FISH FARMING TUNA FROM EGGS

The Japanese are experimenting with raising bluefin tuna in huge ocean enclosures. Researchers from Kinki University are raising bluefin in circular pens, about 70 meters across, in waters off Kushimoticho, Wakayama. After the fish reach a length of one meter and weight of 30 kilograms and their fat content is high enough that can be sold commercially. Some reach a weight of 350 kilograms. The tuna are fed squid and mackerel.

In 2009 Kinki University researchers hatched about 190,000 bluefin tuna eggs, of which about 40,000 grew to be fingerlings, This figure was impressive but still meant only 0.5 percent of the eggs survived, About 60 tons of bluefin tuna meat was produced. Branded Kindai maguro (“Kinki University tuna”), it has a higher fat content than fish caught in the wild.

In June 2002, a team at the Kinki University Fisheries Laboratory led by Professor Hidemi Kumai became the first, to artificially breed bluefin tuna fry from to artificially incubated mature tuna. More than 5,000 eggs were produced by six 7-year-old tuna and fourteen 6-year-old tuna, all of born and raised in captivity. About 160 of the bluefin tuna that hatched in 2002 were still alive in 2006. On average they were about 1.2 meter long. and weighed about 70 kilograms.

Kinki University researchers have also had success raising kelp grouper and burhura, a hybrid species created by crossbreeding Japanese amberjack and goldstriped amberjack. The laboratory hopes to make ¥2 billion a year from selling fish it produces. It sells both fry to fish farmers and fresh fish that are marketed as being safe and high quality. The university successfully bred more that 20 types of fish, including red sea bream, bastard halibut, rock progy and amberjack in the late 1960s.

The term "closed-loop cycle" is used to describe the process of spawning bluefin in captivity and raising them to market maturity. To date, only Kinki University, has been able to successfully hatch bluefin eggs in a lab, raise the fish and sell the mature fish commercially.

With three generations of fish spawned in captivity, Kinki no longer needs to take fish from the sea. [Source: Adam Yamaguchi and Zach Slobig, Los Angeles Times, July 21, 2011]

Although the closed-loop cycle for bluefin may represent the last best hope for saving the species, even this is not a long-term solution. Peter Bridson, aquaculture research manager at the Monterey Bay Aquarium, told the Los Angeles Times, "The best way to be eating bluefin is to reduce our consumption down to what we can catch from a very well-managed, sustainable fishery, and it's probably not a species that should ever really be farmed or ranched."

History of Fish Farming Tuna

The team at Kinki University was able to get tuna to produce fertile eggs in 1979 but all the eggs and fry died within a few weeks. When the tuna spawned again in 1980 and 1982 the fry were kept alive for up to 57 days. The tuna did not spawn again until 1994 and the spawned five times between 1994 and 2001.

In the meantime scientists learned that big fry are smaller fry and this led to a separation of fry by size. In 1994, 1800 two- to three-month-old fry were released into sea pens. But a month later all but 40 were dead. One lived for 246 days and reached a size of 1.3 kilograms. The team concluded that the fish died because the pens were too small and replaced the six-meter square pens with 12-meter octagonal pen made of synthetic fibers. The one-month survival rate increased to 16.4 percent in 1995 and 24.9 percent in 1996.

Sudika tuna farm off Malta
Because young fish can travel fast but can’t turn so well they often collide with net sides of their pens until they are 25 centimeters in length. In 1998 the team developed a circular pen that was six meters deep and 30 meters in diameter. In this pen the one-month survival figure was 55.7 percent. About 400 survived in the pen for more than twp years. The Kinki University team also found that the tuna are very sensitive to light and noise and reacted negatively to the presence of cars traveling near their pens.

