Aquaculture Association of Southern Africa

# NEWSLETTER

OF

## AQUACULTURE ASSOCIATION OF SOUTHERN AFRICA &

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Aquaculture Institute of South Africa

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# A Word from the AASA Chairman and the CEO of AISA

## Etienne Hinrichsen

We are now well into 2008 and just as I started thinking aquaculture development can't possibly get any more challenging – wham, and we're into dealing with the revised regulations on alien species and the (by now infamous) species lists. It becomes a bit confusing when one considers that certain species like trout have pretty much been stocked into most waters where they will survive (not disputing that they have an impact on other fish species), while I believe we are only now seeing the impacts that are being caused by indigenous species like catfish that are being moved outside of their historic distribution range.

In spite of the confusion and challenges that we face I believe firmly that AASA have established a working relationship with the Department of Environmental Affairs and Tourism (DEAT) on these regulations and the listing of species. I have met with them personally and I foresee that we will be working together to find a common foothold in the interest of aquaculture and the environment. In this regard we have already started discussions around zoning areas for trout farming as opposed to the blanket removal of trout advocated by previous versions of the regulations. Although I have had to take some criticism by dealing with trout first, I believe this sets the cooperative relationship in place to deal with other exotic species and aquaculture in general.

As for other aquaculture matters, it is an impossible task to remain abreast of all the news. I have asked the AASA Exco to play a more active role in generating material for the newsletter, but in spite of this I want to leave an open invitation with all of you to communicate any noteworthy aquaculture news to me, the editor or the AASA office. Even a short email will do and remember that day to day activities in your own aquaculture field is potentially valuable and interesting information for others.

The AASA Exco is meeting again at the end of April and any person is welcome to submit aspects that they would like to see included on the agenda. We will also be discussing the venue of the 2009 AASA conference at the meeting and I hope we can follow shortly with more news on where and when this will be taking place. Its almost surreal to be talking conference again!

Increasingly there are associations, farmer groups and other aquaculture organisations popping up all over Africa. Time and resources allowing I want to continue collaborating with all of these so that we may strengthen aquaculture on the entire continent. In this regard, please let us know if you come across any such groups with which we may cooperate.

## Dr. Lizeth Botes

From Lizeth Botes lbotes@ai-sa.org.za

Aquaculture Insurance:

AISA is working with Santam Ltd in order to, on the one hand diversify and fine tune the current insurance policy available to Aquaculture producers, and on the other to develop the sector by facilitating inputs into insurance policies that addresses the needs of the producers.
Although the current example is only for mortalities, Santam Ltd wishes to further get feedback on issues such as Value-chain, product liability, product in transit or storage etc.

Santam has requested AISA's assistance in this regard since they realise that the Aquaculture Sector will probably intensify over the next 5 yrs, that technology will be up-scaled and the risks involved will increase.

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Members from industry interested in providing information on species specific needs with regard to the risk/exposure that should be covered in such a policy should please contact the AISA office. I will further arrange for a discussion session on this document at the next SAWG meeting which is tentatively scheduled for 23 April 2008.

Skills development and Training Programme for the Western Cape (STP):

AISA is also working in collaboration with the SwissContact and the University of Stellenbosch to host the first training workshop open to both the marine and fresh water aquaculture sub-sectors. The training workshop on Life Skills and Business Skills is scheduled to take place from 5-9 May 2008, and the training workshop on Aquaculture Skills is scheduled to take place from 12-16 May 2008.

For further information on venues and costs, please contact the AISA office.

# The Editor's choice

## Editorial

Adrian Piers newsletter@aasa-aqua.co.za

Two articles, one on genetic manipulation of farmed fish, and the other on species introductions caught your Editors attention. What exactly are we talking about here? All living things are a genetic work in progress, with their genetic structure being continuously modified over time. Purists may say yes, but that change is by Nature. But Nature uses some surprising tools, often other species that are co-evolving simultaneously. Is man not one of them?

Mankind has been genetically changing other species ever since he appeared, by hunting them (a process of selection) and by burning vegetation (changing the species composition and leading to genetic changes). The genes of presently farmed wheat and rice are nothing like their wild ancestors. The simple process of selecting the best of a crop for the following seasons planting seeds IS genetic modification, albeit with very crude tools. That all domesticated livestock are genetically modified is plain to see. This process has been used by Man for thousands of years - a long time - the only thing that has changed is that Man, the toolmaker, now has better tools to do exactly the same job, but better.

(see Breakdown of an Ant-Plant Mutualism Follows the Loss of Large Herbivores from an African Savanna - Link below.)

http://www.sciencemag.org/cgi/content/short/319/5860/192

## Genetically engineered fish – Friend or foe of the Environment?

Excerpt from the article by Erik Stokstad

With the world's fish consumption rising, transgenic fish might alleviate pressure on wild stocks. But researchers worry that genetically engineered fish, if they escaped, could wreak ecological havoc. Researchers are paying renewed attention to such escapes as they debate the future of a new type of farmed fish: transgenic species. They have the *potential* to be even more of a menace than existing farmed fish. No genetically engineered fish are commercially farmed yet, but a modified Atlantic salmon is under review by the U.S. Food and Drug Administration, and others are nearing commercialization elsewhere. Says Eric Hallerman of Virginia Polytechnic Institute and State University in Blacksburg: "It's my sense that transgenic fish will go forward in some places in the world whether Greenpeace likes it or not."

Full article from Science Magazine at:-

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http://www.sciencemag.org/cgi/content/full/297/5588/1797

## Are fish introductions always bad?

The public view of introduction of non-native species is often a matter of risk perception rather than risk analysis, with small risks being very often over assessed (i.e. a great majority of research on the impact of non-native freshwater fishes focusing on a few negative cases), so contends Rodolphe Gozlan of Bournemouth University, the author of a paper published in the journal Fish and Fisheries. This has led to the common perception that introductions of non-native fishes pose a threat to biodiversity and should be considered guilty until proven innocent.

His analysis revealed that of the 103 non-native introduced freshwater species identified in the FAO aquaculture database, more than half (52%) were not reported to have an adverse ecological impact on their environment.

The risk of ecological impact after the introduction of a freshwater fish species was also found to be less than 10% for a great majority (84%) of the species analysed.

http://www.practicalfishkeeping.co.uk/pfk/pages/blog.php?blogid=159 and

http://www.innovations-report.de/html/berichte/umwelt_naturschutz/bericht-104222.html

See more on this below under Regulatory matters. Original paper by Rodolphe Gozlan available from Editor on request.

