

GATORS IN THE SAGE

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Sagebrush rustled as 400-lb. prehistoric beasts rose up on strong legs and thundered past us into a steaming pond. After the dust settled, eerie reptilian heads rose through the translucent water until only jewel-like eyes and domed snouts poked above the surface. The high-desert country of the Snake River Plain is a far cry from the lush subtropical swamps of the U.S. Gulf Coast, but a with a perfect combination of sparkling geothermal water and abundant food from local fish farms, captive American alligators thrive in the harsh climate of southern Idaho.

For 50 miles along southern Idaho's Thousand Springs Scenic Byway, life-giving geothermal water reaches the surface in scores of seeps along the Snake River. It is here, near Buhl, where Leo Ray started his successful Fish Breeders of Idaho with his first geothermal well over 25 years ago. His pioneering efforts brought geothermal fish farming to Idaho in the early 1970s, and now promise to usher in a unique growth industry in alligator meat and hides.

A tall, lanky outdoorsman, Ray was born and raised on a farm in Oklahoma. He earned a BS degree in zoology at the University of Oklahoma in 1963, and has continued his studies with more than 100 hours of courses in the sciences and fisheries. By the late 1960s, Ray was running a successful aquaculture operation for African tilapia at the Salton Sea in southern California. It was there that he first learned about the advantages of geothermal waters for aquaculture.

After seeing the wealth of geothermal springs along the Snake River on a trip to Idaho in the early 1970s, Ray quickly realized its potential for raising high-grade fish for market. He looked at various properties for six months during 1972 and 1973 before deciding to buy the site of an old auto junkyard along the breaks of the Snake River Canyon. There he found not only the volume of hot water he needed, but an excellent supply of cold water as well. The hillside site and its fluid resources have proven perfect for his vision of the future.

Ray's Fish Breeders of Idaho, Inc. is located on 170 acres in the Western Snake River Plain geologic province, slashed by the Snake River Canyon from central Idaho west to the Oregon border. The region is thought to be the trace of a "hot spot" now found at Yellowstone National Park, hundreds of miles to the east. Thick lava flows and volcanic deposits are characteristic. It's western portion consists of late Tertiary silicic volcanic rocks and clastic sedimentary rocks, and includes 32 individual low-temperature geothermal systems. The region's geothermal resources have been extensively developed over the past 100 years for aquaculture, greenhouses, and space/district heating.

Upon drilling his first well and raceway for catfish in 1973, Ray gained the distinction of Idaho's first geothermal fish farmer. His first year of production netted 100,000 lbs,

and over the next five years he built ponds and additional raceways, fed today by eight geothermal wells. Cascading the water downslope through his raceways makes efficient use of this free heat from the earth, and lowers fish production costs by simplifying operations.



Figure 1. *Leo Ray standing on one of the raceways.*

Ray's geothermal fish farm is unique. "Most geothermal aquaculture operations are characterized by pumped wells for geothermal water supply," explains Geo-Heat Center (Klamath Falls, OR) Associate Director Kevin Rafferty. "The limited flows from most low-temperature geothermal wells, coupled with the electrical energy necessary to operate the pumps, makes these operations more expensive to build and more complex to operate." But the substantial natural flow of Ray's geothermal spring—coupled with his downslope raceway design—creates excellent economics and provides top quality water conditions for his fish. "Ray's fish farm successfully took advantage of an excellent geothermal resource and a site favorably situated for a raceway aquaculture operation," Rafferty concludes.

Geothermal wells are easy in this part of the world. "Five-hundred foot holes with cable tool hit the water," says Ray, who drilled one well to 1,100 feet, but achieved little additional flow. His eight wells intersect and follow fault-line rubble zones. Faults accessible from his property were indicated to Ray by bends in the river from west to north, natural seeps (3 to 4 gpm) along the river below his property, and large geothermal springs nearby that heat resorts and commercial greenhouses.

Ray's geothermal water flows at a wellhead temperature of 90E to 95EF, with total flow of 4,500 gpm. "To be successful in raising fish, it's good to be able to mix-and-match your hot water with cold," says Ray. "That way you control your oxygen content (hot water holds less) and achieve the optimum temperature for the fish." Ray mixes his geothermal flow with cold well water at a rate of 1,000 gpm during the winter, and between 4,000 and 5,000 gpm during the summer.

That's enough water to run his operations, but he has lost 2,500 gpm in geothermal flows during the last 15 years. "The decline came with hundreds of wells drilled in the area for irrigation and hot water wasted in swimming pools," says Ray, whose property now lies within an Idaho Water Management Area where no new commercial wells are allowed. "Now you can't remove water faster than recharge," says Ray, who claims "1st-in-time" water rights that guarantee his flows.

Ray raises U.S.-native blue and channel catfish, and African tilapia, one of the fastest growing food fish. The catfish enjoy the purest water at the top of his cascading raceways, with more tolerant tilapia at the bottom of the system. With special pellet food devised by Ray and year-round warm water, his catfish grow at more than double their natural growth rates. Respective annual production is 500,000 lbs. and 100,000 lbs. from Ray's geothermal operations.



