AQUARIST & PONDKEEPER

DECEMBER 1995 £2.25

THE AQUARIST IN WINTER

CHRISTMAS GIFT IDEAS

POISONOUS STONEFISH

KEEPING: MADTOM CATS

BREEDING: ANNUAL KILLIFISH

KOI: SUCCESSFUL FILTERING

SPECIAL SUPPLEMENT: Setting up a Marine Aquarium

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Contents

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EDITOR John Dawes

ART EDITOR Adam Turner

ADVERTISEMENT MANAGER John Young
Tel: 0181 904 6686.

ADVERTISEMENT SALES
Caroline Kelly

ADVERTISEMENT PRODUCTION
Pauline Philpott

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9 Tufton Street, Ashford,
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features

MARINE CARE SUPPLEMENT

Also in this issue

editorial

END OF AN ERA... BIRTH OF A NEW ONE

Major changes have taken place at *A&P* since last month's issue. The most significant of these is that the magazine has been acquired by MJ Publications Ltd., a subsidiary of Ashford Composition Ltd. who, for some time now, have been responsible for all the typesetting, page design, etc.

This transfer of ownership has also resulted in other changes, the main one for Vivian (my wife) and me being that this is the last edition which we will be associated with as the editorial team. All communications from now on should therefore be addressed to **Jeff Swaffer, MJ Publications Ltd., Caxton House, Wellesley Road, Ashford, Kent TN24 8ET. Tel: 01233 636349; Fax: 01233 631239.**

It's a very sad day for us, of course, but it's the start of a new era for our beloved magazine and we wish Jeff and the team at MJ Publications Ltd., a happy and successful future as the new *A&P* owners.

Vivian and I have received incredible support, both from readers and contributors, throughout the many years that we've been working on the title and for that we'll be eternally grateful to you all. We've also been inundated with 'phone calls wishing us well, and these have not only been very touching, but also hugely uplifting.

We sincerely hope that our paths cross again in the future. In the meantime, though, we wish you the happiest of Christmases, a super New Year and a great aquatic 1996.

John Dawes

Tomorrow's Aquarist

BY GINA SANDFORD

BUG OF THE MONTH

At close quarters, *Daphnia* are creatures of great beauty.

This time, we look at our old friend *Daphnia*, the water flea. A familiar sight when sold in plastic bags as live food by your local retailer, it is an intriguing little creature that really deserves an article in its own right. As space is limited, I shall restrict myself to a few interesting things you might like to know about *Daphnia*.

Daphnia produce live young in summer and eggs in winter. The over-wintering eggs are frost-resistant.

① Use a good magnifying glass and you can easily see the developing eggs or young in the brood pouch of females.

② Water fleas are found in all sorts of water bodies and form a very important part of the food chain.

③ They eat planktonic algae.

④ If a pool is seasonal and dries out, the eggs will survive in the mud until the rains return.

⑤ There are 10 British species of *Daphnia* — but your fish don't mind which one you feed them!

⑥ Birds transport dormant *Daphnia* eggs from pond to pond, so a seasonal pool that is devoid of *Daphnia* one year, may be full of it the next.

⑦ *Daphnia* is a 'catch-all' term used by aquarists to cover water fleas in the order Cladocera, copepods and ostracods.

Christmas gifts

Two books and two jigsaw puzzles have come my way over the last month. All four would make excellent Christmas presents.

1 Books

The books are both published by **Blandford Press** in their **Aquarists' Handbooks** series, are soft backed and cost £9.99 each. They would both appeal to the novice and experienced aquarist.

I found that *Platies and Swordtails* by **Derek and Pat Lambert** was a 'sit down and read' book that covered everything from keeping and breeding to all the various varieties available in the hobby. (see also **Books for Christmas** by **John Dawes** elsewhere in this issue).

Corydoras Catfish by **Derek Lambourne**, on the other hand, was more a 'flick through to find out which one you've got'. I can imagine it being toted around the shops in your pocket or bag, just in case you come across something new, as the species descriptions make it fairly easy to distinguish one fish from another. I particularly like the breeding section in this one with plenty of hints and tips for you to succeed with breeding Corys.

The one complaint that I have is that these books are in soft-back, as I don't think they will stand the rigours of a judge's case or the exhibitor's pocket for long. Maybe this is a selling ploy — wear out one copy, buy another. Blow that, if mine fall apart, I'll punch the pages and put them in a ring file!

2 Puzzles

Now to the puzzles which are from **Orchard Toys.** The first called *Underwater Adventure* is aimed at 4 to 8-year-olds. A floor puzzle, it has 43 good-sized sturdy pieces, 5 of which are larger than the rest and interchangeable so that each time the child does the puzzle they get a different result (there are 120 different combinations). The final size of the puzzle is 61 x 42cm.

I 'floor tested' this on Rowan, my 5-year-old daughter and her friend Imogen, aged 6. Being mean, I didn't tell them about the interchangeable pieces, but it didn't take them long to find them out for themselves.

There were an awful lot of comments and giggles as they rearranged the pieces. It kept them occupied for well over an hour and anything that can do that, wins my vote.

The second is the beautifully illustrated *Pond Jigsaw*. 41cm in diameter, the outer edge is irregular to allow for plant foliage, toad feet, birds, etc, but the border is white so you can easily identify the pieces. Recommended for 7-year-olds to adults. Elaine, my 9-year-old, had the pleasure of trying this one out (afterwards, I tried it out too, and it's a pretty good puzzle whatever age you are!).

She found it fun to do because there was so much going on in it — a frog leaping into the water, fish swimming about, tadpoles, water snails, mallard, heron, kingfisher and the list goes on. Both she and I have done this puzzle more than once and each time we find something we missed seeing the time before.

The *Underwater Adventure* retails at around £6.25 and the *Pond Jigsaw* is around £5.50. Phone **Orchard Toys on 0115 937 3547** for your nearest stockist and/or a free catalogue and price list.

Sea Life Centre adventure

When **St. Matthews School, Redhill** asked if I'd like to go with them to the **Sea Life Centre in Brighton**, I was a little doubtful — there were 108 5- and 6-year-olds going. But, not being able to resist something fishy, I went.

We had a wonderful time, especially when it came to the touch pool. Crabs, and starfish were the favourites and some of the children were surprised at the velcrose-like feel when they touched the tentacles of the anemones. One of the high points was the star fish that had everted its stomach through its mouth so that it could eat its dinner.

More importantly, although they normally dealt with older children, the staff were able to put across information simply so that the young children in our party could understand.

If you are trying to find somewhere to go over the Christmas holidays, you might like to try your local Sea Life Centre. It should have a lot to offer.

GINA SANDFORD

The touch pool at the Sealife Centre at Brighton, caused great interest and enjoyment.

BACK TO BASICS:

The Perfect Christmas Present

As Dr Iggy Tavares explains, few gifts can be better than an aquarium at Christmas... even if you need to exercise a little patience before buying your fish

Photographs: Dr Iggy Tavares/Pentax UK Ltd.

Christmas will soon be upon us again and, apart from the religious aspects, it is a time for giving presents. What better present can you give your youngster than a freshwater aquarium set-up, which, with a little care, will last for several years?

It is expensive, you might say, but then, it's only in the same price region as an electronic game. Moreover, the electronic game will be played with for a couple of weeks before being put aside and forgotten, while an aquarium set-up could last for many years and generate a lifetime's interest in a healthy hobby.

Basic equipment

The old adage is to buy the biggest aquarium you can afford, but my aims here are to cater for a novice just starting out and to keep the price down to £100. Space, obviously, is another consideration, so I am going to price up for a 24-inch (60-cm) tank which I consider a good size for a beginner.

The basic equipment I would recommend would consist of a tank and hood, a stand, undergravel filter plates, an air pump, a heater thermostat, and lighting and gravel. A budget system advertised in *Aquarist and Pondkeeper* can be had for under £100 and this includes the stand.

Buying second-hand (always a few adverts in *A&P* and your local papers) will cut your outlay by more than 50% and could enable you to get a bigger set-up from the start. Alternatively, smaller (20-inch — 50-cm) pre-assembled plastic aquariums with built-in wet/dry filter, heater and lights are available at £80 to £100. For decoration, I would suggest some plastic plants and rocks for the beginner.

Setting up

The first task is to set up the stand and tank in the selected part of the room, which must have a strong floor capable of taking a 200 lb (90 kg) load. The undergravel filter plates with uplift tubes are fitted in the bottom of the tank, and then, the well washed gravel is placed on the filter plates to a minimum depth of 2.5 inches (6 cm).

Male Dwarf Flag Cichlid (*Laetacara curviceps*) for the slightly more adventurous beginner.

Complete set-ups, like this 20-inch acrylic tank, offer an easy all-inclusive start to the hobby.

The heater-thermostat, the plastic plants and other decorations are organised in the tank, and the outlet tube of the air pump is inserted in the uplift tube before filling the tank with water. The electrics are then switched on, a sachet of nitrifying bacteria added, together with some fish food, and the whole set-up allowed to settle for, at least, a couple of days, if not for a week. During this time, it would be best to check, at least, on the temperature, which should be around 25°C (77°C).

The fish

Community fish, which are reasonably peaceful, cheap and hardy are best for the beginner. My first suggestion would be to add half a dozen Zebra Danios (£5) to the tank, fed very lightly twice a day. Buy the rest of the fish a week later.

This gives the tank a chance to mature, with the growth in numbers of sufficient bacteria to break down the fish wastes. Zebra Danios are beautiful, hardy, shoaling fish which add a lot of activity to a tank.

The choice of other fish is endless. I have kept small shoals of Zebra Danios, Neons and Harlequins to provide a colourful active tank. Half a dozen each of Tiger Barbs and Zebra Danios is another good combination for a fast, active tank. Twelve to fourteen fish, depending on size, is the recommended maximum capacity for these smaller tanks.

Other fish that you might want to consider are Swordtails and Platies, as swell as a whole range of tetras such as Glowlights, Black Neons and Serpae Tetras, to name but a few.

One fish that I would recommend the beginner to avoid is the Black Molly, which, in reality, is a brackish water fish. In my experience, when kept in a freshwater tank, Black Mollies usually develop White Spot or some other illness, which then spreads to the rest of your community, resulting in inevitable losses.

Another fish to avoid is the baby Oscar. This beautiful-looking, initially small, cichlid grows at a tremendous rate and, in a matter of months, if not weeks, could be the sole occupant of your aquarium!

For the more adventurous, you might want to keep a relatively mild-mannered, hardy cichlid pair, such as the Dwarf Flag Cich-

Zebra Danios (this is a long-finned specimen) are great first fish... but get a small shoal and not a single specimen.

lid, which occupy the bottom of the tank most of the time. If you get a pair, they will, in time, spawn and both parents will then look after their young, giving their keeper a lot of pleasure.

Another suitable cichlid for the small beginner's tank is the colourful and hardy Kribensis or even a pair of Angelfish.

Just remember that small fish are food for big fish, so when making your final selection, do not get fish small enough to fit easily in the mouths of other aquarium occupants.

The cichlids suggested have been specially selected because of male-female compatibility during spawning and fry care. However, things could get a little rough towards other occupants during the spawning, but those that I have chosen are all fast-swimming species and come to little harm.

The aquarium, but without the heater is, of course, suitable for Goldfish as well, and would make an ideal home for three or four medium-sized fish. Other coldwater fish to choose from are Bitterlings, etc. Coldwater fish tanks should be more lightly stocked than tropicals.

Feeding and care

All the fish mentioned will eagerly eat a good quality flake food (I use Tetramin). This can be fed sparingly twice a day, with just enough food being given so that it is all eaten within two to three minutes.

Food should never be provided in excess so that it lies on the bottom rotting away and fouling the water. A lot of problems in tank maintenance with beginners is down to over-feeding.

It is probably best to leave live food feeding to when you have more experience. For example, I have learned that *Tubifex* worms spell trouble and I never feed it to any fish. I have lost many a prize fish to bacterial infections soon after feeding washed, apparently clean, *Tubifex*.

With light stocking and controlled feeding, the small aquarium should have relatively few maintenance requirements. This could amount to a 30% water change using a siphon every three weeks or so, during which time the gravel is also hoovered.

A slightly larger (24-in) all-glass tank with full complement of plastic plants.

Swordtails are fast-moving, colourful community fish.

An aquarium set-up is a beautiful gift which will be much appreciated for many years. It gives parents the chance to be involved with their children in setting up the aquarium and maybe even looking after the fish, something one would never get out of a video or electronic game. All the fish mentioned are undemanding and will happily eat flake. Maintenance is also easy.

So, be a little adventurous this Christmas and give your loved one an aquarium... but don't buy or give any fish until the tank has been set up for a little while and has had a chance to mature a bit.

Nowadays, all the best retailers will discourage you very firmly from buying fish at the same time as you buy the aquarium and associated equipment. Be sensible — don't insist in getting everything in one go. Heed their advice and your chances of success will be immeasurably enhanced.

AP

Growing Tips

BY BARRY R JAMES

BARRY JAMES

Hydroponically grown plants.

NO-SOIL CULTURE

Hydroponics is the technique for growing plants without using compost as rooting medium. Many of our aquarium plants are actually produced using this method. All the big continental and most British nurseries employ hydroponic methods to produce their plants. Further, an increasing number of Singaporean plant growers have, for many years, produced a proportion of their plants this way.

Some pros

There are many commercial advantages in using this technique. Foliage is not subject to snail attack and does not become smothered with the velvet-like alga *Audouinella*. The fertilisation regime can also be strictly controlled, giving just the right quantity and variety of elements and as these are mixed on a regular basis, no chemical degredation of fertilisers occurs.

With other techniques, such as CO_2 enrichment, high intensity lighting, misting and diurnal temperature control, plants can be produced on a controlled basis and in a much shorter period of time than would otherwise be the case with more old fashioned methods. All the programmes are overseen by computers.

One con

However, hydroponics can only be used with plants that can be grown emersed. Plants such as *Vallisneria* and *Cabomba* must still be grown in water tanks or open ponds and, due to their low cost, are mostly produced in an open field situation in the Far East.

DIY hydroponics

It should not be assumed by the hobbyist that this technique is purely the perogative of the professional grower. It is certainly possible, and indeed practical, to produce many species of common aquarium plants in a greenhouse or conservatory without going to any great expense, especially during the warmer months of the year.

All that is needed is an Ultratherm Vivarium heating mat and a standard greenhouse tray and canopy. In addition, an aquarium potting kit, a bottle of trace element solution and some basic fertiliser tablets will be required.

Potting kits contain 12 x 2in special-mesh pots plus, 12 x 2in square rockwool blocks. The rockwool blocks are split in half and juvenile plants or cuttings are laid on one half, with a basic fertiliser tablet placed underneath. The other half is folded over, rather in the manner of a sandwich, and the whole block inserted into the pot.