Clean Seas Tuna, a company based in Port Lincoln Australia, has invested ten of millions of dollars to hatch tuna from an indoor hatchery at the hamlet of Arno Bay 120 kilometers north of

Port Lincoln. Here large bluefin tuna are kept in a massive tank that tries to fool the fish into thinking they have reached their spawning grounds by simulating ocean currents, increasing the temperature of the water in their tanks and the amount of light. In March 2008, the company announced a major breakthrough: it collected its first batch of fertilized eggs from a breeding stock of about 20 tuna weighing 160 kilograms.

Clean Seas Tuna has gotten its bleeding stock to spawn several times and produce eggs and larvae but is still working out how to feed and care for the larvae. Many investors are skeptical that Clean Sea will achieve its goal of raising bluefin tuna captivity and say even if they do the cost will be too high to turn a profit. The fish only grow at a rate of one kilogram a month The attraction for Clean Seas is that it will be able to sell tuna without any quotas restricting the company. It hopes to sell 5000 tons year, with its first sales in 2009.

In September 2009, researchers with the Fisheries Laboratory at Kinki University, in Shirahama Wakayama Prefecture and Australia-based Clean Seas Tuna announced they had succeeded in breeding southern bluefin tuna and produced bluefin tuna fry, a step which could open the way to commercial cultivation of bluefin tuna.

Bluefin Tuna Farming Details

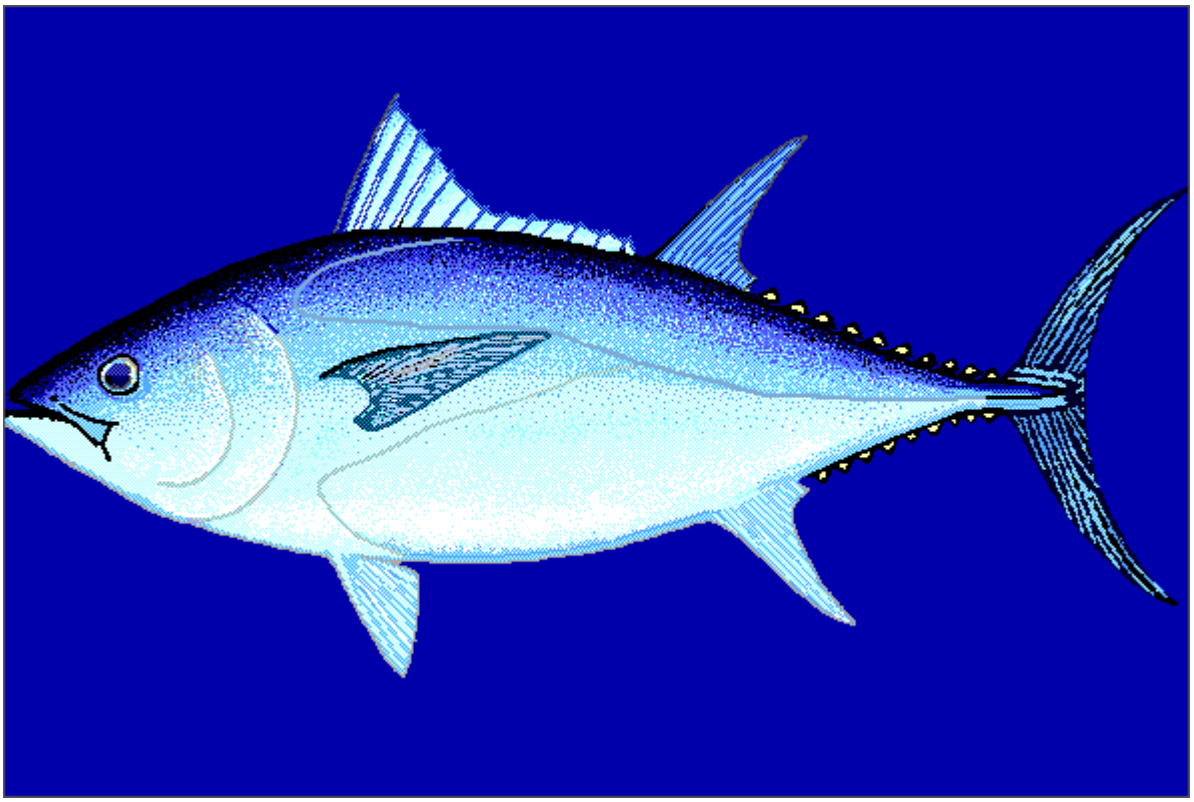
Researchers at Kinki University predict that Japan should be able to produce 100 percent of domestic demand for bluefin tuna with farmed fish raised from eggs rather than caught in the wild. In this process: 1) eggs about 1 millimeter is diameter are fertilized; 2) After about 35 hours three-millimeter fish are artificially hatched and fed on plankton for 15 to 20 days; 3) three- to five-centimeter-long fry eat hatchling parrot bass and other fish for two to three months; 4) 20 to 30-centimeter-long fingerlings eat process for feed for more than four years; 5) mature fish are one meter to one and half meters long.