Figure 2. *A typical channel catfish.*

Fish Breeders of Idaho also raises a million pounds of rainbow trout and 200,000 lbs. of sturgeon annually at coldwater fish farm on an additional 200-acre property. Ray has 2,000 adult sturgeon at an average 120 lbs. and up at his coldwater operation that he hopes to begin spawning soon. "Caviar from Snake River white sturgeon is said to be second only in quality to that from beluga sturgeon in the Caspian Sea," he says. Ray plans to use a portion of his geothermal

operation to quickly "grow out" his sturgeon, but like catfish, they cannot produce eggs at an elevated temperature. For that, Ray lowers their water temperature by 20EF to prompt spawning.

Ray maintains 25 full-time employees, with eight working at the company's hatchery and rearing operations, and the remainder at its processing facility where fish are cleaned and filleted for market. "It takes one to grow it, and two to clean it," says Ray, explaining that much of each processed fish is waste, totaling over 200,000 lbs. each year that must now be landfilled. Though he has plans to begin composting the material, he says, "That's a lot of protein that could be used for another cash crop."

The solution? Alligators. Ray's interest in the ancient reptiles was piqued in the late-1980s as he watched the market for their meat and hides resurge in the South. With his supply of geothermal water, he said, "I knew I had a natural." Ray brought 200 alligator hatchlings from Louisiana to Idaho in 1994. Since then, he has expanded his alligator operation to satisfy a growing market for their succulent meat and superb hides.

Ray imports up to 1,500 hatchlings from Louisiana and Florida every year, raising them to market maturity in dark indoor concrete buildings that suit their largely nocturnal habits. Meanwhile, his hand-picked breeding stock kept in outdoor enclosures has grown to between 10 and 14 feet and 1,000 pounds! He is working to breed these 30 large alligators, to provide a self-sustaining supply of hatchlings and hundreds of new, toothy mouths hungry for his fish processing waste.



Figure 3. *Juvenile alligators with their bright yellow cross-bands.*

In their natural habitat, alligators retreat to burrows when seasonal temperatures fall. But with geothermal water in southern Idaho, Ray's breeding stock often bask in the sun even after winter temperatures fall below freezing. Only when the mercury falls below 0EF do they retire to their ponds. "They're one of the toughest animals around, and haven't changed for 70 million years," Ray explains. "Alligators can

stay underwater for two hours on one breath, live for two years without food, withstand low temperatures, and they feed on carrion—that’s how they survived the great extinction of the dinosaurs.”



Figure 4. *Typical alligators ready for harvest.*

Even so, he continues, “If any of these critters did get loose up here in Idaho, they wouldn’t survive long outside the artificial environment we provide with geothermal water.” To ensure against escape and potential problems with human contact, Ray worked out a plan with the Idaho Department of Fish & Game that encloses his breeding stock with deep-set concrete walls topped with chain-link fence and barbed wire.

Ray currently feeds his alligators with dead fish from his coldwater and geothermal aquaculture operations, and provides free disposal of dead fish from the local fish farming industry. With scores of fish farms in the area (mostly coldwater operations), he has no problem providing his leathery livestock with the food they need to stay in top condition. Ray’s alligators are also a local attraction, with neighbors and busloads of school kids regularly visiting his farm. “Kids are fascinated with dinosaurs, and alligators are just small dinosaurs,” says Ray, who also provides alligators to zoos in Boise and Pocatello every spring.

Since 1995, Ray has processed 3,500 alligators at an average length of over seven feet. Timing is paramount for Ray’s alligator operation. He enters the market each year for January, after southern stocks are depleted. His crew kills eight to 10 alligators per day to maintain continuous processing of meat and hides. The meat is kept frozen for sales throughout the year, but Ray gets top dollar for their hides in late-spring when the market is hungry for leather.

“The smallest hides are used to make wallets, gloves and watch bands,” he explains. “A three-foot alligator makes a cowboy boot, and larger hides are used for coats and luggage.”

Ray isn’t the first geothermal fish farmer in the United States to raise alligators. In Mosca and Lamar, CO, Erwin Young has raised and bred alligators to eat dead fish and processing waste from his tilapia farming operations since 1985. And with publicity about Young’s operation, Husavik, Iceland is now considering a “Krokodil Plan” that would raise alligators with water from its geothermal power plant and district heating system for an environmentally sound solution to disposing of the town’s fishing industry waste.

Today, there are 150 licensed aquaculture farms (mostly coldwater) within a 30-mile radius of Ray’s geothermal operations, that raise over 40 million lbs. of fish annually for market. Of those, four (including Fish Breeders of Idaho) use geothermal water to raise tilapia and catfish. Idaho now claims 10 geothermal fish farms, many of which Ray helped get their start. And with a concerted effort toward education, he sees the potential for far more high-value, geothermal aquaculture in the region.

“This area’s got the best geothermal potential, but some of the poorest farm land in the state,” says Ray, who laments the fact that most owners of geothermal wells in the area consider its heat a nuisance. Indeed, most of geothermal water produced around Ray’s operations is used for irrigation and livestock, demanding that it be cooled before it can be used. But with over 800 geothermal springs and wells in the state,” he continues, “farmers could switch from low-value irrigated crops to high-value aquaculture crops that thrive in hot water.”

According to Ray, demand is growing among American ethnic and regional populations for exotic aquatic foods, from fresh tilapia to alligator and other potential products yet to be explored. Yet the limiting factor in southern Idaho for such new industries is not knowledge about the science and geology of geothermal energy, but lack of readily available information on how to use it to grow high-value, niche aquaculture products. “I couldn’t have my farm without geothermal water,” says Ray, “but I couldn’t make it work without knowledge about how to raise, process and market my crop.”

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