The tray is placed on top of the heating mat and half filled with softened water. The pots are then lined up in the tray and the canopy put over them to retain humidity. Place a damp cloth over the canopy for the first few days or the plants will become dessicated. After this time, the tissues will become hardened off and the cloth may be removed.

The amount of light needed will depend on the species being grown. *Bacopa*, *Hygrophila*, *Echinodorus* and *Marsilea* are just a few of the genera that will thrive under this treatment during the summer months.

When the plants are fully grown, they may be transferred to the aquarium. A minimum temperature of 20-25°C (68-77°F) should be maintained. It is very important to add a few drops of trace element solution every few days in order to supply essential nutrients, such as iron and manganese.

The ABC of Aquarium Plants

The Figwort family, or Scrophulariacea, contains over two hundred genera and over 3,000 species of mainly herbaceous plants. Its best known member is probably the Snapdragon, which gives a good idea of the type of flower produced by these plants.

Bacopa is a small genus with about 100 species, most of which grow in marshy areas throughout the tropical world and many of which are capable of growing in a submerged state. Several species have never found their way into aquaria, even though their original collectors have stated that they are eminently suitable. This is probably because of the isolated habitats in which they were found, such as Cuba and Central South America. Of the four species currently available, only one, *Bacopa amplexicaulis*, is difficult.

1 ***Bacopa caroliniana*** Wetist
Common Name: Red Bacopa.
Distribution: Southern North America.
Description: The thick, fleshy stems bear opposite, oval pale, green leaves which turn coppery in strong light. When grown emersed, it creeps along the mud, turning up at the ends and branching freely until it forms dense mats. Submerged, it grows bolt upright, reaching a length of 40cm (c16in).
Cultivation: It requires fresh, clear nutrient-rich water and strong illumination. Temperature: 18-26°C (64-79°F). It prefers soft water, but is not a calcifuge (i.e. it does not 'hate' calcium-containing water).

2 ***Bacopa monnieri*** Wetist.
Common name: Dwarf Bacopa.
Distribution: Cosmopolitan in tropical and sub-tropical areas.
Description: Similar to *B. caroliniana*, but smaller in all its parts. The leaves are thick and glossy. However, it can reach a length of 50cm (c20in).
Cultivation: The Dwarf Bacopa is an undemanding plant and will tolerate great neglect.

3 ***Bacopa myriophyloides***
Common name: none.
Distribution: Tropical South America.
Description: This charming little plant has thin stems surrounded by whorls of fine mid-green leaves. It reaches a height of only 20-30cm (8-12in) and is an ideal plant for the middle ground of the aquarium. Seldom imported, this species deserves to be better known.
Cultivation: It needs a mean low temperature of 22°C (c72°F) but will tolerate slightly higher degrees of warmth than the other two species described.

BARRY JAMES

***Bacopa caroliniana* — the so-called Red Bacopa.**

KEEPING:

MADTOMS

No, not demented moggies ... but interesting coldwater catfish related to Bullheads. Dr Peter Burgess reports on his experiences with these North American 'oddities'

Photographs by the author

One of my Madtoms (it's probably a Tadpole Madtom) seen from the side. Note the way that the tail fin (caudal) 'wraps' around its base.

I got a surprise one Saturday morning when an aquarist friend telephoned to say that he had seen three "mad toms" for sale in his local shop and knew I'd be interested. Still half asleep, I wondered why on earth should I want to buy a trio of demented cats?

But then the name dawned on me — "madtom" is a cat, of sorts, but not the feline type. It's a small North American catfish which is rarely seen for sale in the UK. Here was an opportunity too good to miss, so I dived into the car, negotiated the M25 motorway, and hoped that I'd reach the shop before anyone else discovered these delightful rarities.

I made it in time, and almost a year later, the three catfish have adjusted well to life in captivity. They make fascinating 'oddball' additions to my coldwater community aquarium.

The genus *Noturus*

The Madtoms (the name is generally spelt as one word) are members of the genus *Noturus*. They belong to the family Ictaluridae, which includes the Bullheads and Channel Catfish. *Noturus* means "back tail" and refers to the fusion of the adipose and caudal fins (in some species), giving the fish a tadpole-like appearance.

Most species are small, slender catfish whose colours range from pale-yellow, grey, brown, to black. Some species, such as the Least Madtom (*N. hildebrandi*) are strongly bicoloured, with dark bands or blotches on the upper surface. Approximately 27 species are known; however, some are difficult to identify.

The pectoral spines provide the best taxonomic clues, as these structures vary between species in their shape and in the number of saw-like 'teeth' projections. Detailed examination of the spine is, unfortunately, only practical with dead specimens. Beware, however: each pectoral spine has a special poison gland at the base which can inflict a painful wound.

Noturus are widely distributed throughout eastern North America, extending northerly beyond the Great Lakes in Canada, and south into eastern Texas and southern Florida. They inhabit a variety of freshwater habitats, preferring flowing waters, such as rubble and boulder riffles, creeks and rivers. A few species are, additionally, recorded from lakes.

Sadly, certain species are highly endangered in the wild, including the Smoky Madtom (*N. baileyi*), Yellowfin Madtom (*N. flavipinnis*), and Pygmy Madtom (*N. stanauli*), of which the last is, arguably, the rarest of all North American fishes. It is therefore important that these endangered species are never exported for the aquarium trade.

Aquarium care

Madtoms are hardy creatures which do well in unheated indoor aquaria (60 to low 70's°F — c15 to 22°C). Being mostly riverine in nature, they are not really suitable for ponds (and, in any case, their dark colours and bottom-dwelling habits would make them exceedingly difficult to see!).

The majority of species do not grow beyond 10cm (4 inches) in length, and are therefore ideal for aquaria. One exception is the Stonecat which can exceed 18cm (7 inches). Their small size is in contrast to the more common ictalurids, such as the Brown Bullhead which may exceed 30cm (12 inches) and the Channel Catfish reaching 45-60cm (18-24 inches). Both these species are highly predatory on other fishes.

In nature, Madtoms tend to hunt for food at night, hiding away during the day under stones or beneath the substrate.

In the aquarium, however, they can usually be persuaded to feed during daylight, especially if they are tempted with live worms.

Madtoms must be provided with plenty of hiding places, such as rocks and other structures under which they can wedge themselves. The substrate should consist of aquarium gravel, which can be supplemented with areas of fine sand in which the fish can bury themselves (never use builder's sand, as this can toxic).

Judging from the literature, most species have no specific requirements for aquatic plants and do not seem to damage them, apart from the occasional uprooting during the catfish's attempts to burrow. It should be mentioned, however, that one species, the Brindled Madtom (*N. miurus*), is known to feed on algae and aquatic vegetation and therefore might do some damage in planted aquaria. The majority of *Noturus* species prefer running waters and this condition can be simulated in the aquarium by directing the outflow of a power filter across the substrate, supplemented with moderate aeration.

Community aquaria

Madtoms are bottom-dwelling fish and, as such, make an ideal addition to community aquaria containing mid-water species. They can be safely kept with other fishes of equal or larger size, but have been known to prey on smaller fishes.

The following coldwater species will happily co-exist with small Madtoms and provide an interesting North American display: Southern Redbelly Dace (*Phoxinus erythrogaster*), Red Shiners (*Cyprinella lutrensis*), Fathead Minnows (*Pimephales promelas*), and small Sunfish (*Enneacanthus* spp.).

All of theses fishes have been imported into the UK and in some, such as the Red Shiners and Redbelly Dace, their beautiful colours rival those of many tropicals.

The Bullhead (this is probably the Black Bullhead — *Ameiurus melas*) is a larger, more stocky fish than a Madtom altogether.

ICTALURID FACTFILE

The family Ictaluridae consists of the Bullheads, Madtoms and their relatives.
Total number of species: approximately 41.
Distribution: North America

Genus	No. Species	Aquarium or pond species
Ictalurus	4	*I. punctatus* (Channel Catfish)
Ameiurus	7	*A. natalis* (Yellow Bullhead)
		A. melas (Black Bullhead)
		A. nebulosus (Brown Bullhead)
Noturus	ca. 27	*N. gyrinus* (Tadpole Madtom)
		N. flavus (Stonecat)
Pylodictus	1	
Satan	1*	
Troglolanis	1*	

* Both eyeless, subterranean species.

Viewed from above, the strong resemblance to a Bullfrog tadpole can be appreciated.

Feeding

Apart from their nocturnal habit, the only other drawback to specimens is their initial reluctance to take anything other than live foods, such as *Tubifex* and bloodworms (at least, this was the case with my three specimens). My Madtoms could be fooled into taking frozen bloodworm or *Tubifex* if this was swirled in front of them, and eventually, they started to forage on non-moving foods. Flake foods do not seem to appeal very much to these catfish.

In the wild, they feed on aquatic larvae of insects, such as mayflies, midges and caddisflies, as well as, small crustacea. Madtoms simply adore earthworms, readily taking specimens twice their body length.

When two Madtoms happen to get hold of opposite ends of a worm, it is reminiscent of a restaurant scene from some romantic film, where the two lovers share a plate of spaghetti — as they suck on the same piece, their mouths get closer and closer … and finally meet. At this point, romance is definitely not on the Madtom's mind, though, and the feeding pair begin a tug of war which eventually concludes when one loses its grip of the juicy prize.

Breeding

I am not aware of Madtoms having been bred in Britain, but they have been successfully spawned in captivity in the United States, as part of a conservation programme for endangered *Noturus* species.

The eggs, which number between about 20 and 100 (depending on the species) are deposited in a cavity beneath a rock or other structure. According to studies on Canadian species, the amber-yellow eggs are very large, between 3.5 and 4mm diameter, with the whole egg mass surrounded by a gelatinous envelope. There is parental care, with the male or both sexes guarding the clutch.

Madtoms live between 2 and 10 years, depending on the species.

Coldwater revolution

I'm not usually given to making predictions, but I feel sure that a coldwater revolution is about to hit the hobby.

The recent importation of Madtom catfishes adds to an increasing range of exotic coldwater fishes reaching this country, most having originated from Asia and North America.

The coldwater aquarium can now rival a tropical set-up in terms of the diversity and coloration of the fish. And with VAT now added to domestic fuel bills, the Madtoms and other exotic coldwater fishes are definitely worth considering. **AAP**

KOI TALK

by Alan Rogers

THE RIVERSIDE PROJECT

Sometime towards the end of September 1994 I was approached by a friend who asked if he could bring along four of his work colleagues to visit me and view my two ponds and Koi. Briefly, I was informed that they intended to construct a Koi pond at their place of employment and needed some useful information and guidance before they commenced such a project.

The request to come and discuss these matters, naturally had me realising that these four enthusiasts had given the subject serious consideration and were going about the pre-planning stage in the correct manner. All too often we hear a pond construction project turning out to be a total disaster, due, basically, to inadequate planning before attempting such an enterprise.

I was intrigued by this project, for I later realised that the reasons and purpose for building such a pond were both fascinating and unusual. In fact, the meeting turned out to be a plan to build a pond which would be, as far as I was concerned, unique in Koi keeping history.

The appointed day arrived where I was introduced to **Jim Prophet, Dave Nichols, Dave Bowen** and **Steve Pearce.** These four enthusiasts, having first taken considerable time to enthuse over the established ponds and fish that were displayed before them, then launched themselves into a multitude of questions sounding out thoughts and ideas that they intended to utilise.

One of the most important aspects of the project was that all of them were currently employed as engineers by **Thames Water Utilities,** the division responsible for sewage treatment based at the **Riverside Plant** in Rainham, in Essex.

Inspired management

The original concept of creating a number of environmental projects at many of their sites and various resources, stemmed from management level at Thames Water. They wished to accentuate a public relations exercise by encouraging species of birds to breed in prepared nesting boxes and among reed marshes, which had the full seal of approval from organisations such as the R.S.P.B. There was also a breeding programme for fruit bats which turned out to be a very successful environmental project. The construction of this Koi pond was to be yet another exercise approved, financed and budgeted by management.

The proposed site for this venture was to be within the main plant complex in a small grassed area between administration buildings and 'within the shadows' of the vast sewage treatment units.

The massive 18-inch steel air pipe.

The team discussing the project by the side of my pond.

The Rainham complex is a spacious 35-acre open site and I naturally questioned the reasons for choosing this specific spot with so much free space available. Jim responded that it was convenient for the engineers to keep an eye on the day-to-day operations, such as the daily routine to remove fish waste by-products like ammonia from bottom drains, regular filter maintenance and feeding the Koi daily. These factors, combined with the close accessibility for electricity to power the pumps, naturally made this choice of site very convenient and suitable.

Futhermore, as an added bonus, tucked neatly between administrative buildings, the finished pond would be afforded a degree of protection from adverse winter conditions which frequently prevail across the Rainham marshes.

Under way

By mid autumn 1994, the four diehards had undertaken the initial digging in the first stages of the construction. A substantial amount of effort and personal time was given by these enthusiasts, although it should be recognised that the management were most considerate in this arrangement.

Naturally, Thames Water had heavy plant and machinery at their disposal for the excavating side of the exercise. The removal of the subsoil diggings, which normally accounts for one of the major expenses of new pond construction, also created no problem whatsoever, due mainly to the accessibility of the area and ease of soil disposal over such a vast site.

However, the dig was not to be without its own unique complications. A recently installed site generator of industrial size was to create a minor setback in the preferential siting of the pond. An early suggestion in the initial planning stage to re-site the monster, was met with the decisive and negative response from higher management. Therefore, the proposed site had to be moved slightly because of this generator location, and a new area 26 feet by 16 feet marked out.

Steel hurdle

Like all the best laid plans in the world, everything was going so well, until once having excavated down to a depth of 4 feet, they struck an 18in steel air pipe, running diagonally across the marked out site. It transpired, that this pipe was a high-pressure air pipe and still in service, supplying essential aeration to the bacterial colonies in the vast sewage treatment tanks on the complex. Like the immovable generator, there was to be no question that this essential service could possibly be re-sited either. Typically, like many original site plan drawings, this vital service was shown a number of feet from its actual location.

Our enthusiastic engineers were confronted with just two possible decisions. Either construct the pond incorporating the air supply pipe, or abort the whole project. The immense commitment that was developing to build this pond was not in any way going to be discouraged and completion was still the ultimate goal.

The objective in the original planning was to build the pond at least 5 feet deep all over. However, because of this unfortunate discovery, it was now proposed that a 4-foot shelf would have to be incorporated, cutting diagonally across the area of the pond. The thought of any possibility of the air supply pipe being accessed for whatever reason in years to come, was put to the back of everyone's mind.

Winter progress

The proposed four bottom drains were all to be repositioned in the deepest sectors of the pond; these were to supply an external multi-bay filtration unit. It was interesting to note here, that all underground pipework was of high-pressure grade and solvent-welded on all joints, undoubtedly, a policy from the past whereby

such professionals acknowledge that cheaper grade materials can often prove to be the 'most expensive'. This is especially true when buried 6 feet down and surrounded in concrete, should a critical fault develop in the future.