## Sink or swim – The future of seafood

Abridged from an article by Jon F. Sica in the Sun-Herald

New technology may bring aquaculture to new territory. Scientists are developing water recirculation technology that may bring aquaculture inland, but it needs to be cheaper for it to be applied for profit, because non US seafood farmers are undercutting prices at the market.

Research at Mote Marine Laboratory's Center for Aquaculture Research is making tank-based, inland fish farming cheaper, cleaner and sustainable. Mote scientists are crafting closed-circuit water recycling systems that produce negligible environmental impacts, which could be used some day as part of a fully integrated aquaculture industry, with feed producers, hatcheries, grow-out facilities and processors. They have found ways to grow the ocean's bounty on dry land, but now they have to make it turn a profit.

However the spectre of global trade, and real estate woes, are casting a pall over Florida's aquaculture industry, and making fish farming a risky business. The Florida Department of Agriculture, Division of Aquaculture, reports that is increasingly difficult for fish farms to compete against foreign rivals, who are not all financially encumbered by strict labour laws and environmental safeguards.

"We are getting killed right now by global trade, we are seeing the industry shrink in the US. It's pure economics," said Paul Zajicek, one of the division's biological administrators. "When we had that real estate bubble, a lot of farms sold, their property got astronomically valuable. Look at our land prices in general. With the competitive nature of seafood in the world, land price alone makes it impossible. The United States is far behind many other countries in aquaculture, even countries in the Caribbean basin are growing cobia and mutton snapper. The Bahamas have got net pens. We are way behind, but it's because environmental concerns have blocked progress."

Environmental concerns such as nutrient-rich water outflow, wasteful water use practices, and the introduction of non-native species are central to aquaculture regulation. "Regulations are much

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more relaxed in other countries. We are far more environmentally conscious about the impacts of aquaculture," said Dr. Kevan Main. A 2006 survey by the department found that Florida has the most stringent aquaculture regulation in the country. Each of Florida's more than 1,100 small fish farms are subjected to surprise inspections at least twice a year by the department's expert inspectors, who each have a master's degree. The National Offshore Marine Aquaculture Act may also one day set standards for marine aquaculture products grown offshore in federal waters and sold from Florida's ports, but that legislation is mired in Congress.

Marine aquaculture operations, which use the open-ocean holding pens to grow fish, also have to worry about biofouling, red tide and hurricanes. Zajicek said "If you are going to decide to do aquaculture, you better have a cast-iron constitution, because the deck is stacked against fish farmers at almost every turn." So far Mote Marine's operation isn't wrapped up in profit projections, it is riding on the spiny, prehistoric back of the Siberian Sturgeon, *Acipenser baerii* and now boasts about 78 tons of sturgeon swimming in its tanks. Sturgeon produce caviar, one of the most highly prized delicacies in the world. They began experimenting with different sturgeon species in 1998 and caviar and meat are now harvested on a regular basis. The meat goes to local markets and restaurants, and the caviar is under contract with the noble Parisian Petrossian brand. Current market price for a kilogram of Mote's caviar is approximately $4,900.

A parallel financial study of the operation is in progress, but the goal of Mote's research is not to make money. One of its key goals is to develop low-cost water-recycling technology. "What we are trying to develop is elegantly simple engineering. Where there is a lot of elegance in the actual engineering, the operation of it will be more simplified," Michaels said. "So you don't need to be a rocket scientist to run a fish farm, that's the ultimate goal."

"The whole industry cannot convert to this technology today," Main said. "We have to develop the technology and perfect it, and as we do that we drive its cost down."

So far Mote has invested approximately $25 million in the center during the last seven years. Main said the center's physical infrastructure is worth $10 million, the same amount of capital she recommends prospective sturgeon farmers start out with.

"The technology is expensive, sturgeon is the only fish it makes economic sense to grow right now," Michaels said. "One of our goals is to drive the cost of this technology down, so it can be applied to more species, and so that the cattle farmer who may want to try something, but not necessarily sturgeon, has an opportunity to try growing another type of fish in an inland facility, away from all the geopolitical issues on the coast." The state expects aquaculture to evolve in coming years, possibly with this technology, but it all depends on the bottom line. "Will recirculation systems get cheap enough to produce a 70-cent fish at the gate?" Zajicek asked. "Probably not. But with something like a sturgeon or maybe a pompano, it could work. All these fish are challenging to raise. But if it was easy, we would be doing it already."

Full story at http://www.sun-herald.com/Newsstory.cfm?pubdate=020108&story=tp1ch6.htm&folder=NewsArchive2

## Letters to the Editor

### Abalone - A training visit to France – the Marine Biology laboratory

From Mathilde Van der Merwe mathilde@sun.ac.za

As part of my PhD study, I visited the laboratory of the Marine Station of the National Museum of Natural History in Concarneau, France from October to December 2007 to acquire technique

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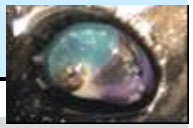
related to cell culture in abalone. Primary cell culture techniques with hemolymph, mantle and gill tissue of the European abalone, Haliotis tuberculata is well established and has been implemented in cell biology research at this institution for the past decade. Primary cell culture can be a valuable system for the assessment of pathological and beneficial microorganisms on abalone farms. Procedures to identify and control hazardous microorganisms is something which is of high significance for abalone farms worldwide as outbreaks of bacterial pathogens (like *vibrio* spp.) cause mass mortalities in cultured abalone. The risk of these pathogens (and of antibiotics used to combat them) spreading to wild stocks pose a threat to biodiversity. Cell culture provides a useful *in vitro* technology to investigate questions like these, as the effect and interaction of different microorganisms can be monitored in a small scale, controlled environment.

Genetic studies for the improvement of cultured abalone *Haliotis midae* stocks will also benefit from, specifically, embryonic primary cell cultures. Using undifferentiated embryonic cells for gene transfer and reintroducing these modified cells into developing embryos can result in offspring where all cell lineages, including the germline cells contain the gene of interest (growth regulation, disease resistance etc.).

Transfer of the *in vitro* cell culture techniques acquired to larval and embryonic tissues from the South African abalone, *Haliotis midae*, can contribute to establishing primary cell cultures and lay the foundation for future cell biology research in this commercially important species.

