Inherently Safer Aquacultural Work
Hierarchical Hazard Controls
By Melvin L. Myers, Robert M. Durborow and Henry P. Cole

1) Falling Lid Hazard
Live tanks on hauling trucks have lids used for filling with water and dumping fish into the tanks. The raised lids traditionally would stand upright off-center to the rear. If the truck moves or wind strikes the lid, it could fall. Several farmers reported incidents in which a lid had fallen on their heads, and one reported that an employee’s finger was amputated in such an event. One farmer used a wooden wedge placed under the raised lid to hold it in place, while another farmer used a locking hinge. Still another used pneumatic hinges as a control against falling lids, thus eliminating the hazard. Some manufacturers have replaced the metal lids with lightweight plastic lids.

2) Impalement Hazard
An impalement hazard exists when trout farmers install electric fences to deter otters by using short rebar rods as posts inserted vertically into the concrete wall of a raceway. A farmer placed insulator caps for the electric wire on top of the rod as an impalement guard and further eliminated the hazard by placing the rods horizontally on the walls.
3) Fall From Elevation Hazard

A fall hazard exists when climbing the ladder on elevated feed bins in order to open and close hatches for feed delivery by an auger. A delivery man fell to his death at a catfish farm in Mississippi more than 5 years ago. Warning signs provide insufficient protection.

One farmer guards against falls by placing a ladder guard on the bin surrounding the ladder so as to counter a fall. At an Idaho trout farm, workers can attach a harness to a cable running up the ladder; the attached self-locking device allows the worker to ascend but grabs the cable in the event of a potential rapid descent. Many farmers eliminate the hazard by designing and installing a ground-level pull handle to open and close the hatches. Nonetheless, if the ladder remains, it should have fall protection installed.
4) Needlestick Hazard
Trout and salmon are vaccinated against disease, which involves using a pneumatic injection gun. Needlestick injections have been known to result in anaphylactic shock. The gun has a finger guard that protects against an inadvertent injection, but the guard is not designed to protect the worker when the injection is done perpendicular to the hand holding the fish.

To solve this problem, farmers have used a corrugated tabletop rather than the traditional flat table top for the procedure, thus reducing the likelihood of an inadvertent needlestick, since the fish could be better secured in a longitudinal direction. This innovation also improved the speed of the operation by better directing the vaccinated fish off the edge of the table and back into the water. Salmon vaccinators in Scotland and Norway have experienced needlestick injuries (Douglas, 1995) and, as a result, a machine has been invented in Norway to automate the vaccination process, thus eliminating the needlestick hazard (Somerset, Krossøy, Biering, et al., 2005).

5) Overhead Power Line Hazard
Another hazard is overhead power line contact by fish harvesting cranes. Warning labels frequently appear on cranes regarding the electrocution hazard of overhead power lines. In an effort to move beyond this kind of active safety control, one farmer replaced 30-ft high poles with 45-ft high poles to provide an additional margin of error against inadvertent electrical contact, whereas other farmers bury power lines, thus eliminating the hazard of overhead contact.
6) Lifting Hazard
Workers in a catfish hatchery would crowd the fish at one end of a raceway, then use a dip net to capture and lift the fish into live tanks for transport. To eliminate the hazard of awkward lifting (often resulting in lower back strain), a farmer constructed a net-and-pulley system for capturing and lifting the fish. The filled net could slip along a rail track for dumping the load into a hauling tank, thus eliminating the lifting hazard.

7) Tractor Overturn Hazard
Tractors that lack ROPS are a well-known hazard that can result in crushing or drowning. When tractors with cabs are used, a second exit is necessary to prevent drowning in the event that the door is blocked by an overturn.

8) Drowning Hazard
In offshore salmon farming, the most serious hazard is drowning, especially among divers. Working around nets exacerbates the hazard because of the potential for entanglement. Net pens may involve an interior net to restrain the fish and an exterior net to protect against predators. A diver died when the regulators on his oxygen tanks were entangled in a net. A control for the hazard is to mount a shroud over the regulators.
9) Traffic Collision Hazard
Traffic collisions are a serious hazard since many deliveries of fish require long hauls with a live load. The loads are in water that can slosh back and forth, leading to instability. In addition, driver fatigue is a problem. This is a difficult problem to solve, but one farmer made the point that maintaining distance from other vehicles is an important intervention. More sophisticated interventions are possible, including electronic distance warning devices.