The pens need to be at least 10 meters deep and 30 meters in diameter so that fish do not collide with nets. The pens need to be away from human activity as they are easily panicked by things like car lights and noise from fireworks, with some injuring themselves by crashing into their nets at high speed. The fish are also vulnerable to to poor water conditions created by typhoons. Night lighting is used to accustom young fish to light.

Bluefin tuna are regarded as particularly difficult to cultivate because of their sensitivity to conditions when laying eggs.. The fish will not lay eggs in temperatures below 26 degrees C or if it is too windy or rainy. Even if the eggs hatch they chance they will becoming a six-centimeter-long fry is only 3 percent. There is only a 0.1 chance the fish will reach a salable size and be sold in markets. Even if they make it to adulthood, many die often panicking and ramming into the net or side of the enclosure.

Farm raised tuna generally has a higher fat content than wild tuna. The main expense of raising blue fin tuna is the cost of food. A one meter tuna need about 15 kilogram of live fish to put on one kilogram of fat, and abbout 1.5 tons to two tons of squid and mackerel are needed to produce a 100 kilogram bluefin tuna. Scientists are currently trying to develop less expensive fish feed. One of main obstacles is her is creating a processed food that doesn't affect the taste of the tuna because what a tuna eats very much affects the taste of its meat.

Prof. Kumai , who spent more than 50 years studying bluefin tuna , told the Yomiuri Shimbun, "It could be possible to meet world demand with farmed fish. In the future we'd like to try releasing fish bred in captivity into the ocean. I'd love to see Kindau maguro swimming around the globe."



Bluefin tuna

Bluefin Tuna Farms with Wild Fish

Fish farms, or fish ranches as they are sometimes called, for bluefin tuna are places where fish corralled in the open sea are brought and kept in giant underwater cages and fattened up with sardines and tuna for between a few months to a year, and then are shot and butchered. About 20 percent of the bluefin tuna consumed in Japan is farmed from wild fish. About 400,000 bluefin tuna are being raised on farms as of 2010.

The technique, which is really more like rustling than ranching, has revolutionized the bluefin industry. Fishermen scoop up schools of spawning tuna and transfer them to 50-meter-wide cages and return to the spawning area catching all the fish they can. The practice is though to be particularly damaging to fish stocks because it captures large number of fish at place they come to spawn. Not only are large numbers of fish caught they are also deprived of producing offspring

Because bluefin tuna swim so fast and are used to migrating long distances they are difficult to keep in small pens. Their delicate skin can be easily damaged if touched by human hands and to much handling can be fatal.

Wild Bluefin Tuna Farming in Australia

Bluefin fish farming began in Australia in the 1980s when quotas and low prices threatened to bankrupt many operators. Fishermen there came up the brilliant idea of netting their quotas and increasing their size and profits.