Link to the Marine Station, Concarneau: http://www.mnhn.fr/mnhn/conc/index2_1.htm

## Abalone



### Farmed Abalone from South Africa - growing the foreign market

By Penny Haw in Business Day

The recently established SA Farmed Abalone Export Council by nine of the country's major abalone farmers is set to flex some muscle in global abalone circles. In an approach similar to that of Wines of SA, the new abalone association's mandate is to promote all SA farmed abalone in key international markets. Cultured *haliotis midae* will have international strategic advertising and promotional campaigns extolling its gastronomic virtues. The council plans to grow market share by building brand awareness among consumers and in the trade in primary markets, beginning with Hong Kong and moving on to mainland China.

Full story at :- http://allafrica.com/stories/200803030666.html

### Abalone fishing ban now in force

From the Times by Tamlyn Stewart

Hundreds of Western Cape abalone fishermen will be rendered destitute by the government's ban on commercial abalone fishing, which came into effect on Friday, 1st February, and there is still no sign of the government's promised social plan of assistance. Environmental Affairs Minister Marthinus van Schalkwyk caused an outcry in October last year when he announced that all wild abalone fishing would be suspended from November 1st 2007. The response forced him to backtrack a week later and postpone the suspension to last week. While the ban is aimed at protecting dwindling stocks, collecting abalone is how many Western Cape communities make their living. Marine and Coastal Management spokeswoman, Carol Moses, said that the department of environmental affairs had set aside R100- million for the development of aquaculture projects.

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But the Democratic Alliance's environment spokesman, Gareth Morgan, said the process had been "poorly thought out" and would not alleviate any short-term problems for abalone fishermen. He said aquaculture projects cost hundreds of thousands of Rands to set up, and there was a long lead time before such projects got going. Bryan Havermann, national director of conservation at the Wildlife and Environment Society of South Africa, said the country's abalone stocks had dwindled to "critical levels. We did say we supported the ban but it does have huge implications for people who rely on it for their livelihood. We need to take drastic measures, but it has become a biodiversity issue versus a social issue," he said.

Fishermen who have no other means of earning a living could be forced to collect abalone illegally. "They will be arrested in accordance with the Marine Living Resources Act. The harvesting of wild stocks of abalone is illegal," Moses said. "The reality is that Marine and Coastal Management does not have the resources to stop poaching. Poaching takes place before Marine and Coastal Management staff are even on duty," she said.

http://www.thetimes.co.za/News/Article.aspx?id=697894

## Marine Aquaculture cluster planned for East London

By Chanel Pringle

Plans are underway to establish a marine aquaculture cluster at the ELIDZ in South Africa.

"This cluster is aimed at those who cultivate abalone, fish, and shrimp, and we want to take advantage of our coastal location with this cluster. There are huge markets in the East for these products," said Simphiwe Kondlo, CEO of East London Industrial Development Zone (ELIDZ). Other priorities for ELIDZ include continuing work on its information and communication technology, electronics, and business process outsourcing and offshoring cluster, which it is has been working on for some time, as well as its agroprocessing cluster, which includes food processing, timber processing, and biofuels. "We are looking at following up with our third cluster, the agroprocessing and food processing cluster this year," says Kondlo.

Full story at:- http://www.engineeringnews.co.za/article.php?a_id=125151

## Abalone farming creates employment in Australia

With more than 40 workers on its books, Australian Bight Abalone is having an enormous impact on the West Coast town of Elliston. The town and surrounds had a population of only 377 on Census night 2006, with just 188 of those employed. By June next year the company expects to have 90 Elliston workers as well as staff in the Adelaide office it is opening on Greenhill Rd next month.

``We've got to find these people," ABA chief executive Andrew Ferguson said. ``It's not access to capital that will hold us back. It's not the ability of the farms to work. It's not the demand side. It's finding people."

While there was opposition from environmentalists and surfers when the venture began, this has now dissipated. ``At least 90 per cent of the town is right behind us," said ABA director Ken Bascomb, whose family has been in the district for generations. ABA also has other aquaculture sites as well

http://www.news.com.au/adelaidenow/story/0,22606,23201763-5003680,00.html

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## Advertisement

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## Abalone farm in Port Elizabeth sold

From Cape Business News

Transnet Limited and Premier Fishing, have concluded an agreement for the sale of Marine Growers, Transnet's abalone farm in Port Elizabeth, to Sekunjalo. Mr Mo Kajee, CEO of Sekunjalo Investments Limited, says, "This acquisition is in line with the Group's strategy to grow its aquaculture interests to meet the growing local and international demand. The capacity of the Group's abalone farm in Gansbaai is in the process of being expanded to 150 tons per annum to meet international demand. The purchase of Marine Growers strengthens our position where we will have additional product to supply the market and also to improve our pipeline in the expansion of the Gansbaai farm."

Last year the total export production for SA was around 1 000 tons. Mr Kajee believes that the export capacity for SA abalone could be 3 000 to 5 000 tons per annum. "It was important to get a foothold on the farm in the Eastern Cape which has an excellent growth rate. This is an opportunity to increase our SA market share significantly over the next three to five years. Furthermore, we believe that the demand for SA abalone from China alone could be as much as 3 000 and 5 000 tons per annum. The rest of the Asian market is growing and could demand a further 2 000 tons" said Kajee. With the decline in fishing resources worldwide, the effects of climate change on the ocean and the demand for healthy living, the demand for aquaculture products will be growing year–on-year.

Full story http://www.cbn.co.za/dailynews/2717.html

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## Catfish

No submissions

## Crayfish and Lobsters

### Lobster polyculture research

By Andrew Gomes

Cages submerged in the ocean off Hawaii are a growing venue for farming fish, and now a research team plans to study the viability of adding Hawaiian lobster and shrimp to the mix. The idea is that bottom-feeding crustaceans can conveniently live off the waste and uneaten food falling from the fish into a separate cage below. The setup, if feasible, would blunt one of the chief criticisms of open-ocean aquaculture, that it produces concentrated levels of fish feces that harm the environment. Full story at the link below.

http://the.honoluluadvertiser.com/article/2008/Feb/17/bz/hawaii802170340.html

## Eels

No submissions

## Ornamentals

### Worlds biggest Ornamental fish show

Information from Practical Fishkeeping


Aquarama, the world's biggest ornamental fish show was recently held in Singapore. When it comes to fishkeeping events there are few, if any, that can top this one. Known as the tenth International Ornamental Fish and Accessories Exhibition, there were some 200 exhibitors, 6000 trade visitors and 25,000 visitors, all housed in the dedicated convention facility at Suntec. It covered a vast 10,000 square meters, and was laid out at about three quarters trade stands to one quarter fish show. The trade stands had companies showing off their wares and generating as much new business and publicity as they could. The fish show is laid out with identical tanks in each category being built into special walk-around displays for each species. Entries were on display for four days. As Singapore is the world's largest exporter of tropical fish, about half the trade stands were fish breeding and exporting companies, and of those, about half again were dragonfish breeders.

