chimney or ramp extension for turtles to climb out of the trap or to reach air (Fig. 2). The extension allows escape, while fyke traps remain on the bottom in deep water. The upper area of the chute could be covered in mesh so that turtles can reach air yet fish are retained. These modifications do not cut the trap netting as the upper end is tied closed (and opened to remove catch). The extension tube can be sewn or tied to this opening end of the trap. These changes should not add appreciably to the cost or operation of these large-sized traps.

MANAGEMENT IMPLICATIONS

Virtually no mortality of turtles occurs in hoop and fyke traps that provide access to air or are checked frequently. In contrast, some traps that target fish or crabs are set deep or for 1–3 days. These may result in turtle bycatch and mortalities, especially in warmer weather. Biologists can add excluder devices or grates in front of trap mouths to

reduce turtle captures while retaining the usual rate of fish or crab yields. Further, ramps or chimneys installed into traps may allow all sizes of turtles to escape or reach air. I recommend an education campaign to promote these means to protect freshwater turtles, but such a program has yet to be developed.

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