A concrete collar was prepared and set around the perimeter of the pond. This was to act as the eventual support for the blockwork wall which would ultimately raise the pond out of the ground by approximately 20 inches. Because of the knowledge of the air pipe below, a butyl liner was chosen rather than concrete and fibre-glass finish. The logic behind this decision was that a butyl liner was somewhat easier to remove, should that emergency ever arise.

The work continued right through the winter and early spring months of 1995, hampered by only the severest of the weather. By mid April, the main construction of the pond and filter bays was completed and the day was fast approaching for the initial filling of the pond.

The pond nearing completion under the shadow of the treatment works.

The filter

The filter chamber, which was to be sited some 20 feet away, was designed on a five multi-bay chamber, plus a control/pump house situated at the end. Like the pond, it was raised out of the ground approximately 20 inches and constructed out of blockwork and, finally, concrete rendered.

The four bottom drains came into a deep settlement discharge chamber and could be operated by releasing any one of the four-inch gate valves. Each filter chamber had the facility of being drained or flushed through four-inch pipework; this aspect would keep filter maintenance down to a bare minimum.

The second chamber was fitted out with a number of rows of suspended brushes which would filter out any further floating solids that managed to evade retention in the first settlement. The third and fourth chambers were fitted out with filtration matting and Flocor, respectively. Each chamber was connected by two four-inch pipework connectors serving an up-and-down water flow. The matting and flocor chambers were installed, with additional aeration supplied via airlines from a Hi-blow air pump sited in the final pump chamber.

The design and layout of the filter was such that the water would be drawn via gravity through the various stages of filtration, into the final pumping chamber by two flanged central heating pumps. From the pumps, the water would be returned to the pond through one direct venturi return and via a long winding trickle-stream water return.

This last feature would add a simple but effective touch to the final aesthetic looks of the pond. The intention was to plant a varied selection of pond plants in this waterway, which would also serve as a vegetable filter by finally mopping up any traces of nitrates not eliminated in the main filters.

Creative timber use

A quantity of redundant telegraph poles around the site were utilised for a number of features. For instance, a very formidable looking pergola was constructed over the pond to add further aesthetic appeal, furthermore serving the dual purpose of protection from the harshness of intense sunlight, which would otherwise stimulate the uncontrolled growth of algae. A quantity of greenhouse shading suspended over the timbers would provide the necessary restriction by filtering out this excessive sunlight.

Only in very rare occasions in Japan have I seen timber of these dimensions used for the purpose of building such a structure.

A higher observation point at the planted area of the pond saw further talented use of these surplus timbers.

Successful 'launch'

The day had finally arrived when the pond would be filled with water, and this was to be something quite special. Final effluent from the sewage treatment plant was to be the mainstay of initial water fill-up and some 6,000 gallons of the outflow were to be consumed in the process. The pumps were switched on and the water started to flow through the filters. Shortly after this, half a dozen small Koi, about six to eight inches, were introduced to the pond, and their behaviour anxiously monitored.

The Koi immediately settled down in their new environment and, before long, the vital population of filter-colonising bacteria was quickly established. By mid-May '95, further and larger Koi were introduced, only to be rewarded with a period of successful spawning from several females. This accomplishment was a bonus, which our overjoyed enthusiasts had not expected, but it certainly highlighted the excellent quality of the water. Koi are demanding fish requiring robust health and consistent water quality par excellance, before even considering to indulge in such rituals.

Our four 'diehards', after months of planning and building, could now see the rewards for their efforts. They had finally reached the decorative stage of the exercise, and the acquisition of natural rocks, plants and trees were the order of the day. An effective screening was erected around the enormous generator and the rocky water return looked very impressive.

Outstanding success

Parties of children from local schools frequently visit the plant as part of their field studies, for the purpose of researching their environment. The completed pond now serves a dual purpose for both Thames Water Utilities and the visiting students, where direct relation between the principal function of the plant and a miniaturised working example of the fundamentals of waste treatment can be seen and appreciated. What better example can be displayed to these students than active and vigorous Koi, growing in a healthy closed environment?

This demonstration of using treated final effluent directly into a pond is, to my knowledge, 'first' in Koi keeping history, and should be further recognised as an outstanding accomplishment by the authorities concerned. All too often we criticise publicly when our attention is drawn to pollutants contaminating our beaches, shorelines and rivers. I therefore rather feel that the Riverside Project represents refreshingly good news and warrants publicity and commendation.

Since the early part of this summer, the pond (having been finally completed) has been gaining further improvement as the system matures with time. I have no doubt that Jim Prophet, Dave Nichols, Steve Pearce and Dave Bowen, together with the management of Thames Water Utilities, will feel that the Riverside Project was definitely worth the time and effort. Everyone will continue to gain satisfaction, and future generations of young students will be able to understand and appreciate the principles behind effective water treatment by actually experiencing these two very similar environments side by side.

The excellent multi-chamber filter.

The water course almost ready for planting.

BOOKS for CHRISTMAS

As we rush headlong into our traditional Christmas present buying frenzy, especially if we are planning to buy items relating to aquarium, pond and herptile keeping, we don't always take those few invaluable minutes required to think things out properly. Far too many well-intentioned present buyers, for example, still give live animals as gifts, despite our repeated advice to the contrary (unless, of course, the recipient is adequately geared up to receive such exciting presents).

Where books are concerned, though, no such problems apply. Important at any time of the year, books really come into their own at Christmas time. They don't need looking after, can be picked up and put down at any time, can provide hours of entertainment and — most importantly — can help us prepare properly for looking after the pets we are going to buy after Christmas.

As ever, there are loads of excellent books on offer this year, at all price levels. Here are brief summaries of just some of the more recent ones to come my way over the past few weeks.

John Dawes

1 *Amphibians in Captivity*
By: Marc Stainiszewski
Published by: **T.F.H. Publications, Inc.**
ISBN: 0793 801 338
Price: £50.00

Marc Staniszewski is well known to *A&P* readers via his excellent herpetological articles. This book, I am delighted to say, is well up to Marc's enviably high standards. It is truly an amphibian keeper's dream.

Full marks also to the author for tackling the humane aspects of feeding pinkies, fuzzies and other small mammals to large amphibians (an omission I have often bemoaned in other herpetological publications).

I would say that this book is an absolute 'must' for the serious amphibian keeper and should be at the top of the shopping list. It's also jam-packed throughout its 544 pages with vital information, photographs and artwork.

2 *Platies and Swordtails*
By: Derek and Pat Lambert
Published by: **Blandford Press**
ISBN: 0 7137 2368 8
Price: £9.99

Derek and Pat Lambert are two more names which are well known to our readers, both as writers and as founders of Viviparous — the Livebearer Information Service. They, too, have done an excellent job in the 124 pages (including Index) made available to them by the publishers.

Every species (wild) of the genus *Xiphophorus* is not only described, but also illustrated by means of, at least, one colour photograph. There are also some great shots of cultivated varieties, plus, of course, lots of advice on keeping, breeding etc.

This super paperback represents the most accurate and up to date document on Platies and Swordtails available to aquarists. Mind you, knowing the authors concerned as I do, I would not have expected anything less from them. Now, if only Derek and Pat had had 248 pages available, instead of 124...! Congratulations to you both.

Also in the same **Aquarist's Handbook** series is another £9.99 gem — this time for catfish fans. Written by well-known catfish expert Derek Lambourne, *Corydoras Catfish* (ISBN: 0 7137 2367 X) is every bit as desirable as *Platies and Swordtails*. Why not buy both?

3 The Barron's 'Stack'

I have received a whole stack of books published by **Barrons Educational Series** and distributed by **Coral Reef Technology Ltd. (Tel: 01932 355121)**.

Even the swiftest glance through the list will be enough to convince you that it contains something to meet your likes and/or needs.

Some of the books, like *Goldfish: A Complete Pet Owner's Manual*, by Marshall Ostrow (£4.50) have been around for a little time (but are still as valuable as ever), while others, such as *Aquarium Plants Manual*, by Ines Scheurman (£4.50) are of more recent origin.

All, however, represent interesting, informative reading at very attractive prices and are well worth considering seriously as Christmas presents for the aquarist in the family.

Other titles include: *The New Saltwater Aquarium Handbook* (£6.50), *The New Aquarium Handbook* (£6.50), *Aquarium Fish* (£8.99), *Aquarium Fish Breeding* (£6.50), *Killifish* (£4.95), *Discus Fish* (£4.50), *Cichlids* (£4.50), *Tropical Fish* (£4.50) and *Goldfish and Ornamental Carp* (£13.99).

An "absolute must" for serious amphibian keepers — Marc Staniszewski's new book.

"At first the neighbours were a bit concerned... but when the vandalism and break-ins dropped considerably, they now help me feed them."

NEWSDESK

Enter the Dragons

They've taken some time coming, but the Dragons are here at last! Well, not quite dragons with flaming nostrils searching for an easy killing, but the equally almost-legendary Red Dragon Fish (*Scleropages formosus*) of the Orient.

As established *A&P* readers know, exciting things concerning Dragon Fish captive breeding projects have been happening in the Far East for some time now. Last year — after much research, investment and sheer hard work — a collaborative captive-breeding venture between **Rainbow Aquarium Pte Ltd.** and Singapore's **Primary Production Department (PPD)** resulted in CITES granting clearance for Rainbow's proprietor, **Ho Kian Huat**, to export certified captive-bred specimens of all three varieties of Dragon Fish (Green, Gold and Red) in unlimited numbers worldwide.

At first, the vast majority of specimens were exported to Japan but now, at last, the first of these captive-bred specimens ever imported into the UK have arrived, courtesy of **Dragon Fish Aquatic Ltd.**

The first batch (around 6in+ - 15cm+ in length) are all, at least, F2's (second filial generation) and have been bred by Rainbow Aquarium in Singapore. Each specimen is individually micro-chipped with a unique electronic tag number and is accompanied by a Certificate of Identity issued by Singapore's PPD, thus confirming that they are CITES approved for worldwide trade.

JOHN DAVIES

Almost-mature Red Dragon Fish bred by Singapore's Rainbow Aquarium Pte Ltd.

Serious enquiries (these fish don't — in fact, *can't* — come cheap) are welcomed by **Dragon Fish Aquatic Ltd. Tel: 01753 551426; Fax: 01753 522269,** from whom stocks are now available.

Swallow flies West

Swallow Aquatics, which already owns two well-established and highly respected retail outlets in Rayleigh (Essex) and East Harling (Norfolk) — plus a recently opened shop at Southfleet, near Gravesend (Kent) — has now 'flown west' and opened its fourth outlet in Colchester.

Officially opened on 2 October, the new Swallow Aquatics centre is now fully stocked with a wide range of livestock, including a large selection of marines and reptiles. By spring 1996, a new tropical house and dry goods area will also have been added to the existing tropical and dry goods facilities.

The manager, **Paul Sawkins** was among Sparsholt College's first graduates. He was formerly based at Swallow's Rayleigh premises and has extensive management experience and great enthusiasm for all matters aquatic.

Swallow Aquatics (Colchester) is based at the former Aquapets site at **West's Garden Centre, London Road, Stanway, Colchester, Essex. Tel: 01206 210360.**

SeaLife open Centre on the Costa del Sol

There are 16 **SeaLife Centres** around the shores of Britain now, with a 17th planned for Birmingham. The owners, **Vardon Attractions Ltd.**, decided to move into Europe and recently opened two Centres, one in Holland (Scheveningen) and Belgium (Blankenberge). The 19th Centre is the first in Spain and the popular Costa del Sol was chosen for the **Parque Submarino**.

The coastal part of the town of Benalmádena (pronounced Ben'l-mää-day-na) was chosen by Vardon Ltd. because it is within easy reach of the tourist centres of Torremolinos, Fuengirola and Marbella. Work started on the centre last January and was completed in record time by July. It is sited on the marina, where there are many other attractions, restaurants and plenty of parking spaces.

The centre has traditional SeaLife acrylic tanks of the local species, including a walk-through tunnel called '*viaje al fondo del mar*' (journey to the bottom of the sea). The many Mediterranean species are displayed, from seahorses (*Caballo marino*) to Sharks (*Tiburón*). The centre is open from 10am to midnight every day.

The grand opening ceremony was held at 10pm on the evening of 7 September by the Mayor of Benalmádena, **Sr. Enrique Bolin**, after speeches by the president of Vardon Ltd., **David Mace** and the manager of the centre, **Mike Stephenson.** The curator is **Rod Hayes,** who moved to Spain from the SeaLife Centre at Blackpool.

A plaque was unveiled, while a string orchestra played under the Mediterranean moon. Over 200 specially invited guests attended and they were given Spanish sherry and canapes, followed by a guided tour of the centre. The guests ranged from Japanese technical staff, to Spanish Navy Officers, Vardon engineers, to Spanish journalists with their parents and friends.

British representatives were **Dr David Ford** and his wife **Dorothy,** also chosen for an invitation by Vardon because all the SeaLife Centres use **Aquarian** flake foods for their smaller marine fish. David reported that the centre was well worth a visit when British aquarists are on a Spanish holiday. The signs are in Spanish and English and the staff are bilingual.

Sealife on the Costa... not to be missed.

DR DAVID FORD

Conservation at Bristol Zoo

Bristol Zoo held an *Underwater Week* from 7 to 13 August, organised by their aquarium curator, **Colin Grist.** The Zoo placed a large marquee in their grounds, containing aquatic trade and information stands.

The **Federation of British Aquatic Societies** gave advice to visitors on fishkeeping and **Coral Reef Technology Ltd** showed the art of keeping marines. However, the main theme was conservation with displays by **OFI (UK), Aquatic Conservation Network, Marine Conservation Society** and the **Slimbridge Wildfowl Trust.**

Dr Peter Burgess of the University of Plymouth showed photographs of his **Aquarian-sponsored** trip to Trinidad to conserve endangered livebearers, while Bristol itself was well represented with a tank display by the **Bristol Aquarist Society** and the **Bristol Scuba Club** showing underwater videos.

On the Friday evening **Dr David Ford** of the **Aquarian Advisory Service** gave a lecture to invited aquarist clubs — Bristol, Cardiff and Nailsea AS — about the latest findings by **Waltham Aquacentre** on fish nutrition. This was followed by a tour of the Bristol Zoo Aquarium, including a behind-the-scenes tour.

COLIN GRIST

David Skepper receiving a Tropiquarium from Hagen's Steve Johnson as his prize for winning the drawing competition held during Bristol Zoo's Underwater Week.

Filtration advice

A six-page colour leaflet entitled *Aquarium Filtration Made Easy* has been published by pond and aquarium accessories manufacturer **Interpet,** to coincide with the launch of the second unit in a range of self-priming external aquarium filters.