The next Aquarama will be in 2009: www.aquarama.com.sg

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More stories from the event below.

Live Aquarama coverage from Singapore
Aquarama 2007 opens in Singapore
More to come from Aquarama...
Raffles Arowana takes top prize at Aquarama
Aquarama's most expensive fish?
Aquarama Planted Tank Competition
Plecos at Aquarama
Discus at Aquarama
Arowana harvesting in Singapore
Tank-bred Puntius denisonii
The big three
Goldfish at Aquarama

Full report at http://www.practicalfishkeeping.co.uk/pfk/pages/show_article.php?article_id=642

## Oysters & Mussels

### Man made Oyster reefs thriving in the US

By Lawrence Latane III.

Scientists got a rare look at sunken treasure as they eagerly watched a man-made oyster reef emerge from the bottom of the Rappahannock River. Pulled out by a crane mounted on a barge and hovering over the river, the 6-ton concrete rectangle came up dripping salt water and mud crabs and bristling with clues that Virginia's native oyster might yet find a future in the Chesapeake Bay.

"This is what we were waiting to see," said Virginia Institute of Marine Science professor Rom Lipcius as he reached out to touch a hand-sized oyster growing from the module that had been sunk nearly seven years ago. The size of the oyster suggests it is 5 or 6 years old. That means it managed to survive and propagate despite disease onslaughts that have all but destroyed the bay's once-mighty oyster population. Hundreds more of its kind in all sizes wrapped the module like a rough wool sweater. Best described as a concrete layer cake made of 7-foot wide by 7-foot long layers of honey-combed precast concrete, the module had been sitting on the bottom in 28 feet of water since 2000. It marked the center of a broad field of concrete rubble placed in the river beginning in 1999 as a test of its appeal to oysters. Having studied a portion of the reef two years ago, Lipcius suspects the module and surrounding rubble have the densest oyster population in the bay. "What you don't see are the 170 reefs out here. Each is seven layers of 12-foot by 12-foot sections of concrete pavement," Lipcius said. He estimated that there are no less than 2 million and possibly more than 5 million oysters amid the reefs.

Robert W. Jensen conceived the idea of using scrap concrete as oyster reef several years ago when the nearby Norris Bridge was undergoing major renovations. Jensen got state approval to create two reef sites in the lower Rappahannock. He says the idea ought to be expanded throughout the bay's oyster-growing regions to revive the species. He dismisses sceptics who long ago concluded that what he was really promoting was a cheap place for contractors to dump used concrete. "I'm doing this because it's something that needs to be done," he said.
Jensen deployed the reefs and checks on them periodically with the help of McLean, a Maryland-based marine-contracting firm that did the Norris Bridge repair work. One of the company's floating cranes was on the river last week to replace a worn fastener in a bridge-support beam. That gave Jensen and Lipcius a chance to use the crane to lift the concrete module for the first time since it

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had been dropped overboard.

Virginia Institute of Marine Science graduate student Russell Burke is writing his dissertation on Jensen's effort. It is titled "The Use of Alternative Substrate for Native Oyster Restoration." Lipcius said the layers of concrete comprising the module can quickly increase oyster populations. Oysters need a clean hard surface for attachment after an initial start in life as free-floating larvae. All manner of aquatic life colonizes the modules. Artificial reefs, Lipcius said, attract fish, support oysters and other bivalves that filter and clean water. Research continues on the structures. VIMS has deployed some of its own 4-foot by 4-foot modules in the bay near Poquoson for study purposes and is planning to place addition modules in the Lynnhaven River and Broad Bay near Virginia Beach. The more Lipcius learns about the Rappahannock reefs, the more he likes them.

http://www.inrich.com/cva/ric/news/state.apx.-content-articles-RTD-2007-11-05-0128.html

See also:-

http://www.dailypress.com/business/dp-biz_oysterreport_0117jan17,0,5015514.story

### Exotic sex lives of oysters revealed

Pacific oysters have an extraordinarily diverse range of proteins on the surfaces of their sperm and eggs and these proteins take the place of the behavioural mechanisms that act in other organisms.

http://www.telegraph.co.uk/earth/main.jhtml?xml=/earth/2008/02/11/scioyster111.xml

## Shrimp and Prawns

### Sea Ark secures contract in Saudi Arabia

Sea Ark, which produces prawns at Coega in the Eastern Cape, South Africa, said it had signed a R70-million agreement for the use of its locally developed prawn farming system in Saudi Arabia. Sea Ark will develop a commercial pilot plant at the existing open-pond prawn farming facility of the Al Faulk Group in Jeddah.

Article at http://www.growfish.com.au/content.asp?ContentId=10825

### Genetic selection in Hawaii

The Oceanic Institute is developing advanced selective breeding techniques, disease management control methods and intensive production systems that are biologically sustainable. It owns the most genetically diverse population of shrimp, and keeps records of all shrimp pedigrees. They claim to be able to improve the animal genetically while minimizing inbreeding, and take the best animals from the diverse population to make them available to industry.

http://starbulletin.com/2008/02/25/news/story04.html

### Triploid prawns developed in Australia

From the FishEnews newsletter

A technique developed at the University of Queensland is intended to provide the Australian prawn farming industry with a competitive edge over international producers. The process results in prawns with three sets of chromosomes rather than the norm, which is two. The treated prawns are

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invariably female which means they are larger than males by some 30 per cent on harvesting after six months. Large prawns, weight for weight, command a higher price than smaller animals. The technique was developed by molecular biologist Dr Melony Sellars. Two minutes after female prawns release their eggs, the eggs are subjected to an environmental shock involving a sudden increase in temperature. The shock interrupts the process under which an egg is generated with half of its mother's chromosomes and is available for fertilisation by adding a second set of chromosomes from a male. Both sets of female chromosomes are retained, while sperm provides a third set, creating triploid prawns. Another advantage of triploids is that they have greater genetic diversity and potentially a greater chance of responding well to changed environmental conditions, and to disease threats. The intent is to verify that increased genetic diversity is an advantage. The prawns produced using Dr Sellar's technique are completely sterile, preventing other breeders from taking benefiting from the genetic advantages. Thus the prawns cannot affect natural populations via an accidental release into the environment, and a revenue stream is available since farmers must regularly purchase seed stock. Work to date has been performed under laboratory conditions. Development of a commercial process for the environmental shock treatment, which demands great precision is underway.