Tuna fishermen in Australia operate under a quota system. After overfishing seriously depleted tuna fisheries in the 1980s, fishermen were required to obtain an individual transferable quota which gave them the right to catch a certain number of fish each year. The quota system was great for the fishermen. Fisherman that once earned $600 a ton selling fish to canneries began making more than $1,000 per fish, selling them to buyers for the Japanese market. The quotas are expensive. They are bought and sold like stocks.

Bluefin tuna farmed in Australia are caught in nets during a two-week "round-up" and slowly towed to floating pens near the shore. The tuna are fed and harvested when prices are high on the Tokyo market. The fish are fattened up with pilchards and anchovies and sold when they double in size to around 32 kilograms.

The 2,000 or so tuna kept in a single pen are worth around $2 million. They are so valuable armed guards keep watch over them. At harvest time the fish are gently guided into a boat (any bruising lowers the price) and killed and flash frozen and put on Tokyo-bound planes

Australia exports 10,000 metric tons of bluefin worth $200 million. Almost all is from penned stocks. Australia and New Zealand are concerned about potential overfishing of bluefin tuna in the Southern Sea by Japanese ships.

Bluefin Tuna Farms in the Mediterranean

Farming of bluefin tuna is common in the Mediterranean. The practice began there in Croatia in 1996 and since has then has begun in Italy, Spain and Turkey. In the Mediterranean the tuna are caught in their spawning ground in waters off Libya. They are transferred to underwater boxes and fattened up with fish meal, sardines, mackerel and squid, up to two years, to increase the fatty meat valued in Japan. According to a WWF report fish farming is responsible for depleting stocks of bluefin tuna in the Mediterranean because so many spawning fish are caught. Japanese firms own a sizable part of the bluefin tuna farm industry in the Mediterranean.

As of 2007 there were 69 tuna ranching operations in the Mediterranean. About 60 percent were owned by the tuna baron Francisco Fuentes of Cartagena-Spain-based Ricardo Fuentes & Sons, who runs an industrial scale operation with huge purse seine fishing boats, sea cages, tug boats and support boats, many of them purchases made with EU and Spanish subsidies. The company reportedly makes profits of $220 million a year and has partnerships with the Tokyo trading giants Mitsui and Mitsubishi. The company reportedly gained access to Libyan bluefin tuna spawning grounds through personal connections with the family of Libyan leader Muamar Qaddafi. Seif al Islam Qaddafi, the leader's son, reportedly has earned millions of dollars from the bluefin tuna trade, according to Bregazzi.

In 1996, Croatians who had developed techniques for fattening and bluefin tuna in Australia, established the first Mediterranean tuna ranch in the Adriatic. Fen Montaigne wrote in National Geographic, "The prospect of producing a steady---and highly profitable'supply of fatty Mediterranean bluefin set off a cascade of events that has proved disastrous. The Mediterranean fleet has increased its effort three fold, with the bluefin flotilla now totaling 1,700 vessels, including 314 purse seiners. Compounding the problem, the advent of tuna ranching made it difficult for the European Union and national governments to enforce quotas...The spread of tuna ranching means bluefin are being wiped out at all stages of their life cycle. In Croatia, for instance, the industry is based almost entirely on fattening juveniles for two to three years, which means fish are killed before they spawn. Elsewhere in places such as the Balearic Islands, large females, capable of producing 40 million eggs are being wiped out. In just ten years bluefin populations have been driven down sharply."

So much bluefin tuna came out of the Mediterranean that the Japanese stockpiled tens of thousands of toms of the fish in in giant freezers and cut the price paid to fishermen by half to around $7 to $9 a kilogram.

Catching Bluefin Tuna for Farms in the Mediterranean

Describing a bluefin tuna round up off the island of Ibeza, Spain by boats from the tuna farming firms Ecolofish and Fuentes & Sons, Fen Montaigne wrote in National Geographic, “Around 11:00am the spotter planes spied a school, setting the purse seiners on a 19-knot dash. The stakes were high. Even small school of 200 bluefin can, when fattened, fetch a more than a half million dollars in the Japanese market.. Galaz watched through binoculars as an Ecolofish seiner reached the school first and began circling it with a mile-long net.