10) Aerator Entanglement Hazard
Power-take-off (PTO) entanglements are a recognized problem on farms, but in powering aerators, this problem is exacerbated by the use of PTOs with extended drivelines to reach the aerators in ponds. Guarding is typically absent from these drive lines, but a substitute power source is electric motors mounted on the aerator itself that can eliminate the PTO entanglement hazard.
11) Paddle Entanglement Hazard
Catfish hatcheries require simulation of the male fanning water flow over the eggs before they hatch, and mechanical paddles in troughs are the technology that is typically used to artificially provide this flow. Metal paddles are bolted to a shaft that continuously turns, but skin abrasion and hair/clothing entanglement are hazards for workers exposed to the rotating paddles.

A control used to stop the rotation of the shaft in the event of an entanglement is a panic wire running overhead above the trough. Alternatively, a facility simply set the motor that powered the paddles (by way of drive belts) on top of an unsecured sawhorse; when unusual tension was placed on the trough paddles, the motor was disturbed, became disengaged from the drive belts and no longer powered the paddles. Another farmer eliminated the risk by replacing the metal with plastic paddles (created from 5-gallon containers) that were wrapped and bolted around the shaft loosely enough to allow them to slip when entanglements occur (Coblentz, 2005). The plastic paddles also prevent abrasions.

12) Solar Radiation Hazard
While most tasks around raceways require a lot of mobility, some do not. One of the stationary tasks is vaccinating fish. To protect the worker against solar radiation (as well as rain), a farmer constructed a simple canopy for shade.
13) Wasp Sting Hazard
Ladder rungs used when climbing up the side of feed bins are curled, hollow bars with open fluting across the backside of the step, which often harbor nesting wasps. Workers would be stung when climbing the ladders. The problem was eliminated by filling the hollow space with foam insulation.

14) Confined Space Hazard
On some farms and hatcheries, pumps are placed in pits to run water efficiently. These pits are confined spaces, especially when covered with a manhole cover or lid. To eliminate this hazard, one farm operation removed the pit cover, placed rails as barriers around the pit, raised pump controls up to ground level, and arranged ground piping disconnects and cables for raising the pump from the pit for repair or maintenance. This employer adapted its occupational safety and health procedures from its fish processing division to its farming operation. This employer also requests an annual inspection by the state OSHA consultation program to continuously improve worker safety.
15) Net Entanglement Hazard
Farmers use bird netting to protect the fish from bird predators in raceways. One farmer tossed netting across the raceway where it draped down into the water. This posed a hazard for potential drowning if a worker were to fall into the raceway and become entangled in the net. Other farmers built a wood frame for the net that would rest on the raceway walls to keep birds away, but nonetheless, some birds such as ducks were able to lift the frame and enter the raceway. The best solution was to build net structures over the raceways high enough to allow workers and equipment to maneuver, eliminating the entanglement hazards.

16) Fish Harvesting Hazard
Harvesting fish is a labor-intensive activity. Workers must crowd fish with a seining net in ponds or screens in raceways, then use dip nets to scoop up the fish, and lift the dip nets either manually or by a crane into a live haul tank for transport to the processing facility. Trout and shrimp farmers have found that this drudgery can be eliminated by using a fish pump. Pumps can be part of a fixed structure or can be portable and are used to pump fish from raceways into live haul tanks or to remove shrimp from pond bottoms. Pumps do not work yet for catfish because their spines jam in the pump.
17) Truck Bed Fall Hazard

The principle fall hazard associated with working around live tanks on truck beds is climbing onto the bed from the steps to the cab. In addition, falls occur from the truck bed ledge around the live tanks. Some farmers have redesigned truck beds with safety features. One such feature is a fold-down walkway alongside the truck bed; another is a retractable safety rail along the length of the truck that protects workers on the walkway from falls. This railing also blocks access from the cab steps, thus eliminating awkward access from the cab steps, but with another feature to be added: a ladder at the rear of the truck bed with hand rails. Two other features need to be added; a midrail and a toe board.

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