## Tilapia

### FISH INFO network Market Report on Tilapia

http://www.eurofish.dk/indexSub.php?id=3529

### 25 Million Tilapia killed by cold weather in Israel

By Yaakov Lappin in the Jerusalem Post

Kibbutz fishing industry leaders recently held an emergency meeting with local council heads in the North following the death of 25 million tilapia fish during the recent cold spell. Fish farms in the Emek Hama'ayanot region make up 80 percent of the fishing trade in Israel, and took a battering during the unusually cold weather. The full extent of the damage is only being realized now, industry representatives said.

Tilapia fish are especially sensitive to the cold. Carp, on the other hand, are resilient to cold weather, and were not affected by the weather. The Emek Hama'ayanot Regional Council estimated the damage to be worth NIS 60 million, and has initiated a rescue plan aimed at focusing government aid to the worst affected areas.

### International Tilapia market in turmoil after large losses in China

From Intrafish

Buyers and suppliers of frozen tilapia are bracing for major disruptions in the market over the next year as the devastating extent of losses in China becomes clearer. The latest estimates from tilapia suppliers and buyers put total losses from the late January cold snap at upwards of 70 percent of the current crop in mainland China, a huge volume loss no supplier could put an accurate figure to.

Though primarily market-sized fish were lost in the die-off, fingerlings and broodstock were also affected, which could extend the impact of the losses into 2009. Nearly all suppliers questioned on the impact said supplies of frozen tilapia out of China will be extremely tight until at least the end of the year. Three Chinese provinces were hit hard by the cold weather. Guangxi and Fujing, where some 10 percent of the tilapia is produced, were nearly decimated. Guangdong province, where

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some 60 percent of China's tilapia is grown, lost between 60 percent and 70 percent of its current crop. Hainan Island, another major tilapia production area, was reportedly spared losses. The impact on market prices is being felt, several sources said. Estimates of the rises in China market prices range from some 30 percent on the low end to 100 percent on the high end.
"It's huge. It's going to have a big impact," said Jason Carter, marketing director at Behai-based Elite Seafood, which raises 50 percent of its tilapia in ponds and 50 percent in cages. "It's going to cause some challenges in the market." The effect on the wider tilapia market is as of yet unclear. Nervous buyers have heard all kinds of reports about the extent of the damage, but are only beginning to realize they will likely face at the very least volume reductions or disruptions to their programs. Ronald Patton, president of tilapia producer Grobest USA, a subsidiary of Taiwan-based tilapia farmer and processor Grobest, said those companies that can supply fish will no doubt be forced to raise prices. "There will be fish," Patton said of Grobest's program business. "The question is price." Jim Nunneley, vice president of sales and marketing for Rain Forest Aquaculture, which farms tilapia in Costa Rica, said for now, there are more questions than answers. "It's huge, but the market hasn't really reacted yet," Nunnely told IntraFish.
Mike Picchietti, president of Regal Springs Tilapia, which produces in tilapia in Honduras and Indonesia, agreed with Nunnely the tilapia market in the United States has yet to move on the news. "I'd say people will have to pay more if they want tilapia," Picchietti said.
The biggest questions surround price and inventory levels in the United States. Importers brought in huge volumes of tilapia in the third and fourth quarters in anticipation of Lent.
With no accurate picture of how long those suppliers will last, it's difficult for buyers or suppliers to know how the market situation will look the next few months. Program business and newly launched tilapia products in particular will be concerned about the supply disruption. With China still in the grip of winter, questions remain about any further impact on supply. Questions also linger about the reliability of supply for what has become one of America's most popular fish.

## Trout and Salmon

### Scientists refute Report on sea lice

Twenty of the world's leading fisheries scientists have concluded that a recent study on the effects of sea lice on juvenile wild salmon fails to support its own hypothesis, according to a new study to be published in "Reviews in Fisheries Science". This peer reviewed paper by Brooks and Jones can be read here :-

http://www.salmonfarmers.org/attachments/01_30_08_Brooks_and_Jones_%20In_press.pdf

The group of senior scientists analyzed a controversial paper recently published in Science magazine last month by Krkosek et al (2007). The Krkosek et al. study had concluded that sea lice associated with salmon farming in British Columbia's Broughton Archipelago region is leading to the eminent extinction of local pink salmon stocks. The latest peer reviewed study by lead authors Kenneth M. Brooks and Simon R.M. Jones, concludes that by using selective data, questionable analytical procedures and unsubstantiated assumptions, the dire predictions made by Krkosek et al. are completely unfounded. In fact, contrary to the conclusions reached by Krkosek et al., Broughton pink salmon have been steadily increasing with no indication that they are threatened with extinction. The Krkosek study failed to demonstrate any cause and effect relationship between sea lice infected pink salmon fry and larval lice on farmed salmon. Additionally, pink salmon mortality rates are not substantiated, faulty mathematical models are used and existing science that does not support the authors conclusions is omitted.

Full article with more links at:-

http://www.aquafeed.com/read-article.php?id=2283&sectionid=1

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## Genetic discovery will produce healthier fish

From the Fish Site

Norwegian researchers have identified a gene that controls the fish's susceptibility to infectious pancreatic necrosis (IPN), a viral disease which has cost Norwegian aquaculture great losses. This significant breakthrough in molecular research will aid productivity and profits for the aquaculture industry, as a result of fewer losses and better fish welfare, says Aqua Gen the company that discovered the gene. The technology has already been implemented in the company's practical selective breeding, and it has plans to expand the research to include other important viral diseases, such as pancreas disease (PD).

http://www.thefishsite.com/fishnews/6287/genetic-discovey-will-produce-healthier-farmed-fish

## Salmon history and diminishing runs on the Columbia river

A good report on the plight of America's once most prolific fisheries, the Columbia River, and efforts to save its diminishing salmon runs.

http://www.motherearthnews.com/Nature-Community/1994-08-01/End-of-the-Line.aspx

# Other

## Marine aquaculture grows in Australia

(Kingfish, *Seriola lalandi lalandi* is known as Yellowtail in South Africa - Ed.)

When Port Lincoln seafood magnate Hagen Stehr floated Clean Seas Tuna in late 2005, the market was sceptical. Fish farming, breeding tuna and a Port Lincoln tuna fisherman were all fairly new to the stock market. Since then the dynamic fisherman, who is as comfortable in the circles of power in Adelaide as he is on a fishing boat, has surprised the market and even himself with the growth of a Clean Seas sideline business - kingfish farming.