The leaflet is designed to encourage fishkeepers to use external filters by explaining their simplicity of use. Copies are available, free of charge, from pet shops or direct from **Interpet, Vincent Lane, Dorking, Surrey RH4 3YX. Tel: 01306 881033; Fax: 01306 885009**

It's crackers to give pets for Christmas

"Christmas may be a time of giving, but please do not be tempted to give a pet as a Christmas present," is the plea from **Gairn Ross,** director of veterinary services of the **PDSA (People's Dispensary for Sick Animals)** — Britain's largest veterinary charity. (As established readers of *A&P* will know, we fully support this bit of invaluable advice).

"Puppies and kittens are attractive and their appeal can be difficult to resist at any time of year, but never be tempted to buy a pet on impulse. Remember, deciding to own a pet means making a commitment to care for that animal for the rest of its life. You cannot make that decision for someone else.

"Sadly, Christmas cheer soon turns to misery for thousands of pets that are abandoned each year, once they have ceased to be a novelty, or their care has become too expensive or time-consuming. These pets have often been acquired without forethought or given as Christmas presents to unsuspecting friends."

To guide you through the do's and don'ts of responsible pet ownership during the Christmas period, the PDSA has produced a leaflet entitled *Paws for Thought this Christmas.* Packed with helpful advice, this leaflet can be obtained by sending a large SAE with your request to: **The PR Dept (PFT), PDSA, Whitechapel Way, Priorslee, Telford, Shropshire TF2 9PQ.**

COLDWATER JOTTINGS

BY STEPHEN J. SMITH

Goldfish delights

One of the main themes of **Coldwater Jottings** over the past year or so has been to encourage fishkeepers to try their hand with some of the lesser-known species of coldwater fish. We have had some remarkable response, and congratulations are due to all those who have given it a go, as well as to those of you who have let us know about your successes and failures.

But we must not forget, or even ignore, the basis of our hobby, which, like it or not, lies with the ever-popular Goldfish. So, as a Christmas treat, that month's **Jottings** takes a sideways glance at some of the issues centred specifically around the world's most popular pet fish.

Coming up roses?

Now is the time of year when we tend to turn away from our ponds to the warmth of the fireside and the indoor aquarium. Don't, however, be tempted to neglect the welfare of your pond fish. They need as much attention now as ever, as the temperatures dip drastically in contrast to the 'highs' of the summer just so few months ago.

For me, the pond water at this time of the year always appears to be 'dark' and 'heavy', even in well-filtered ponds. This is partly due to the fact that light levels dip from autumn onwards, giving the pond a much duller appearance. Regular partial water changes are an essential part of your husbandry... and please, do not turn the filter off 'for the winter'.

I know of one former Koi keeper who, at this time of year, used to turn his pump off, strip his filter down, and leave it for the winter. The problem came to my attention when he asked me for advice on why his fish all died at the onset of the spring — every spring! Despite my advice to keep the filter running throughout the winter, he continued his 'regime', only to tell me a couple of years later that he had turned his pond into a rosebed "because stripping the filter down every year was *too much trouble*"...!!

I do tend to reduce the rate of flow through the filter (by turning a valve positioned at the *outlet* of the pump). A further expedient is to cover the pond with polythene sheeting stretched over wooden frames (the transparent type normally used for greenhouses is UV-resistant and will last longer), to help in alleviating the risk the pond surface freezing.

Rotting fins

No, this is not a slant upon our Scandinavian cousins (who, I understand are keen fishkeepers), but a reflection upon a recent debate over the 'information superhighway' which has centred around the symptoms and causes of rotting fins on Goldfish.

The 'posting', on the Newsgroup *rec.ponds* (unfortunately, there isn't a Goldfish newsgroup as such — perhaps we should rectify that situation) came from a Goldfish keeper called **Brian**, who wondered if nitrate was at the root of his problems with a Goldfish aquarium: "Two weeks ago, the Fantails in my 29-gallon tank were losing all of their fins," explained Brian. "It looked like their fins were rotting off, so I did a number of tests to the water and found out that I had a high level of nitrates in the tank. Since I thought I had to wait several weeks for the biological cycle in my tank to complete, I didn't do anything more than a filter cleaning for 4 weeks prior."

He added: "I did a 50% water change two days ago and a 20% three days before that. I did all the tests over again and my nitrates are still very high (50%). I added two new fish to the tank to see if it was really the tank or a bad test and, although they were both still alive when I left for work, one of them was still as though he was sleeping or something (no, not sideways!). I was wondering if I should do another 50% water change tonight or if doing so many large changes would be too much of a shock to the ecosystem."

The answer appears to me to be quite simple: 29 gallons is a small tank in which to keep any number of Goldfish, so I would suggest that you are overstocking, Brian, and that the symptoms you are experiencing are, quite simply, ammonia burn due to overstocking.

Don't forget, fish excrete LIQUID waste (mainly ammonia) as well as solid waste, so they are swimming in their own toilet! My 'rule of thumb' is to forget fancy mathematical formulae and simply take into account the SURFACE AREA of the tank. Accommodate no more than ONE FISH per square foot of surface area. Thus, if your tank is 24 x 12in, then two fish is plenty. If they are big fish, keep fewer (eg: I have successfully kept two large Orandas in a three-foot tank without any problems).

It is always better to understock, underfeed, and overfilter. The result: healthy and happy stock, and a fishkeeper who can really ENJOY the fish.

And finally...

I wish all our readers a very Merry Christmas.

Out of the cold

No matter what precautions I take with my ponds over the winter months, I still find that just one or two of my best Fancy Goldfish 'get got' by the low temperatures. I have found that particularly susceptible varieties are Moors, while any of the Veiltailed varieties are susceptible.

The answer is quite simple: bring these fish indoors for the winter. Try to transfer your most vulnerable specimens to indoor aquariums before outdoor temperatures fall too low (when the relative heat of your prepared aquarium in the living room will cause further problems). I also set up indoor 'growing-on' aquariums for young fish which have hatched and developed quite well in the pond throughout the year, but which will easily fall prey to the cold if you try to overwinter them outdoors for their first winter.

Usually, once transferred indoors, these fish will continue to feed well and will be seen to grow significantly; while, of course, you have effectively 'extended' your season of enjoying your Goldfish to a year-round pursuit.

Moors appear to be particularly susceptible to cold winter conditions.

BILL WATKINS

Far out in Far East

I was intrigued to receive a communication from a Singaporean Goldfish keeper who quite stopped me in my tracks with a request for information on where to buy Goldfish... in Singapore!

Now, I had always rightly regarded Singapore as the ornamental fish capital of the world. However, it seems that although every year, thousands upon thousands of ornamental fish are exported throughout the globe from Singapore, obtaining fish for private enjoyment within that country may not be as easy as I had supposed.

However, I was delighted to pass on information of a retail outlet which I visited in Singapore in 1989, which, I am sure, will meet the needs of my correspondent. **Macho Ranchus**, situated in the Specialists' Shopping Centre in Orchard Road, Singapore, gave a most warm welcome when I last visited them and will be sure to provide every assistance in your pleasurable pursuit of Goldfish keeping.

STEPHEN SMITH

A corner inside Macho Ranchus: Mecca for Singaporean Goldfish keepers.

TRAVELLER'S TALES

icefish for christmas

If you are given Icefish for a Christmas present, keeping them in your aquarium is quite a challenge... but, as Aquarian's **Dr David Ford** discovered, it is possible.

Photographs by the author

Icefish come from the Antarctic, and they can be kept in a marine aquarium, but the water temperature needs to be always below zero Celsius! There are no bacteria in the water at this temperature, so biofilters will not work, hence an ammonia crisis is always threatening. You need to do lots of water changes — at minus 0°C too, of course.

The fish also tend to sit still a lot, but they are, nevertheless, fascinating fish to scientists. Here's why...

Christmas-time in the Antarctic is actually the height of summer, but the temperature remains well below zero. Even the sea is at minus 2°C, but it is still home to nearly 60 species of fish. The most abundant of the four families, with 18 species, are the Icefishes (Chaenichthyidae), the largest being *Chaenocephalus aceratus*, which can grow to 60cm (2ft) and weigh a kilogram (2.2lb).

Also common are the Iceland Cod (not related in any way to our Cod) Notothenioidei, a favourite food of the Antarctic seals. These fish prey on each other, with the seal as the top predator. The seal is a mammal and has the speed and energy of the warm-blooded animals, but the fish are cold-blooded and live in water below freezing. So, where and how can they hide?

The Icefishes and Cod have powerful pectoral muscles that slowly move the fish through the water, guided by a rigid body and caudal fin. Their blood is white! There is no haemoglobin because the chemistry for oxygen transportation does not work at these temperatures. The blood plasma only has about 1% dissolved oxygen and more is absorbed through their scaleless skin.

To escape being eaten, the fish's tail fin can give a burst of speed to drive the fish into the ice crystals hanging down below the sea surface. The fish then remains dormant for many hours as the body chemistry recovers.

Anti-freeze spit

The Icefish's milk-like blood contains an organic anti-freeze agent that acts like the propylene glycol we use in cars. It prevents the fish's internal body fluids from freezing. Then there is also the problem of drinking. Even fish need to drink water and to avoid the chemistry involved in purifying seawater (like the coral fishes) the fish chew the freshwater crystals of glacier ice.

This should, of course, just refreeze in the fish's gut, with the resulting expansion harming internal organs. However, the fish's anti-freeze chemical is in their spit. This remarkable substance coats the ice crystals as they are bitten off and chewed, turning them into liquid water.

The International Antarctic Research Group based on the continent are studying the Icefish and their anti-freeze system and they have discovered that the chemical will not only stop ice crystals forming (you can safely freeze fresh strawberries!) but it stops kidney stones growing too.

Captive Icefishes

It is against international law to collect the Icefishes for hobby or display, because anything taken from the Antarctic must be for research purposes only. However, surplus fish from such research work can be placed in aquaria and there are two public aquaria where Icefish are on show: the International Antarctic Centre at Christchurch, New Zealand South Island, and Kelly Tarlton's Aquarium at Auckland in North Island.

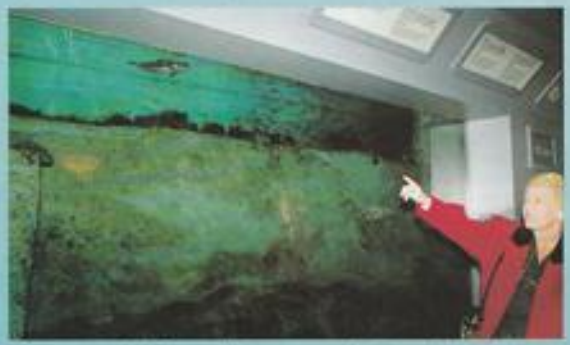
American divers wearing the latest technology suits for life support in the icy waters collect the fish. Some are tagged with electronic devices for satellite tracking (the fish shoals appear and disappear seasonally, but to where and why, we do not yet know). Samples are also placed in polybags packed with ice and flown under escort to New Zealand, where the universities of both islands study the fish. These cannot be returned to Antarctica, so they are given to the two public aquaria, where they are displayed in seawater tanks kept at zero degrees.

Biological filtration — as I mentioned earlier – does not work at zero temperatures, since there are no bacteria in the water. The tanks therefore have to be filtered mechanically and the excreta discarded, with regular partial seawater changes to dilute ammonia. The water temperature cannot be controlled directly without prohibitively expensive cooling units using titanium heat exchangers, so the tanks are housed in a room that is refrigerated to –1°C.

The show tanks are sited in this refrigerated room just behind a double glazed window opening onto the public area. In this way, visitors can see the Icefish in comfort.

Curator **Craig Thorburn** of Kelly Tarlton's Aquarium told me fascinating tales of the problems of collecting Icefish and shipping them back at never more than freezing temperatures. But it's having got the Icefish into an aquarium, that the problems really begin...

'Anti-freeze Fishes' is a display of Icefishes in Kelly Tarlton's Aquarium, New Zealand.



My secretary/wife/travelling companion Dorothy, pointing to a rare event — an Icefish that moved! This is the Icefish display at the International Antarctic Centre, Christchurch, New Zealand.

SHORE WATCH

BY ANDY HORTON

Vanishing oysters

In the poor light of dawn, it is hard to make out the bright red beak of the Oystercatcher as it probes among the mussels and cockles. In the past, it acquired its name on a diet of oysters, but this once super-abundant molluac is now so rare that the most you see will be an occasional specimen on the shore.

ANDY HORTON

Oyster with Dogwhelk and Common Starfish.

In the late nineteenth century, 30 million oysters were shipped in one year from Shoeham-by-Sea railway station to the markets in the big cities. This was only a fraction of the catch, as 500 million passed through Billingsgate annually, while on the other side of the English Channel, the French were dredging them off the seabed at the same frantic rate.

All sea resources are finite and whereas a few shore specimens collected from the shore for a snack, or to exhibit in aquaria, is unlikely to be harmful, thoughtless and greedy overcollection can diminish the shore fauna for good.

A thick carpet of white freshly fallen snow completely covered the shingle, right down to where the waves washed against the land. In this deceptively peaceful scene, a visitor could hear the roar of the sea and the fierce undertow as the pebbles were rolled about.

Ground temperature above the strandline was well below 0°C (32°F), but no ice had formed on the brackish water pools that were not refreshed by the neap tides. Seawater freezes at lower temperatures than fresh, with the melting point recorded at minus 1.91°C (c29°F).

It is always much colder than the melting point before the water actually freezes. Exceptionally, shore pools or even the shallow sea, can freeze over temporarily off the coast of Britain.

Although the sea temperatures remain relatively stable, the conditions between high and low tide can be extreme and are comparable to a terrestrial habitat. It is only a small selection of hardy invertebrates that can withstand the extremes of temperature. Examples include the Periwinkle, Limpet and the stationary Mussel.

The shore in December is relatively barren of fish and invertebrates of interest to the aquarist and general naturalist.

Resident worms

Mysterious events on the shore can usually be explained after direct and patient observation. Small piles of sand, a centimetre or two in diameter, in odd shapes, with a constituency of sawdust, gradually appear on the floor of sandy pools. They are likely to be the ejections of the hidden Sand Mason.

This polychaete worm constructs a mucus tube in which it lives at mid-tide level below the surface of the sand. The small branches at the top of the tube are frequently seen. The worm, itself, will be more than a spade length down.

Many other worms live in the sand. Seaside visitors are likely to be familiar with the coiled ejections made by the Lugworm. Ragworms can filter-feed using a blob of mucus; most can bite as well. In the King Rag, for example, the bite can break human skin and draw blood.

The Sea Mouse is the largest of several scale worms, and is up to 15cm (6in) long, and flattened up to 5cm (2in) wide in the middle, with bristles that shine with iridescence.

Northern seas

The nutrient-rich seas of the northern hemisphere support an abundant harvest of some of the most edible fish, feeding on copepods and other small crustacean life. Although familiar species like the cod and the herring form abundant shoals, the variety of different species is relatively small, especially when compared to warmer seas.