“Before Ecolofish’s boat could compete its circle, a Fuentes seiner rushed forward and stopped just short of the unfurling net. Under one of the few rules that exist in the free-for-all for Mediterranean bluefin, this symbolic touch entitled the competing boats to split the catch fifty-fifty.

“Over the next several hours, divers transferred fish---163 bluefin, averaging about 300 pounds---from the purse-seine net into the sea cage, a large holding pen about 160 feet in diameter, with a sturdy plastic frame, supporting a heavy mesh net...The open cage, already brimming with a thousand bluefin tuna caught days before, was aligned with the purse-seine net...After untying the large mesh gates of the pen, Galaz and his divers began herding fish. Peeling off from the their gyre, the bluefin whizzed into the cage like torpedoes.

Chikuyo Tuna

Tuna raised on the farms described above are known as chikuyo tuna. One of the aims of the process is to increase the body fat on the fish. A high fat contents means that up to 70 percent of the fish can be sold as fatty, premium-priced toro (normally only 20 percent of a fish can be sold as toro). But a lack of exercise leaves the flesh overly soft and lacking in taste and texture.

Much of the toro sold in sushi bars is chikuyo tuna. It cost about half as much as wild tuna and its availability has brought down the price of toro (traditionally the highest grade tuna) so that it can be enjoyed by ordinary consumers. Oversupply has caused prices to drop even further. Now toro is available for as little as ¥1,000 per kilogram compared to ¥5,000 per kilogram that it sold for in the Bubble Economy era in the 1980s. The lower prices have meant that the best quality toro is now even available at conveyor belt sushi restaurants. Japan imported about 3,000 tons of chikuyo tuna 1995 and 35,000 tons in 2005.

Chikuyo tuna is known for being particularly fatty. In wild bluefin tuna 30 percent to 40 percent of the fish excluding the head is classified as toro. In chikuyo bluefin tuna the figures rises to 70 percent or even 80 percent. When he first encountered chikuyo tuna one sushi restaurant chef told the Yomiuri Shimbun, “The tuna was like a big chunk of fat. A real sushi lover would find the tuna’s smell different from the flavor of wild bluefin tuna.” The fish have more fat and thus softer meat in part because the farm-raised bluefin tuna get less exercise swimming around in small enclosed spaces than wild fish do in the open sea.

Kenshi Yamada, sushi chef and owner of Noshi Sushi, which serves the Baja-farmed bluefin told the Los Angeles Times, "The farmed fish tastes a little different, but most people can't tell the difference in taste. It has a little more fat than the wild fish," he says.

Problems with Bluefin Tuna Farms

The European Union and the WWF warns that bluefin tuna producers should stop using fish as feed in tuna farms because of the risks of spreading exotic viruses in the Mediterranean. The European tuna farming industry buys more than 200,000 tons of mostly frozen and untreated fish annually from the North Atlantic, West Africa and South America. The fact that so much fish from non-native sources is dumped in such small area raises the risk of disease.

The network of the companies and trading firms that control the bluefin tuna trade is difficult to regulate. The flow of money is complex and hard to follow and filled with “data black holes” and difficult-to-regulate cross-border relationships. For example, one Spanish-funded company is based in Libya and uses Tunisian-registered ships to catch tuna hauled to fish ponds in Turkey, Greece and Malta.

Often it is hard to figure where the fish came from as they were caught in one place, raised in pen in another place and sold at yet other places. On fisheries official in Japan told the Yomiuri Shimbun. “When the fish arrives in Japan, it’s impossible to know which country caught them and exactly how long it had been since they were placed in the pens.”