The kingfish success has helped the Clean Seas share price rise from the float price of 50c to $1.81, while the serious business of attempting to breed tuna continues. While academics have for years described aquaculture as an industry of the future, Mr Stehr is gaining widespread respect for his ability to achieve progress. The kingfish harvest has grown from a weekly 300kg to 50 tonnes worth $500,000 a week and is marching towards 200 tonnes a week in the next few years. In the same time the farm-gate price of kingfish has jumped from $4.60kg to about $10.75kg.

Markets in Russia and Europe are taking up to 25 tonnes at a time, while domestic consumers are increasingly finding favour with farmed kingfish. The simple equation of the world's growing demand for seafood versus the declining wild catch is a strong argument in its favour. After the farming of Atlantic salmon in Tasmania and tuna at Port Lincoln, kingfish has emerged as the third great finfish success of Australian aquaculture. The ambitious businessman is confident the breeding of tuna will be achieved before too long, providing further impetus for growth. The local industry is so confident it will be achieved that Primary Industries and Resources South Australia is forecasting annual production of propagated tuna of 10,000 tonnes annually by about 2013. It will greatly expand the local tuna industry with the annual farm turn-off from wild caught tuna forecast to be 10,500 tonnes by then. Clean Seas, apart from providing substantial economic benefits to the state, has increased employment from about 20 people when it floated to about 200.

http://www.news.com.au/adelaidenow/story/0,22606,23201754-5003680,00.html

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### Tuna cage farming in Malta

By James Debono in Malta Today

A total of 80 cages used for aquaculture in Malta occupy a surface area of 78,773 square metres, as much as 11 football pitches, the recently published Census on Fisheries published by the National Office of Statistics reveals. According to the NSO, total production of farmed fish in 2005 amounted to 5.1 million kilograms, yielding a value of €48 million. Bluefin tuna alone, which accounted for 82.6% of the total weight of farmed fish, yielded €44 million. Aquaculture in Malta currently employs 192 persons, 130 of whom working on a full-time basis and the remaining 62 on part-time. 28 are foreign workers.
Surprisingly the census refers to tuna penning under the misnomer of tuna farming. The World Wildlife Fund distinguishes between true aquaculture, where fish are bred and reared in captivity; and tuna penning, which involves the fattening in cages of wild-caught tuna. The WWF warns that overfishing of tuna ranched in countries like Malta could lead to the extinction of the species.
In October 2007 it called for an immediate three-year closure of the Mediterranean Bluefin tuna fishery, following a season of unprecedented illegal and uncontrolled fishing.

### Electricity failure! ----- Beware South African fish farmers!

From the New Straights Times, Malaysia

A cut in power supply for six hours cost a fish breeder losses of RM1 million after some 150,000 Barramundi died when its oxygen supply was interrupted. Relating the incident, Lim Bun Thong said at 9.30pm the power supply was suddenly interrupted. Knowing that the fish would only survive for three hours without oxygen, he quickly called the local electricity company. The power supply was down until 3.30am and the dead fish started floating on the pond. Lim started to breed the barramundi seven months ago. They would weigh between 600g and 2kg when fully grown, and when sold to wholesalers would fetch RM12 per kilogram for the Chinese New Year celebrations.

## Feeds

No submissions

## Environment, Health and Disease issues

### US researchers in vaccine breakthrough

From the Fish Farmer

In preliminary trials, NOAA Sea Grant researchers have for the first time demonstrated the feasibility of using a live-attenuated vaccine to prevent the deadly *Streptococcus iniae* infection in

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fish. The success raises the possibility of being able to inoculate hybrid striped bass, tilapia, rainbow trout and other cultured species orally through feed, instead of having to inject individual fish, a prohibitively labour intensive process for American farms.

Besides the economic benefits, live-attenuated vaccines also stimulate a more robust immune response than vaccines from killed pathogens, thus offering better protection from infection, said John Buchanan, a former researcher at the University of California at San Diego. There are currently two vaccines on the market for preventing *S. iniae* infections, AquaVac Garvetil and Norvax Strep Si. Both are classical vaccines based on exposing fish to killed versions of bacterial pathogens. However, neither is approved for use in the United States, Buchanan said. In addition, AquaVac is for use in tilapia only, and Norvax is most effective when fish are immersed in a 60 second dip initially; subsequent booster doses can be delivered orally.

The vaccine that Buchanan and UC San Diego pediatrics professor Victor Nizet are testing, in collaboration with Kent SeaTech, is based on mutating genes of the bacterial pathogen, not on killing the pathogen outright. These mutants have weakened virulence, but they can still infect fish, eliciting a strong adaptive immune response, in which antibodies to the real pathogen are created. In the trials so far, their vaccine has been administered through injection, which means that each fish has to be given a shot. However, as Jim Carlberg, president of Kent SeaTech, emphasised "The beauty of live-attenuated vaccines is that you have the potential to put the vaccine in feed." The key is to be able to mutate a gene that does not wipe out the weakened pathogen's ability to orally infect the animal. "A vaccine that can be put in feed would have a huge potential advantage in cost," Carlberg said. "Oral delivery is the gold standard for aquaculture," agreed Jeff Locke, a doctoral student with Nizet, who used to work at Kent SeaTech, a large hybrid striped bass farm in Southern California.

*S. iniae* is a ubiquitous disease and a fairly chronic problem. It has a huge economic impact on worldwide aquaculture. About 26 species of fish are susceptible to *S. iniae*, which causes meningitis.