This Arctic-Boreal fauna reaches its southernmost point of distribution in the seas off the north and east of Britain.

The distribution of species is not entirely dependant on latitude, though, because of the tremendous importance of the warm ocean current known as the North Atlantic Drift (or Gulf Stream) which pushes warmer saltier water against the western shores of Ireland, Cornwall, and the south-west of Scotland, with a lesser effect as the water surges towards the east.

This means that the North Sea furthest from the influence of the North Atlantic Drift experiences some of the coldest temperatures, especially off the coasts of north-east England.

Temperature of the sea is the main factor limiting where certain fish and smaller animals can be found.

This has great significance to the aquarist, who needs to keep fish and invertebrates within the temperature-range in which they naturally occur.

Arctic species

The Eelpout is unique among British bony (Teleost) fishes because it hatches its young viviparously. The eggs develop in the female for 3 to 4 weeks in September, and the larvae continue to grow within the parent until the beginning of the next year. The Eelpout is absent from the English Channel, but is reported by rockpoolers from the southern North Sea.

As it only grows to 30cm — 12in (max. 50cm — c20in) it should be suitable for larger aquaria, if the temperature is kept below 14°C (57°F), with an obligatory cooling system. However, I have no records of its husbandry, although Scottish aquarists have collected young fish from the shore.

Butterfish, common under rocks on the shore, are absent intertidally during the summer, because of their preference for colder seas. This species is noted for ocellated eye spots underneath the dorsal fin. Shore specimens are invariably infected with a flatworm parasite called *Cryptocotyle lingua*, which encysts to form visible black blisters on the skin. Other shore fishes like the Rockling and the Bullhead also harbour this parasite.

It is known as a trigenetic symbiont, because it requires three host species, a sea bird, periwinkle and a shore fish in its life cycle. It also has a free-swimming stage. This contrasts it with monogenetic parasites like *Amyloodinium* which are the sourge of aquaria, because they can easily spread from one fish to another.

Two other Arctic species excite comment when they are found on the shore. These are Montagu's Sea Snail, a plump orange fish which is about 6cm (2.4in) long and has a sucking disc like the Lumpsucker, and the Armoured Bullhead. Both are caught in shrimp (push) nets.

Arctic fish seen in Public aquaria include the formidable Catfish (or Wolffish) with sharp teeth capable of tackling large urchins and hard-shelled crabs.

RON BARRETT

Montagu's Sea Snail (*Liparis montagui*) is — despite its name — a fish... and a beautiful one at that.

DECEMBER CHECKLIST

Molluscs	
Common Periwinkle	*Littorina littorea*
Edible Mussel	*Mytilus edulis*
Common Limpet	*Patella vulgata*
European Oyster	*Ostrea edulis*
Dogwhelk	*Nucella lapillus*
Worms	
Sand Mason	*Lanice conchilega*
Lugworm	*Arenicola marina*
King Rag	*Nearithes virens*
Sea Mouse	*Aphrodita aculeata*
Crustaceans	
Shore Crab	*Carcinus maenas*
Short-legged Spider Crab	*Pisa tetraodon*
Spiny Spider Crab	*Maia squinado*
Fish	
Butterfish	*Pholis gunnellus*
Eelpout	*Zoarces viviparus*
5-Bearded Rockling	*Ciliata mustela*
Bullhead or Sea Scorpion	*Taurulus bubalis*
Montagu's Sea Snail	*Liparis montagui*
Catfish or Wolf-fish	*Anarrhichas lupus*
Armoured Bullhead or Pogge	*Agonus cataphractus*
Small-headed Clingfish	*Apletodon dentatus*

British Sea Temperatures*

DECEMBER	°C	°F
Thurso		
North Scotland	7.8	46
Newcastle	7.8	46
Donegal	10.0	50
Brighton	8.9	48
Plymouth	10.0	50
Gibraltar	15.6	60

* These sea temperatures were taken from maps supplied by the Deacon Oceanographic Laboratory. They are the mean average surface temperatures taken offshore. In very shallow waters and estuaries, higher and lower temperatures are often recorded. However, these temperatures are a useful guide to the ideal temperature for coldwater species in aquaria.

ANDY HORTON

Some of the many super books available that would be more than gratefully received by any keen aquarist at any time, but particularly so at Christmas.

Top 10 Christmas book list

1 *Handbook of the Marine Fauna of North-West Europe.*
Edited by: P J Hayward & J S Ryland.
Published by: **Oxford University Press** (1995)
ISBN: 0 19 854054 X (Hbk)
ISBN: 0 19 854055 8 (Pbk)
Paberback price: £29.50

This is the definitive handbook guide for the experienced rockpooler and marine biologist. It should be on your shelf and on the shelf of every public library. There is comprehensive and up-to-date identification of all invertebrate species likely to be seen in the seas around the British Isles. Fishermen will need a further book as the fish list omits some open-water fish. Marine mammals are excluded. Excellent line drawings only.

Newcomers to the hobby are referred to the September issue of *A&P* when some popular identification guides were listed.

2 *Marine Wildlife of Atlantic Europe.*
By: Amanda Young, with photographs by Paul Kay.
Published by: **Immel Publishing** (1994) (not actually published until 1995)
ISBN: 0 907151 81 7

This is an excellent book with splendid colour photographs of many of the common animals and seaweeds likely to be seen by rockpoolers, divers and casual visitors to the coast. It is not a comprehensive identification manual, but rather a book that describes the behaviour and appearance of the inhabitants of the marine world around the British Isles. Recommended.

3 *Animals of Sandy Shores*
By: Peter J Hayward
Published by: **Naturalists' Handbooks: 21, Richmond Publishing Co.** (1994)
ISBN: 0 85546 293 0 Paper
ISBN: 0 85546 294 9 Hardcover

An extremely detailed study of the characteristics and ecology of a sandy shore and the animals that live for the most part buried in the sand. This is not an easy read for the novice rockpooler, but should appeal to the serious student of the seashore. Recommended. There is another good book in the series, *Animals on Seaweeds*, by the same author.

4 *A Field Guide to the Nudibranchs of the British Isles.*
By: Bernard E Picton and Christine C Morrow.
Published by: **Immel Publishing** (1994)
ISBN: 1 898162 05 0

This is both a comprehensive guide and a descriptive guide to the true sea slugs, gastropod molluscs called the Nudibranchia, that have completely lost their shells. Each species has been excellently photographed. This book should appeal to divers and rockpoolers. There are a few animals that are sometimes called sea-slugs, like the Sea Hare which still retains part of its shell. These belong to a separate order called the Anaspidea that are not nudibranchs and are not included. There are no anatomical line drawings. Recommended.

5 *Guide to the Identification of Whales, Dolphins and Porpoises in European Seas.*
By: Peter G H Evans
Published by: **Sea Watch Foundation Publications** (1995)
ISBN: 1 85716 193 9

This is a very useful little booklet to identify the cetaceans that can be seen in the seas around the British Isles, with colour photographs of all the common species that should enable you to identify each species if you can get close enough in fine weather. There is a list of addresses and further reading.

6 *Marine Aquarium Keeping.*
By: Stephen Spotte
Published by: **John Wiley & Sons (1993)**
ISBN: 0 471 59489 X

Although described as a no-frills, no-nonsense book for beginners, it is not the best book for those starting up in the hobby of marine fishkeeping. However, for advanced marine aquarists its straightforward style and sensible ordered explanations put it in a class of its own ahead of any other book on the subject. Essential reading.

7 *The Care and Management of Decapod Crustaceans in Captivity.*
By: R W Ingle
Published by: **Universities Federation for Animal Welfare** (1995)
ISBN: 0 900767 86 3

Decapod crustaceans: prawns, crabs, lobsters etc. are often kept by aquarists. They are not too difficult to keep, but species have their own particular requirements. Ray Ingle is an expert on British crabs. Aquarium management is very much in the style of Stephen Spotte. Aspects of crustacean biology are included. This is a compilation of information published elsewhere, but if you want it all in one book, it is a good buy. Extensive bibliography. There is a *UFAW Handbook on Cephalopods* in the same series.

8 *Sea Bass, Biology, Exploitation and Conservation.*
By: Graham D Pickett and Michael G Pawson
Published by: **Chapman & Hall** (1994) **Fish & Fisheries 12**
ISBN: 0 412 40090 1

Of interest to anglers and fish biologists in southern England, this book examines the biology of the Bass and its connection with commercial and recreational fishing, with a few notes on Bass behaviour in aquaria.

9 *Secrets of the Seashore.*
By: Various authors
Published by: **Hodder and Stoughton. Reader's Digest** (1984, reprinted 1989)
ISBN: 0 276 37436 3

This book, first published in the last decade, still represents a good value introduction to the world of the seashore.

10 *Glaucus.**
Edited by: Andy Horton
Published by: **The British Marine Life Study Society.**
Quarterly 48-page journal for advanced students of the marine wildlife of the seas surrounding the British Isles.
ISSN: 0963 9519

** My personal recommendation for all native marine aquarists. This journal bridges the gap between the popular books and scientific papers and offers members a chance to contribute their own observations.*

Ed.

Have a Fishy Christmas!

Have you ever wondered whether or not fish know that it's Christmas? **Susan Brewer** is absolutely certain that they do. Read on...

Fish, like any other creatures kept in captivity, become subject to a routine. It upsets them if you deviate from it. If, each morning at 7.30, you nip downstairs, sprinkle a few fish flakes on the water and say, "Hello sweetie" as you waggle your finger at your favourite Angel, Oscar or Plecostomus, they get to know. And likewise, they know that they have their supper at 8.30 in the evening, tank lights go out at 9.30, and room lights at 11.

Resented oversights

What happens at Christmas? You stagger downstairs, exhausted, at noon because the kids woke you in the small hours, sink into a chair with a mince pie or two, stuff yourself silly on turkey, pud and nuts and watch the Queen. Sometime, mid-afternoon, a sudden thought pierces your befuddled brain. It says "Fish!"

So you sprinkle some flakes onto the water — maybe a bit more for luck, because, after all, it's Christmas — and they're attacked with gusto by a shoal of small tropicals who seem to have turned into Piranhas, giving their best impersonation of fish starved for a month, glaring at you resentfully with their mouths full.

Your favourite Angel, Oscar or Plecostomus shimmies to the front, smile forming on its fishy lips as it realises that you haven't emigrated, got lost or died after all. The smile quickly turns to a quiver of dismay as it realises you look, well, 'different'.

Your neck is wreathed in tinsel, a squeaky blowout hangs from your mouth and you're wearing the silly red hat you found in your cracker. Terrified and trembling, your fishy friend backs hurriedly away and cowers behind a rock.

Then, about midnight, when you're thinking of going to bed, you happen to glance at the fish tank. An accusing row of fishy noses pressed against the glass reminds you that, not only haven't they had their supper, they expect room lights to go out so they can get some sleep.

Guiltily, you feed them and beat a hasty retreat. But the damage has been done — the fish will remember and mutter darkly among themselves about "The Day Our Routine Was Interrupted."

What if you have a Christmas party? It's not unknown for some more-than-merry guest to think it hilarious to pour the dregs of drinks into the fish tank, or decide to see if fish eat olives, or even fiddle with the switch which controls the lights/heater/filter. So beware!

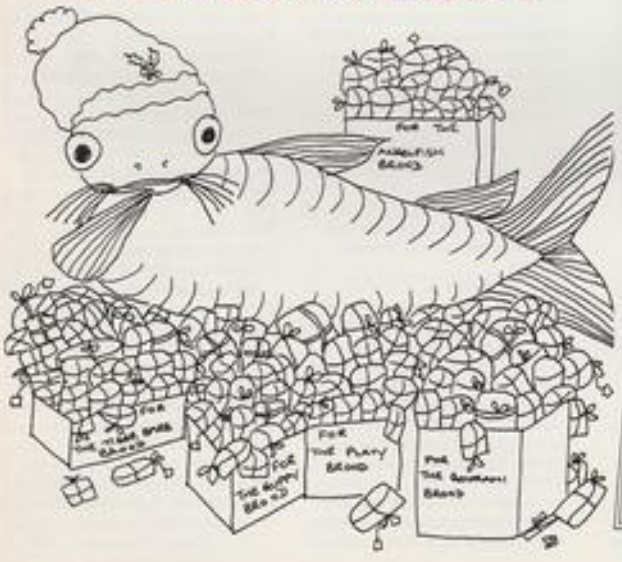
Christmas shopping

It isn't always such a good idea to purchase fish just before Christmas, especially if you plan to be away for some time. Having said that, I know that it's extremely tempting to want your aquarium at its well-stocked best, especially if you're expecting guests. But if you can bear to wait until the festivities are over, then your new acquisitions will be able to settle to a regular routine.

You'll also be able to watch them in peace without being called away to carve the turkey, peel the spuds, or nip down to the open-all-day-even-though-it's-Christmas cornershop because you forgot to buy any cranberry sauce.

So, now you see why I think fish know that it's Christmas. I bet as soon as the tree and the decorations go up, they remember from last year! And if you want any further proof, just think about that famous Christmas fish, the fish that everybody sings about. What do you mean, you've never heard of him? You MUST know about Rudolph the Red-nosed Tetra. Well, just for you, I've written the story down. Happy Christmas!

And the human Santa reckons HE has problems?



WRITE BACK

Top marks for *A&P*

As a contributor to *A&P* I want to congratulate you and your other authors for some articles in the August and September issues:

① **Aquarama:** thanks a lot for thinking about people who didn't go to Singapore! I didn't see a single line written about it in French magazines.

② Good idea to give the names of different plants in *Nature Aquarium World*. This was previously very obscure for us, who are not friends with Japanese Koi or plant names.

③ About hybrids (**D. Lambert's** article): it is good to remind people that hybridisation is something more natural than we generally think. Nobody has bad thoughts against Poeciliids or Discus, or even our dogs or vegetables! But when it is new...!

④ About the background in September's **Editorial**: same remark. It is new, so people have to say something negative. We heard the same thing in France about this background, but maybe a little bit more moderate! It is perhaps because it is expensive, and people think they'll never buy it? So, a little touch of envy? Why not be positive and say: "This is a good idea. I'll try to do the same for my tank." Some polyurethane moss, one or two friends for help and for fun, a tinge of creativity... and that's it!

⑤ **Sue Arnold** at the fish centre... it is so true!!

⑥ Nice to have such recent news about **Conservation in the Philippines**. It is useful to publish more and more papers about this kind of subject. Just a little thing, the fishes in the Fire Coral are not *Zanclus*, but *Heniochus*, maybe the *chrysostomus* species (they are too small in the picture for me to be fully affirmative).

Marie-Paule Piednoir
St. Julien-de-Crempse, France.

H.A.D.A.S. thanks

Might I prevail, through your pages, to offer sincere thanks, on behalf of **Hounslow & District A.S.** to all who supported the society's recent Open Show?