Environmentally-Friendly Bluefin Tuna Farms in Baja California

In pens off Baja California, an Icelandic company is raising bluefin tuna in way it will please consumers and environmentalists alike. Adam Yamaguchi and Zach Slobig wrote in the Los Angeles Times, “Umami, an Icelandic seafood conglomerate, purchased a Mexican aquaculture operation in late 2010 and is ranching what it calls "sustainable" Pacific bluefin.

Umami-owned Baja Aquafarms operates two concessions off northern Baja California---21 pens tucked behind the Coronado Islands---and an additional 11 pens 70 miles south, off craggy Salsipuedes. Each of these 100-foot-deep floating feedlots holds roughly 60 tons of the prized fish.Starting every year in the late spring, a fleet of boats, aided by spotter planes, catches and hauls fish back here for systematic fattening and eventual slaughter.

Unlike meat sources such as beef, pork or even salmon, which are bred and farmed, even ranched tuna must be considered a "wild" animal source. Bluefin tuna, which average 600 pounds at maturity, are notoriously difficult to breed in captivity, and thus, ranches such as Baja Aquafarms must catch wild tuna, only to fatten them up to increase the yield of meat. But because the fishermen are taking from an already depleted population of fish, the sustainability of such practices is questionable.

Still, Umami, which reported sales of $42 million in the fiscal third quarter ending March 31, with a profit of $10 million, says its operations have lessened its environmental footprint. "Our operations are fundamentally different from other operations in the way that we farm the fish longer," Jonsson says. "The amount of fish we have to catch from the ocean is less, and the overall utilization of natural resources is better." He points out that ranches once would feed an individual bluefin only for a few months, but they are now fed for up to three years to weights of close to 300 pounds---minimizing the number of individual fish that need to be caught while maximizing each fish's yield of flesh.

Javier Vivanco has managed the daily operations at Baja Aquafarms for a decade. He pulls up to the young adult pens to give the tuna their second feeding of the day. The bluefin boil up to the surface clockwise while a legion of sea lions bark and dive for scraps. "We're not using pellets of artificial feed. We're using real food---the natural feed source of the bluefin," Jonsson says as he motors out of the San Diego harbor.Fresh, locally caught sardines are shoveled into the pens daily by the boatload. Jonsson touts Umami's feed conversion ratio---the weight of feed mass converted into body mass---as 17 to 1, meaning it takes 17 pounds of sardines to make a single pound of bluefin flesh in these waters off Baja.

Are Bluefin Tuna Farms in Baja California Really as Environmentally-Friendly as Claimed?

"It's really hard to have sustainable and bluefin sort of in the same sentence. It's always a bit of an oxymoron," Peter Bridson, aquaculture research manager at the Monterey Bay Aquarium, told the Los Angeles Times. [Source: Adam Yamaguchi and Zach Slobig, Los Angeles Times, July 21, 2011]

The bluefin's migratory nature, as well as relatively slow sexual maturity, compounds the problem with fishing it sustainably. "The tuna come over to Mexico when they're 1 to 2 years old, and then when they're 5 to 6 years old they start migrating back over toward the other side of the Pacific to reproduce," Bridson says."So every tuna that's caught in Mexico---whether it's eaten directly or whether it's stuck into the ranch---is not going to be able to reproduce."

Farmed salmon require 3 to 4 pounds of feed per pound of weight gain compared to 17 pounds for one pound of farmed bluefin tuna. "The bluefin is very energy intensive," Bridson told the Los Angeles Times. "It's more like a Ferrari than a Toyota Prius in that respect. It's a really difficult species to ever grow sustainably." Jonsson response to this is that in the wild, bluefin take nearly twice the toll on bait fish, eating 30 pounds for every pound of growth.

Image Sources: Wikimedia Commons, National Oceanic and Atmospheric Administration (NOAA)

Text Sources: New York Times, Washington Post, Los Angeles Times, Times of London, Yomiuri Shimbun, The Guardian, National Geographic, The New Yorker, Time, Newsweek, Reuters, AP, Lonely Planet Guides, Compton’s Encyclopedia and various books and other publications.

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