## Aquaculture Vaccines – progress and the future

The rapid progress in the development and delivery of fish vaccines for a wide range of species is now providing significant health and economic benefits to world aquaculture, says leading immunologist Professor Patrick Smith. Speaking at the thirteenth Annual Conference of the European Association of Fish Pathologists hosted in Grado, Italy, the Director of Schering Plough's Global Aquaculture new business development/feasibility unit, was also awarded honorary membership of the organisation in recognition of his lifelong work for aquatic animal health. In his plenary session lecture - 'Fish vaccines - a short but remarkable journey', Professor Smith highlighted the major benefits now derived from a continual commitment to research.

http://www.thefishsite.com/fishnews/6298/aquaculture-vaccines-25-years-progress-and-a-vision-for-the-future

## Can Seafood be organic?

Article from the Organic Guide

Sustainable and organic practices are a relatively new development in ocean-based aquaculture. In order to achieve their provisional organic status, aquatic farms must establish a range of ecologically sound practices which include their commitment to stock welfare, habitat protection, prohibitions on chemical use, and consumer safety. A distinctive characteristic of most organic farms is their scale of operation. By raising smaller quantities of fish, the potential for disease and habitat degradation is significantly decreased. This assists organic sea farmers in maintaining high standards of product quality and also increases their ability to respond quickly to consumer demands and preferences. For full article see:-

http://www.organicguide.com/food-drink/seafood/is-seafood-organic/

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# Research matters, Reviews & Training

## Farming fish for profits: A small step towards food security in sub-Saharan Africa

Paper by Nathanael Hishamunda and Neil B. Ridler

Abstract

In addition to volatile fluctuations due to seasonal or regional factors, food security has two main components; access and availability. This paper presents a diagrammatical model to indicate how aquaculture, particularly private sector aquaculture, can contribute to these components of food security in sub-Sahara Africa. Food accessibility is increased when commercial aquaculture generates employment. Without such employment the poor might never translate their need for food into effective demand. Food availability is increased, either immediately when aquaculture output is sold in the domestic market, or later when the foreign exchange earned from aquaculture exports is used to import food.

This paper does not argue that commercial aquaculture will eliminate poverty within sub-Sahara Africa. The sector is too marginal. However, it can be one “small step” among others. Moreover, driven by the private sector, commercial aquaculture does not need onerous public (or donor) funding. It therefore should not be ignored by policy-makers. At the local level the impact on communities can be dramatic. This is illustrated in the Kariba area of Zimbabwe, where commercial tilapia farms provide jobs and incomes in an impoverished region. These incomes enable workers and their families to purchase food. In addition the farms supply the local population with whole fish and fish heads, which are a source of protein. Some policy options are suggested to promote private investment in the sector, with an emphasis on polices that incur few government expenditures.

Full paper :- http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VCB-4J624WX-1&_user=6142859&_coverDate=10%2F31%2F2006&_alid=681013326&_rdoc=15&_fmt=full&_orig=search&_cdi=5950&_sort=d&_docanchor=&_artOutline=Y&view=c&_ct=126&_acct=C000032099&_version=1&_urlVersion=0&_userid=6142859&md5=2de1bf6deec56e9a0ec6bbb67649a3a8#bbib10

## Gene Banking aquatic species in India

By Ashok B Sharma in the Financial Express

The Lucknow-based National Bureau of Fish Genetic Resources (NBFGR) has begun the process of Indian fish germplasm accessions with a view to develop a repository for future use and as well as for protecting the Indian species from bio-piracy. The Indian Council of Agricultural Research (ICAR) has constituted a six-member committee headed by its deputy director-general for fisheries for protection of fish germplasm through registration and documentation. NBFGR as a nodal agency has issued the necessary guidelines for implementation.

India has rich aquatic biodiversity spread across different ecosystems. Out of the the 27,800 fish species found across the world, about 11% are found in Indian waters. Apart from finfish resources, nearly 2934 species of crustaceans, 5000 species of mollusks and 765 species of echinoderms also contribute to India's rich aquatic germplasm resources, according to AD Diwan, assistant director-general of fisheries.

India is the fourth largest producer of fish in the world and second largest producer of inland fish. The total fish production is around 6 million tonne per year. The fishery sector provides

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employment to seven million people and its share in the GDP is around 1.4%. Majority of aquaculture is supported by three species of Indian major carps and one species of shrimp.

Natural aquatic germplasm resources are important as majority of the genetic resources for food still come from the wild due to low documentation level in the fishery sector. In other words, capture fishery is equally important as breeding for nutritional security across the globe. This is in contrast to the animal farming and agriculture where domesticated varieties only contribute to the food basket. Aquatic germplasm resources are also an important source of various products of commercial value and to sustain other related trades like ornamental fishes.

“The NBFGR has taken up the challenge to secure the Intellectual Property Rights (IPRs) related to aquatic germplasm so that the country is able to maintain its stake on its natural wealth and their potential benefits,” said a senior scientist. He said that the repositories would store the accessions of genetic stocks discovered and varieties developed. It would maintain accessions for future use to retrieve information as well as whole or part of genome, if species were not found in nature.

To harness the potential of biotechnological innovations, it will be essential that DNA, whole and modified as gene constructs be part of the repository and added this would also provide material for future research work. The species level accessions can be secured through building DNA and tissue banks as a fast mode to store materials for long term. Sperm or cells and live gene bank accessions can be made only for prioritized and selected fish species. Identification of genetic stock or races in the wild populations of cultivable fish species would be taken up through concentrated efforts using molecular markers, morphological and production traits.

http://www.financialexpress.com/news/Indian-begins-documenting-fish-species/266209/

## Cuttlefish bred and grown in captivity

From the Taipei Times

National Penghu University has successfully cultivated cuttlefish in a fully controlled environment, an achievement that could help stop cuttlefish dwindling in the wild. "The birth of the cuttlefish in an artificially controlled environment is the first program of its kind in Taiwan," said Wong Chin-ping, a university researcher. Wong said the research team successfully cultivated 1,500 cuttlefish last spring from 2,000 eggs collected in the wild. One hundred of those were raised in a tank at a laboratory and were fed shrimp. The cuttlefish grew rapidly to weigh 500g to 800g at nine months. They later laid eggs, producing around 1,000 cuttlefish of 1cm to 3cm in size. About 500 of them died before reaching maturity. The project's aim is to enable Taiwan to mass produce cuttlefish, a popular seafood, for consumption. However, in recent years, the number of cuttlefish in the wild has dropped sharply. Only a few research teams have been trying to raise them in tanks.

The mollusc used in the project is the pharaoh cuttlefish. Its normal life expectancy is about one year and it lays approximately 300 to 500 eggs only once in its lifetime, Wong said. Under "full cultivation" conditions, the survival rate of the cuttlefish species in the project has been 80 percent so far, a rate that is far higher than in the wild, said Hsue Yung-lin, a university student participating in the program. Hsue said that the cuttlefish grew more quickly in captivity because of the feed provided to them.

## European research on fish as human food project

From Cordis News

From cod liver oil to Omega 3 in salmon, the health benefits of eating fish have long been promoted, and still are by modern doctors. Eager to further propagate these 'fishy' benefits, the EU has been providing funding to research projects investigating the benefits of fish and seafood in the human diet.