Despite apparent falling numbers around the show scene this year, we were delighted to play host to no fewer than 383 fishes (and their owners) on the day. Thankfully, the sun shone and the fish rewarded every visitor by displaying their very best colours.

The Judges performed valiantly, the refreshments came thick and fast (thanks to the **Hounslow Formation Catering Team**) while the constantly playing fish videos, and the Club Shop (aided and abetted by **Terry Waller's** amicable chatter and superb tank display) kept everyone occupied until the hall was open.

John Egan came all the way from Wales and went home not entirely unrewarded: he won Best in Show with a catfish, plus almost a clean sweep (1st, 2nd and 3rd) in the FBAS Championship Trophy Class for Rasboras and also took first in Cichlids. These awards gained two Gold Stars on his Cards.

Many, many thanks again to all concerned. See you all again next year!

Bob Nelhams,
Hon Sec., H.A.D.A.S.

Anamo's algae eater

I read Barry James' remark on page 76 of the September issue (**Growing Tips**) regarding algae-eating shrimps.

The shrimp recommended by Takashi Amano is *Caridina japonica*, or Yamatonuma-shrimp as he calls it. I am not aware of any import of this to Europe, but other *Caridina* species occur in the trade from time to time.

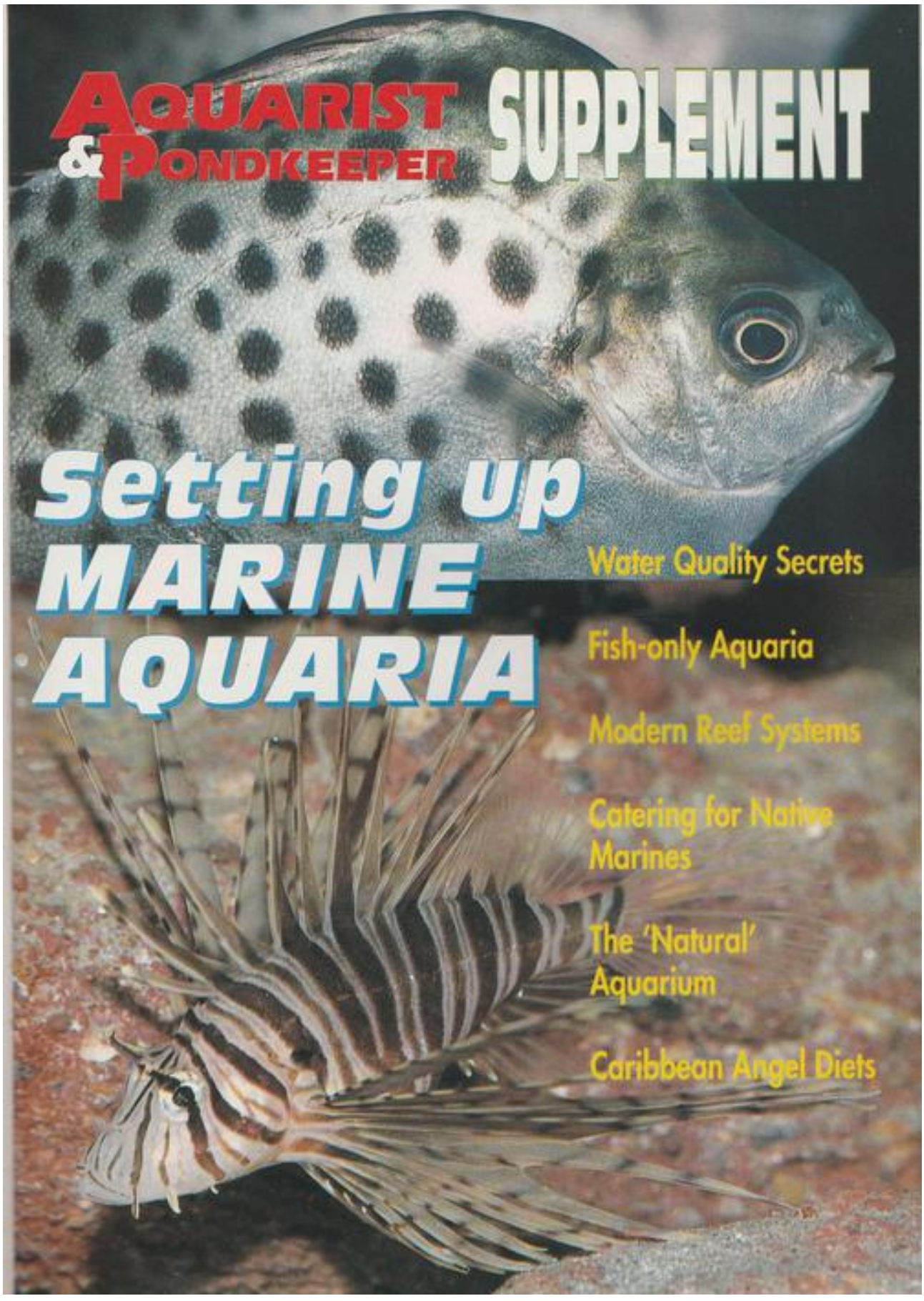
The accompanying picture shows a species which is common in the trade in Germany. It has become popular as an algae grazer and does quite an excellent job as such. It is relatively small, attaining a maximum size of approximately 2cm, and is absolutely peaceful and quite hardy.

I have not been able to ascertain where this particular species is imported from, but apparently, similar species are being imported both from Africa and from Southeast Asia. The imports occur in such large numbers that it definitely should also be available to the British trade.

Svein Fossä,
Grimstad,
Norway.

Caridina, the algae-eating shrimp.

FISH HEADS


AQUARIST & PONDKEEPER
SUPPLEMENT
Setting up MARINE AQUARIA
Water Quality Secrets
Fish-only Aquaria
Modern Reef Systems
Catering for Native Marines
The 'Natural' Aquarium
Caribbean Angel Diets

MARINE WATER KEEPING

Illustrations — unless otherwise indicated — by the author.

At the heart of every system described in this *Supplement* lies a good water quality regime. Philip Hunt casts his expert eye over this all-important aspect of successful marine aquarium keeping.

The marine aquarium and, in particular, the reef tank, is probably the most demanding of all systems in terms of the water quality required for long-term success. But what do we mean by perfect water in a marine system?

The answer is straightforward: conditions should be as close as possible to those on an unpolluted coral reef. Creating these conditions is what the marine tank is all about, and all the high-tech aquarium equipment in the world is simply a means to this end.

Fish and invertebrates pollute water by living in it. In the reef tank, in addition to the products of metabolism, many invertebrates also 'deliberately' secrete toxins into the water around them, with the intention of killing or inhibiting the growth of neighbouring corals. Left to their own devices, our aquarium inhabitants would rapidly turn their living space into a toxic soup.

CORAL REEF TECHNOLOGY/RED SEA FISH pHARMS

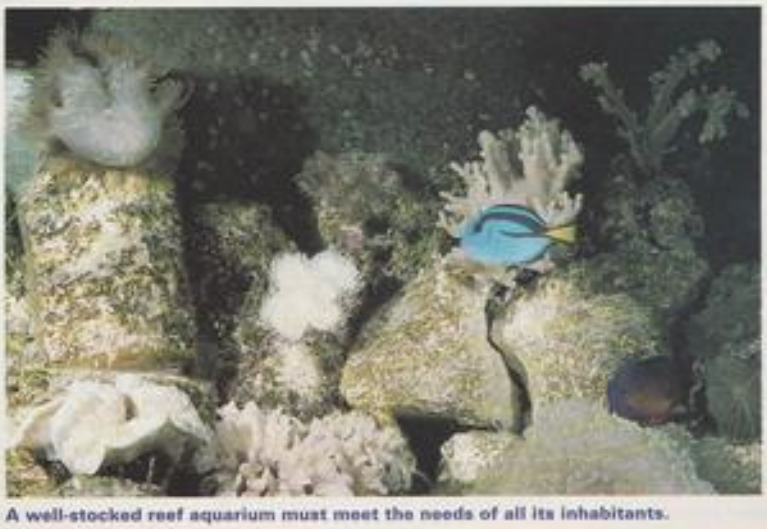
A powerful venturi protein skimmer.

The natural solution

In the wild, nature handles these potential pollution problems with ease. Despite the incredible density of living creatures on a coral reef, nutrient (i.e. waste product) levels are very low.

Several factors are involved in this. Firstly, of course, the sea is rather larger than the average aquarium, so any excreted compounds are diluted tremendously. Also, as in a tropical rainforest, nutrients are cycled efficiently between the living organisms present. Just as rainforests grow on very poor soil, so the water around coral reefs is very nutrient-poor because most of the nutrients are locked up in biomass.

In a sense, then, the water is nutrient-poor, as much because of the dense population, as despite it. The waste products of fish and invertebrates are rapidly absorbed and used as nutrients by other forms of life; this is mainly (70-80%) done by plants, with bacteria picking up the remainder. That there is very little visible plant life on a healthy reef is due to the density of animal life; algae are eaten virtually as soon as they grow, providing another example of the efficient cycling of nutrients through the ecosystem.



A well-stocked reef aquarium must meet the needs of all its inhabitants.

Aquarium solutions

Fish and invertebrates can be considered to produce three types of waste products. The most visible is solid faecal matter, which is insoluble in water and is present as suspended particles. The others are dissolved wastes, in two forms: simple compounds, such as ammonia and creatinine, and more complex molecules, such as proteins and other macromolecules.

Ultimately, all these become ammonia, as bacteria break them down. Both suspended faecal matter and complex organics also often contain phosphate, another major pollutant, so it is clearly a good idea to remove them before they can break down. Happily, the technology exists to do just this.

Mechanical filtration is designed to remove solid wastes before they decompose. There are various methods in which this can be done. Canister filters packed with mechanical media are the traditional solution, and the pre-filter of a trickle system fulfils the same function. Careful siphoning of waste when performing partial water changes is also helpful.

Mechanical filters of whatever type, however, should be cleaned regularly, otherwise the solids will just decay on the filter medium, defeating the object. In a reef system, unless 'live sand' filtration is being used, or animals which requires sand or gravel bed are being kept, it is a good idea not to use such substrates; this makes

REGULAR MAINTENANCE

Maintain calcium at 420mg/l
- More important in reef tanks
- Partial water changes (adequate in systems with low calcium demand, i.e. with few hard corals or clams, little calcareous macroalgae)
- Add calcium supplements
  - Kalkwasser (calcium hydroxide)
  - Calcium chloride
  - Chelated calcium

Maintain adequate concentrations of strontium, molybdenum, iodine
- More important in reef tanks
- Partial water changes
- Add supplements

Maintain stable specific gravity
- Top up with fresh water daily
- Use an automatic level controller

Maintain alkalinity
- Partial water changes (adequate in systems with low fish population)
- Add proprietary buffer compounds

Keep levels of dissolved organics as low as possible
- Partial water changes
- Maintain skimmer efficiency
  - Clean foam columns regularly
  - Where applicable, change airstones regularly
  - Dismantle and service as recommended by manufacturer
- Replace chemical filter media regularly
- Clean mechanical filters frequently

Regular partial water changes are the single most important maintenance task — but don't neglect the rest!

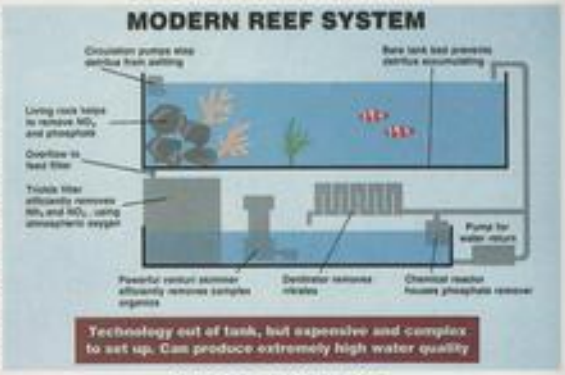
the removal of solid wastes much easier.

Provision of good water flow and turbulence throughout the aquarium also prevents detritus accumulating.

Complex organic molecules can also be removed before they break down. Carbon and other chemical filter media are one solution, but far better, and in my opinion, essential for almost any marine tank, is the protein skimmer. Skimmers enable the load on the biological filter to be dramatically reduced. In reef tanks they are doubly useful, because they can also remove the toxic secretions produced by many soft corals, which otherise could inhibit the growth of other species.

Skimmers come in a variety of designs. It is essential, however, to get one which is matched to the tank volume, and to beware of some of the skimmers supplied with system tanks or some trickle filters. Often, these are too small to be very efficient.

Some compact venturi designs are extremely powerful (the Tunze models and Red Sea Fish pHarm's Berlin skimmers spring to mind), but to handle large tanks and/or high stocking densities, simple columnar, air-driven models need big columns and a high throughput of both water and air. Skimmers should be set up carefully and maintained properly if they are to run at maximum efficiency.



A modern reef aquarium.

Handling ammonia

Ammonia and other nitrogenous compounds can be disposed of relatively easily. Without going into too much detail, as most people are familiar with the basic process, bacteria can oxidise ammonia to nitrite, using the energy produced for matabolism. Other bacteria can then oxidise the nitrite further to nitrate.

This is the classic biological filtration pathway which is well known to most aquarists. The nitrate can then be converted to nitrogen gas by more bacteria; this diffuses into the atmosphere and the ammonia has been completely removed from the aquarium.

1 Ammonia to nitrate

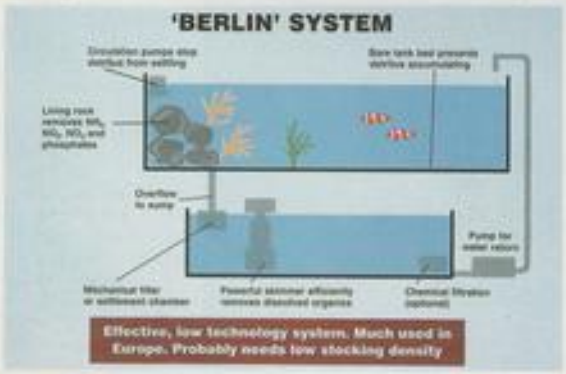
To do this vital work, though, the bacteria need certain conditions. For instance, they need a solid surface to grow on (and the greater the surface area, the larger the potential bacterial population), and oxygen at specific levels. Bacteria which do the first two steps of the process require as much oxygen as possible, whereas those which convert nitrate to nitrogen require conditions in which oxygen is almost, or entirely, absent. Bacteria also appear to function better in the dark.

What we refer to as biological filter systems are actually no more than homes for these bacteria. In an undergravel system, the bacteria live on the tank substrate, and get their oxygen from the water, whereas in a trickle filter, the bacteria live on the medium or media and are exposed to a mixture of water and air.

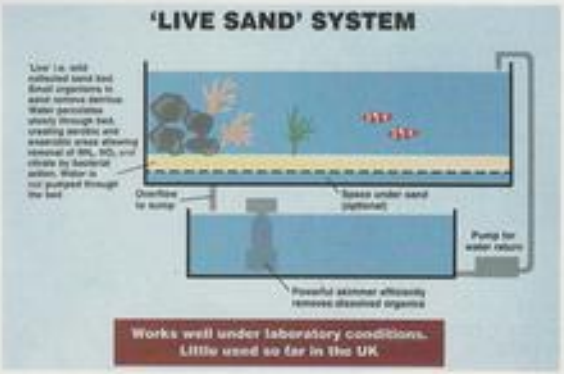
Obviously, there are other ways in which this can be achieved, though many have never really been exploited in the marine aquarium setting, probably as a result of the conservatism of marine aquarists. Many of us, I suspect, are still haunted by the idea of marines being difficult to keep and so, out of fear of failure, stick to well-tried techniques, even if these only yield passable, rather than optimum, results.

All that is really required for a simple biological filter is a surface area of sufficient size exposed to a supply of well-oxygenated water. If that water is mechanically clean, ie, suspended particles have been removed, so much the better; that way the filter will not be clogged by detritus.

This can be achieved in a variety of



The 'Berlin System' for running a reef aquarium.



The new 'Live Sand' System.

ways. A power canister filter packed with a layer of mechanical medium followed by a large volume of high surface area medium such as sintered glass or expanded clay granules, is one. Another, which is well-established in public aquaria and large dealers, is the fluidised sand filter.

Neither of these approaches has really caught on with home aquarists (although domestic-sized fluidised sand bed filters have only just arrived on the market), but both are far more efficient than undergravels, partly because of the separation of mechanical and biological filtration, and also because of the better media surface area and potentially high oxygen levels.

In terms of efficiency in the first stages of biological filtration, however, the trickle filter remains king; the oxygen levels attainable are much higher and media with a very high surface area can be used. This efficiency does have a price, however, in the high evaporation rate typical of these filters.

Optimum Water Parameters

- **Temperature stable within range 22-28°C**
- **Oxygen at saturation level: precise concentration varies according to temperature and salinity**
- **pH in range 8.2-8.4, with a diurnal variation of around 0.2 units**
- **Calcium level around 420 mg/l**
- **Alkalinity 2.5 meq/l or 7°dKH as carbonate hardness**
- **Ammonia zero**
- **Nitrite zero**
- **Nitrate zero**
- **Phosphate zero**
- **Specific gravity stable within range 1.022-1.026**

2 Nitrate to nitrogen

The final stage of biological filtration, the reduction of nitrate to nitrogen gas, requires radically different conditions. The bacteria involved still require a substrate on which to grow, but this time, the water must be as low in oxygen as possible.

In practice, this often means that a separate filter (a denitrator) must be provided. Such filters are tricky to set up; water flow rates must be controlled carefully, as too fast a flow will result in inefficient nitrate reduction, and too slow a flow can lead to the bacteria producing toxic compounds, such as hydrogen sulphide.

To boost the efficiency of these filters, a source of organic carbon, such as lactose or ethanol, is sometimes added, and again, this needs to be controlled precisely.

Happily, there are alternatives to these filters, in the form of porous filter media, sintered glass for example, which are designed to provide a home for aerobic bacteria on the surface, but with anaerobes deeper inside. These media only need to be placed somewhere in the system with water passing over them, and they work very well, the only drawback being their high price.

3 Phosphates

Using either of these systems, coupled with a good aerobic biological filter, should enable the aquarist to keep levels of dissolved nitrogenous wastes at around zero. Such systems, will not, however, remove phosphates, and in conventional reef tanks this is done either by using phosphate binding compounds or by cultivating algae, which use the phosphates as nutrients. There are other 'biological' ways of managing an aquarium, however, and some of these can deal with both nitrogenous wastes *and* phosphates.

4 Complex organics

There are some dissolved compounds which do not seem to be readily broken down by bacterial action in the aquarium and so, tend to accumulate. These are complex organic molecules which tend to give old aquarium water a yellow colouring and seem to be toxic to the inhabitants when present at high concentration. These compounds can be removed by using chemical filtration, usually in the form of carbon or polymeric adsorbents, such as Polyfilters.

Complex organics seem to be a bigger problem in fish-only aquaria than reef tanks, probably as a result of high fish stocking densities, but chemical filtration media (especially polymeric adsorbents) can be very useful in any system, as a lot of other pollutants, which might originate outside the aquarium (compounds from cigarette smoke, for example) can also be removed.

CORAL REEF TECHNOLOGY/RED SEA FISH PHARMS

Fluidised sand filters, now to the domestic aquarium market, provide extremely efficient biological filtration in a compact package and need little maintenance.

Halfway to nature

Aquarists in mainland Europe have, for many years, used a system which has come to be known as the Berlin System to maintain reef aquaria (see also **Colin Grist's** article: **Sifting Sands — the Natural System** and **Svein Fossa's** contribution, **The Modern Coral Reef Aquarium**). This system, at first glance, appears to use no biological filtration, depending on protein skimmers and mechanical filtration to do all the work. Berlin Systems, however, use large quantities of living rock; this, with its flora and fauna, acts as a biological filter.

Algae and bacteria growing on the rock pick up nitrogenous wastes and phosphates, while within the porous rock, anaerobic bacteria live and these remove nitrate from the system. The multitude of small animals associated with living rock also help by, as on a real reef, locking up nutrients in their bodies. The diversity of life in the system helps to keep free nutrient levels down.

Of course, living rock will perform this function in *any* reef system, but the Berlin System places greater reliance on it than other systems and requires larger quantities. The protein skimmer is also a key component of the system, and because it is not supported by a conventional biological filter, it needs to be much more powerful than in an ordinary tank.

The advantages of the Berlin System are that nitrates tend to be less of a problem than with trickle filters (and, thus, require no auxiliary filtration), that evaporation rates are lower, helping to keep conditions stable, and that the large quantity of living rock provides a better ecosystem within the tank.

The downside of these systems is that very powerful skimmers can strip vital trace elements and vitamins from the

Most soft corals, such as this *Dendronephthya*, will not thrive in the presence of nitrogenous wastes, or high levels of phosphates. They contribute to pollution problems, however, by secreting toxins (intended to inhibit the growth of other corals) into the water.

water and these need to be added back regularly in supplement form. It is also likely that stocking densities in Berlin Systems need to be lower than in aquaria with supplemental biological filtration.

Living sand

A much newer method of filtration is so-called live sand filtration. This has become popular recently in the USA and, basically, involves using a layer of sand, either on the tank floor, or suspended just above it, with a dead space beneath. At least part of the sand comes from a wild source, and so is 'live', i.e. colonised by many small animals.

Water is not pumped through the sand, but percolates through it slowly as a result of diffusion and the movements of the animals within. This leads to a balance of aerobic and anaerobic areas, which provide conditions for the activities of all the bacteria involved in disposing of nitrogenous waste products.

The living organisms in the sand, like those on live rock, also increase the biodiversity in the system and help with the 'locking up' of nutrients. Like the Berlin System, live sand filtration depends on a powerful protein skimmer. The two systems are sometimes combined.

All the way back?

As noted above, bacterial activity does not account for much of the 'waste disposal' activities of a wild reef; nutrients are, for the most part cycled between animals and plants in the form of algae. This process can be used to 'filter' tanks, but, as yet, it has found little application in the home aquarium. Public aquaria have made use of algal filtration methods for several years, however, with great success.

Algae filters, or scrubbers as they are usually termed, have great advantages over bacterial methods. All nitrogenous wastes, phosphates and some other toxic compounds can be removed by the algae, which, in the process, boost the oxygen level of the tank. The algae can even be cropped at intervals and used as fish food! Alternatively, surplus can be discarded, thus completely removing nutrients from the system and compensating for the food which the aquarist adds.

Domestic size algae scrubbers are on sale in the USA, but have not yet really taken off in popularity; we have yet to see them in the UK.

A recent book, *Dynamic Aquaria: Building Living Ecosystems* by Walter Adey and Karen Loveland (**Academic Press**, 1991) describes the use of algae scrubbers in both domestic aquaria and zoo-size systems. The systems they describe require no other filtration accessories; skimmers and mechanical and chemical filtration are redundant, as the algae are flexible enough to cope with the products of the breakdown of complex and solid wastes.

Algal filtration, if it does work in the domestic setting (and Adey and Loveland make a very convincing case that it does), could revolutionise marine (and particularly reef tank) filtration, and I, for one, am very keen to see algae scrubbers hit the domestic market.

Many roads to a single destination?

Keeping marine water conditions correct can be achieved in a number of different ways, as described above. However, these technological methods are of little use if the aquarist does not use his or her commonsense.

Run any of the systems described in this article without taking care about such fundamentals as proper (i.e. not excessive) stocking levels, correct (i.e. not excessive) feeding and adequate maintenance, and your aquarium will simply not work. Rather, you will have a system full of hair and slime algae, stressed (and therefore diseased) fish and short-lived inverts.

Get all these things right and your aquarium will flourish, producing the type of spectacular living reef display which all marine aquarists long to have. AMP

Biological Filter Systems: Pros and Cons

Filter type	Advantages	Disadvantages

Undergravel	• Inexpensive
	• Aids buffering? (calcareous media)
	• Combined biological/mechanical action
		• Inefficient
		  - Low surface area
		  - Low oxygen availability
		• High maintenance
		  - Prone to clogging
		  - Needs frequent cleaning
		  - Bed needs periodic replacement
		• No handling of nitrates

Trickle	• Highly efficient
	  - High oxygen availability
	  - High surface area
	• Boosts tank redox potential
	• Equipment taken out of tank
	• Easy to add accessories
	• Low maintenance
	  - Media never cleaned/replaced
	  - Prefilter cleaning only
		• Expensive
		• Complex to set up
		  - Ideally, tank should be drilled
		  - Need to ensure no water loss when pump turned off
		  - Needs ancillary equipment (pipes, valves, overflow weirs, etc)
		• No handling of nitrates (in basic form)
		• High evaporation rate

Fluidised sand	• Highly efficient
	  - Very high surface area
	  - Bacterial colonies constantly renewed
	  - Bacterial film kept thin
	• Low maintenance
	• No clogging
		• Expensive
		• No handling of nitrates
		• Some models can be difficult to set up

fish-only AQUARIUM

Gordon Kay's personal guide for first-time 'fish-only' marine aquarists.

Marine aquariums have come a long way since the 60's, when Graham Cox introduced the undergravel filter and revolutionised the hobby for good. Since then, not only has that particular filter system been honed and refined, but many others have been introduced — with varying degrees of success — along with lighting products and heaters, electronic gadgets and test kits, all designed to make the life of the seawater aquarist easier and increase the longevity of animals in captivity.

Of course, all of this progress means that we have a lot of options to consider before we even think of buying any equipment.

Aquarium size

The first decision we must make concerns the size of the aquarium. This one is easy. Buy the biggest tank that you can (a) afford and (b) find room for.

The reasoning behind this is the very nature of the ecosystem — for that is what we shall have — which we are creating. In a new seawater aquarium, the water quality will fluctuate alarmingly. When one considers that coral fishes come from one of the most stable environments on earth, where they have never had to cope with changing conditions and so have never evolved the mechanisms to enable them to do so, then one can see that water quality which is all over the place is to be avoided. The effects of deteriorating water quality will be far less dangerous the larger the aquarium is.

Undergravel filters

The second — and probably the most important — consideration is in the filter system we will employ. Graham Cox's undergravel filter system — albeit a more updated version of it — is still the most popularly used among newcomers in Britain. This is probably because the system is both cheap and simple to establish and produces predictable results.

Because of these advantages, most writers recommend the undergravel filter system to beginners without reserve. I myself am among that band of writers. An undergravel filter will be the best option in regard to economy and user-friendliness, at least, for the first year of your seawater aquarium career.

The ever-popular undergravel filter is available in varying sizes and with varying subleties worked in. All, however, function on the same basic principle.

1 Installation

An undergravel filter is established by laying one (or more, depending on the size of the tank) filter plate, which you buy from your dealer, along with its attendant uplift pipes, on the base of the aquarium. It is always preferable to use an uplift pipe at each end of the aquarium, in order to allow an even flow of water through the filter.

Over this filter plate is placed a layer of either crushed cockle shell or calcium plus. This layer does two jobs. First, it allows the free flow of water under the filter plates and up the uplift pipes, but stops the much finer coral sand (which is used on top) from passing through the holes in the plate. Second, either medium will help buffer the water, so that its pH will stay above 8.0.

On top of this first layer — which should be used at the rate of 10lb per square foot — is laid a gravel tidy. This is a nylon mesh which, again, allows the flow of water, while preventing the two layers of filter media from becoming mixed. The advantage of using this gravel tidy will be seen if the filter ever needs to be stripped for any reason.

The final layer of filter medium — coral sand — is now laid on top, again at the rate of 10lb per sq. ft.

2 Moving the water

Now that we have constructed the filter, water has to be moved through it. In the old days, this was done with an air pump, to which was attached a length of airline

GORDON WILKINS

Wimple Fish belong to the same family as butterflyfishes, but are suitable for beginners.

LINDA LEWIS

The Scat is extremely hardy.

LINDA LEWIS

Lionfish are beautiful... but watch those spines!

with an airstone on the other end. The airstone was pushed down the uplift pipes and, when the pump was turned on, the resultant mixture of air and water — being lighter than the surrounding water — would be pushed out of the uplift and back into the aquarium.

However, this system has several disadvantages. The moment an airstone is used, it starts to clog, so that the amount of water being moved — which is, at best, pure guesswork anyway — reduces to a trickle over time.

Because the amount of water being passed through the filter is so important, I would never attempt to run an undergravel filter with an airpump. A far more reliable method is to use small, submersible pumps, called powerheads, on top of each uplift. These are reliable, give a constant flow, are quiet and cheap to run. Some of the most modern powerheads have flow-meters displayed on their sides, so that the amount of water that they are shifting can be seen at a glance.

Generally speaking, water should pass through the filter bed of a fish-only aquarium at least 3 or 4 times the volume of the aquarium every hour. In other words, in a tank holding 100 gallons, we need two power heads with a combined flow capacity of 300 gallons — minimum. Therefore, we need to buy two pumps, each with a capacity of at least 150 gallons per hour.

Heating the water

We now have to consider how we will heat the water in our aquarium — unless, that is, we are lucky enough to live in the tropics!

There are several ways of achieving this heat, all of them with differing costs and performance, but the cheapest and most reliable method is to use a combined heater/thermostat which has been specially developed for the aquarium hobby. Here again, two heater/thermostats would be better, so as to give an even spread of heat.

If one unit were to be set a degree or so lower than the other, then, should one fail, at least there is some heat being produced. Conversely, should one heater stick in the ON position, it is then unlikely that enough heat would be produced to boil the fishes. In our 100-gallon aquarium, two heaters of 150 watts should do the job admirably.