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The biggest project to date in this area is SEAFOODplus, a one-of-a-kind, integrated seafood research project, or indeed series of projects, as it involves some 20 different studies. It has a strategic objective to minimise health problems for consumers and provide them with healthier, safer food products. With (€)14.4 million in European Commission support and headed by Professor Torger Børresen of the Danish Institute for Fisheries Research, SEAFOODplus will improve the use of by-products, ensure fish farming is ethically responsible, and that goods are tailor-made.

http://cordis.europa.eu/fetch?CALLER=EN_NEWS&ACTION=D&SESSION=&RCN=29043

Project website:- http://www.seafoodplus.org

## Regulatory matters

### Freshwater Fish introductions are rarely a threat to the Environment

By Alister Doyle, Reuters

Freshwater fish can be introduced more safely than expected to new regions for farming with fewer than 10 percent damaging wildlife in their new homes. Many countries wrongly view alien fish species, such as trout, catfish, perch or salmon, as posing a big risk when put in new rivers and lakes, said Rodolphe Gozlan, a French scientist who works at Bournemouth University in Britain.

"We shouldn't exaggerate the risks of non-native species," Gozlan, who also advises the European Commission on the safety of fish farming, told Reuters. "The risk of ecological impact after the introduction of a freshwater fish species is less than 10 percent for the great majority of fish species introduced," he wrote in the March edition of the journal Fish and Fisheries.

Some types, such as the perch or catfish, were more likely to cause disruptions. But many nations had accepted the view that all alien fish were "guilty until proven innocent", he said. A study of 103 introduced fish species in an aquaculture database by the U.N.'s Food and Agriculture Organization showed that 54 were reported with no adverse impact on their new habitats. "Fish farming will expand around the world in coming years," Gozlan said. "Overfishing at sea is not sustainable and we will have to rely more on farmed fish."

That meant it made more sense for governments to assess the risks of new species rather than seek to ban them.

Full story at:-

http://www.reuters.com/article/latestCrisis/idUSL19493273

## Conferences & Upcoming events

### Upcoming events in the Western Cape

Southern Aquaculture Working Group: 23 April 200

Training workshop on Life Skills and Business Skills: 19-22 May 2008

Training workshop on Aquaculture Skills: 26-30 May 2008

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See above under Dr. Lizeth Botes CEO AISA comment for more details lbotes@ai-sa.org.za

### Offshore Mariculture in Spain

Offshore Mariculture 2008 will held at the Alicante Congress Centre on 22-24 October 2008. A two day conference with the third day dedicated to fish farm and technical centre visits. Website:-

http://www.offshoremariculture.com/

### Upcoming International Aquaculture events

WORLD AQUACULTURE 2008
Busan, Korea - May 19-23, 2008

AUSTRALASIAN AQUACULTURE 2008
Brisbane, Australia - August 3-6, 2008

AQUACULTURE EUROPE 2008
Krakow, Poland - September 15-18, 2008

AQUACULTURE AMERICA 2009
Seattle, Washington, USA - February 15-18, 2009

WORLD AQUACULTURE 2009
Veracruz, Mexico - May 25-29, 2009

AQUACULTURE 2010
San Diego, California, USA - March 1-5, 2010

Contact by phone or fax +32-9-2334912 E-mail: mario.stael@scarlet.be

Website: www.marevent.com

### 32nd Annual Larval Fish Conference

The 32nd Annual Larval Fish Conference will be held 4-7 August 2008 in Kiel Germany

http://www.larvalfishcon.org/

## Property

### Aquaculture farm for sale

This is a unique opportunity to own a beautiful piece of scenic Schoemanskloof in Mpumalanga, roughly equidistant 50 km between Machadodorp and Nelspruit, just off the N4. The farm is currently operating as part of one of the oldest goldfish and koi producers in SA. The purchase of this property offers the opportunity of getting into the aquaculture business, using existing infrastructure. While the farm currently operates as a portion of a 2-farm production line (hatchery/nursery phase), it is for sale as a workable, independent unit.

- 47 Ha farm, including ponds, a large portion of mountainous, virgin bush and a long stretch of prime river frontage
- 73 excavated earth ponds, 38 currently functional

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- One 15 Kw and one 22 Kw water pumps on Crocodile River
- Water supply to 22 ponds (surface area 0.89 Ha, volume 3333 cubic metres) from 22 Kw pump, approximately 20 cubic metres/hour
- Water supply to 16 ponds (surface area 1.73 Ha, volume 7923 cubic metres) from 15 Kw pump, approx. 30 cubic metres/hour or can be gravity fed from a water canal from the Crocodile River
- 4-bedroom cottage with pretty garden and stunning views, surrounded by electrified security fence
- Option to join the security radio network, operated by the local supportive and friendly community
- Electricity supply from Escom as well as a large back-up generator
- Staff accommodation
- Scheduled water allocation - 10 Ha
- This individual unit would be suitable for a variety of aquaculture ventures, including koi. Should it be needed, Falls Fish Farm (a long-established business), will be able to assist with marketing produce and advice, as required and negotiated
- In addition, should the buyer be interested, staff experienced and skilled in aquaculture would be available for employment
- The farm has magnificent views and the area is renowned for its birdlife (including the Narina Trogon, Knysna & Purple-Crested Turacos & African Finfoot) and the area also has a lot of wildlife, including caracal, hippos, porcupines, various buck and many others.

Price negotiable - please call to discuss if interested - (013) 733-3135 or 733-4179.

# Employment

### Employment sought 1

Specialized in AQUACULTURE NUTRITION during Post-Graduation and worked on the effect of salinity on food intake, growth, conversion efficiency and proximate composition in juveniles of Penaeus indicus for M.Sc. Dissertation. I have detailed knowledge on all aspects of shrimp farming operations: (Semi intensive, modified extensive, extensive using river / sea water / ground water for Penaeus monodon, P.indicus and Penaeus vannamei) besides exposure to culture of finfishes - Tilapia , Sea bass (Lates calcarifer), Cobia and Sea bream.

M. Kalyanaraman, Telephone: 00 91 80 25212565.(India)
E-mail: mkalyanaraman2003@yahoo.co.in

### Employment sought 2

Research and development, Supervision of tasks, Human resources and administration, Breeding of a large range of tropical fish species, Treatment of sick or distressed tropical & cold-water fish. Spawning & care of fish from the following Groups/Families
- Anabantidae
- Callichthyidae
- Characinae
- Cichlidae
- Cyprinidae
- Loricaridae
- Osphronemidae

Karl Smit Tel: 011 867 3035 Cell: 083 598 0506
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