Tank lighting

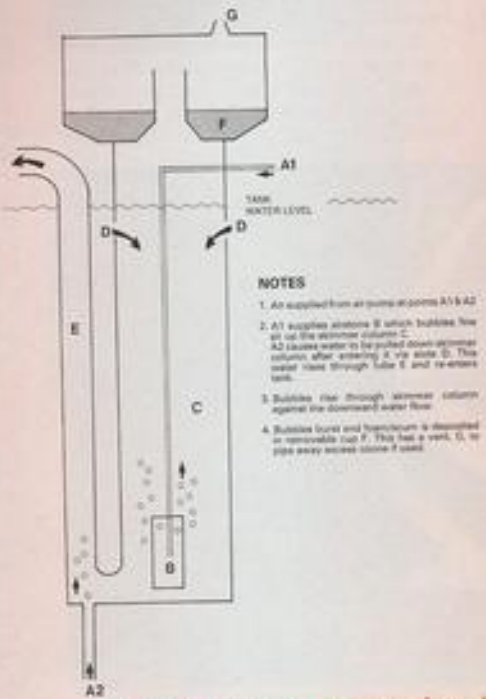
Almost every living creature needs a cycle of light and darkness and fishes are no different. Furthermore — and perhaps most important — we need light in order to see our fishes; they also need to be able to see their food!

In a fish-only aquarium, lighting is an easy issue, as opposed to an invertebrate system, where lighting is such a complex topic that it warrants an article on its own. We need light purely for the purposes I have already mentioned.

Again, there are many ways in which we could provide light, with varying costs and efficiency. The most popular light source is the cheapest and easiest to install, and that is fluorescent tubes. These have the added advantage of being cheap to run and giving an even spread of light.

As we need only concern ourselves with providing enough light to see our fishes and for them to find their dinner, then two tubes, each roughly the same length as the aquarium, should suffice. In deep tanks — those of 24in or more — three would be better, if a dark bottom layer is to be avoided.

Buy tubes which are designed specifically for the marine aquarium. These give a whiter, more natural, appearance to the aquarium. Each tube will need a special starter unit to 'fire' it and these should be housed in an aquarium hood designed for the purpose, with a cover glass between them and the water surface.



Protein skimmers are tremendous aids to water quality maintenance.

Additional gear

Now, you'll be glad to know that we are almost kitted out and ready to set up our aquarium. But there are still a couple of items we will need.

The first is a stick-on thermometer to enable us to monitor the water temperature, which should be maintained at around 75°F (24°C). You've probably guessed that I'm going to recommend that you use two, one at either end of the tank, so that cold spots can be identified and eliminated.

The second piece of kit is usually referred to in books as an "optional extra", but in my opinion, it is essential. It is a protein skimmer.

You will remember that we talked about the filter system a few paragraphs ago. Well, there are certain substances which a biological filter — whatever the type — simply cannot deal with. There are also those which it can deal with, but which cut short the filter's useful life. A good protein skimmer will be able to eliminate up to 80% of waste substances BEFORE they even reach the filter.

LINDA LEWIS

The Flame Angel: an exception within its family.

There are some excellent hydrometers available nowadays.

This it does by exploiting the fact that these substances are surfactant, which means that they are attracted to any air/water interface. By providing this interface — a bubble, or, more precisely, hundreds of bubbles — the skimmer collects these substances and deposits them in a cup, so that they can be easily collected and disposed of.

Of course, this is merely an overview of protein skimming. Space dictates that a detailed account must be obtained elsewhere, but time should be taken to do just that, since there are many types of protein skimmer.

Setting up

When the time actually comes to set up the aquarium, make sure that you have all of the equipment to hand and that the site is clear of anything that is not essential to the job in hand.

1 The aquarium should be washed in clean water (water only!!) before you start. First, lay the filter plates at the base of the tank. If you have a non-standard sized aquarium, you will have two plates and may even have to cut them. When you do cut them, ensure that you do not cut them in such a way as to either block the flow of water over the whole area, or short circuit the flow.

2 Wash the cockle shell or calcium plus, so as to rid it of the dusty residue which is always present. The best way to do this is to use a plastic brewer's bucket and run water over it, using either the tap or hosepipe. Wash only 5 or 10lbs at a time and stir while running the water. In this way, the water will begin to run clear after a while and you can tip the medium into the aquarium. Spread it evenly until all of it is in place.

3 When this first layer of filter medium is in place, it is time to add to it the gravel tidy. Simply lay the mesh over the calcium plus and cut it to fit around the uplifts, taking care not to leave any parts uncovered, otherwise the whole point of the gravel tidy will be lost.

4 It is now simply a matter of washing the coral sand and laying it over the gravel tidy, in exactly the same way as you did with that first layer.

5 When the filter components are in place, the electrical equipment can be put into place. The means that powerheads can be placed atop the uplift pipes, heaters can be put into their place and lights can be wired into the hood. Obviously, nothing should be switched on yet!!

6 The aquarium now needs to be decorated. This can be done with rocks, coral skeletons or sea shells. If you choose either of the latter, they will need to be sterilised prior to use. To do this, boil them in a saucepan for 30 minutes, then rinse them thoroughly. It is now that you can do your own thing, because there are no rules as to how you should decorate an aquarium. Use your own imagination but leave a few gaps and hiding places for the fishes along the way.

7 At this point, we can add the water. Whatever brand of sea salt you have chosen is of no real importance, as they all give more or less the same specific gravity at any given volume. All you need to do is to calculate ROUGHLY how much you will need for the size of the aquarium — you will be able to do this if you read the label — and pour the salt over the sand.

Next, with a saucer or similar placed on top of the sand so that you disturb the minimum amount of all the work you have done, fill the aquarium with water from the tap.

8 Turn on the electricity and check that everything is working, stick the thermometers onto the outside front of the glass — and go to bed. You deserve it!

9 When you awake, the salt will have dissolved and the water will have cleared and probably reached the temperature which you set on the thermostat. Check the specific gravity with your hydrometer. If it is too low, simply add more salt and wait a few more hours. If it is too high, siphon some water out and store it for further use. Add more freshwater until the required SG is reached.

10 After a day or two, you can start maturing the filter so that the aquarium can support life.

11 By now, you will have realised that this article has been merely a guide. You will need to do more detailed reading, but at least, I hope that you have grasped the basic nuts and bolts of what is a truly wonderful hobby. AAP

Recommended species for beginners

1 **Scat** (*Scatophagus argus*) Usually sold as a freshwater species, but one which actually does better in seawater. In the wild, found in estuaries and open ocean. Highly tolerant of fluctuating conditions as a result. Likes lots of greenstuff in its diet.

2 **Malayan Angel** (*Monodactylus argenteus*) Like the previous species, is found in estuaries, as well as freshwater. Again, very tolerant of fluctuating conditions. Can be boisterous.

3 **Lionfish** (*Pterois voltans*) Like any other member of its family, is extremely hardy and even becomes tame. BEWARE! The spines of all Lionfish are extremely poisonous.

4 **Black Triggerfish (sometimes Blue Triggerfish)** (*Odonus niger*) Although all triggerfishes are very hardy, most are aggressive and boisterous, therefore not to be recommended to beginners. This species is the exception.

5 **Bicolour Blenny** (*Ecsenius bicolor*) A lovely little fish, with endearing behavioural patterns. Highly recommended.

6 **Flame Angel** (*Centropyge loriculus*) Although angelfishes are not, generally, for beginners, this species is so hardy that it can be wholeheartedly recommended. If, that is, you can afford it!!

7 **Black Pyramid Butterflyfish** (*Hemitaurichthys zoster*) Like angelfishes, butterflies can never be recommended to beginners, but this species — like the next one — is definitely the exception to the rule. Very hardy, long-lived and interesting.

8 **Wimple Fish** (*Heniochus acuminatus*) The second exception to the rule about beginners and butterflyfishes. Perhaps not quite as hardy as the previous species, but I would have no hesitation in recommending this wonderful species.

You will notice that, in contrast to most writers, I have not suggested that you start with damsels or clownfishes. The reason for this is threefold. First, damsels become very pugnacious as they grow. Starting with three or four damsels will mean that you'll be somewhat restricted in your choice of fishes later. Although SOME clownfish species are hardy, there are many that aren't. I don't consider that clownfishes can be unreservedly recommended. Finally, I simply wanted to present some species which are just a little different from those usually trotted out.

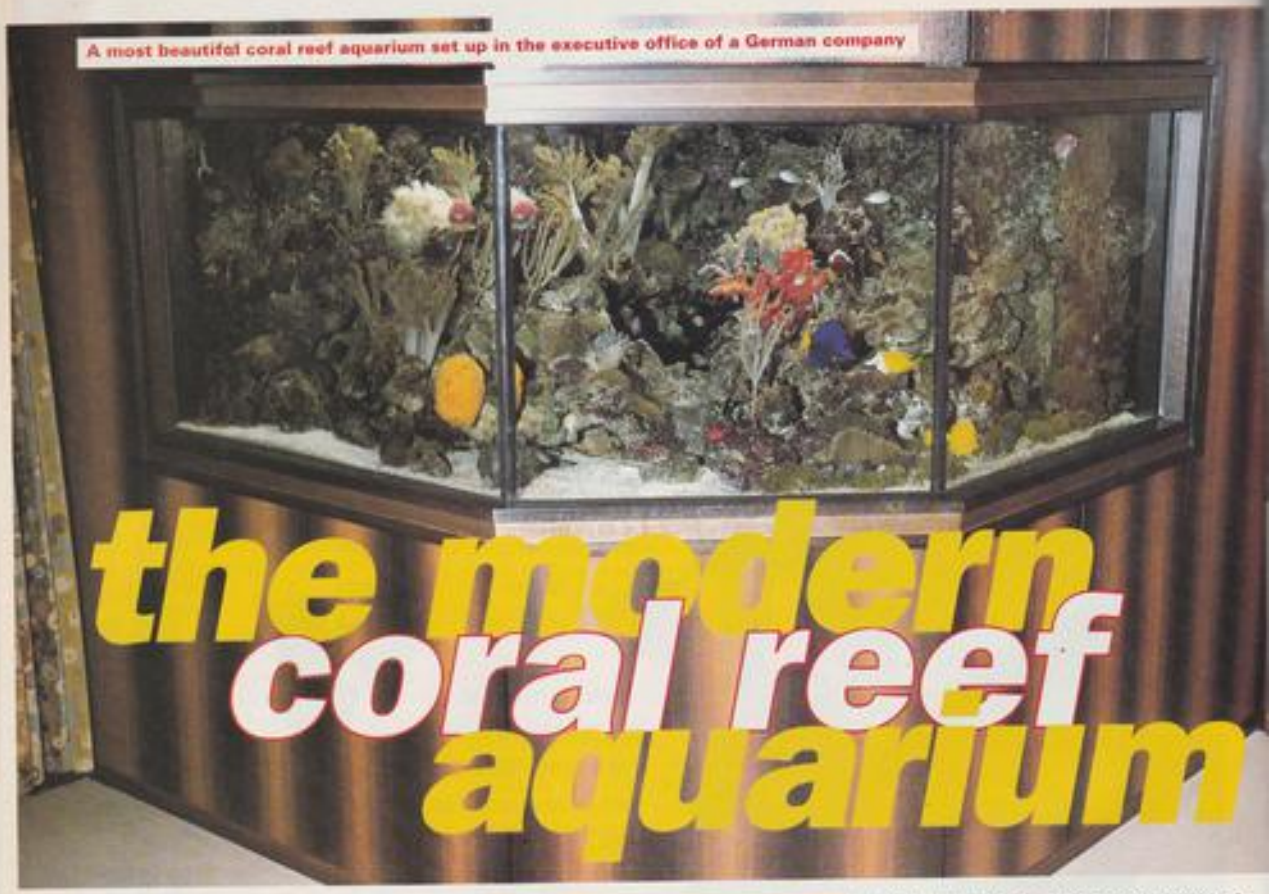
The stocking rule

When the aquarium filter is matured, it houses only enough bacteria to deal with a limited biological load. This capacity will expand as the load increases, but it takes time for it to do so. For this reason, we cannot simply buy whatever and whenever the fancy takes us. We have to build up slowly in order to give the filter time to catch up.

When Graham Cox **first introduced the undergravel filter, he also introduced a rule which has been proffered every since.**

The rule says: "One inch of fish to every four gallons of aquarium water for the first six months. One inch of fish to every two gallons thereafter".

It should be remembered that these levels MUST be reached gradually.



A most beautiful coral reef aquarium set up in the executive office of a German company

the modern coral reef aquarium

Svein Fossà discusses the latest approaches to successful home reef creation and upkeep

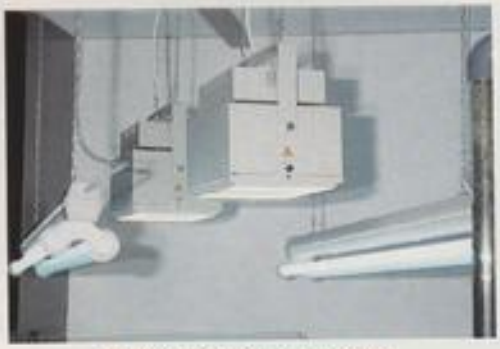
Photographs by the author

Only by looking back in time, can we see the coral reef aquarium in the right perspective. In order to acknowledge the many positive developments in marine aquatics, one has to look back at least some 20 years. The average tropical marine aquarium of the time was typified by a large selection of fishes and, perhaps, some anemones.

I remember very well my own first marine tank in the seventies — overgrown with dense clusters of the green filamentous algae — exactly as recommended in books and magazine articles. Like most eager aquarists, I tried out whatever invertebrates were available through the aquarium trade, most of which did not live more than a few months. Even the hardiest of anemones simply wouldn't survive. **Why?**

Developments

The typical marine aquarium of the seventies was equipped with an undergravel filter and/or outside mechanical powerfilters which were set up to function biologically. The lighting was selected largely for the sole purpose of bringing out the best colours in the fishes and consisted, typically, of a few fluorescent tubes. The decor consisted mostly of dead coral skeletons or of calcareous rocks.



A look behind the scenes of the German office aquarium. Metal halide lamps and actinic blue fluorescent tubes have been used to create the appropriate lighting.

Aquarists concentrated on fish and one of the main problems of the time was treating and preventing fish diseases. Much of this was achieved by keeping the aquarium environment as sterile as possible and by applying cures based on copper and various dyes — quite a contradiction compared with the intention of maintaining water quality through biological filtration. There isn't much fantasy needed to see why so many of these tanks failed.

In the early '80s, we started to see systems based on dry/wet biological filtration. The decorations were live rocks or dead calcareous rocks, while the illumination was still fluorescent tubes. Several variations of the technical set-up and equipment were tested by aquarists and many commercial system set-ups appeared on the market all over the world.

Personally, I have tested some variations of the system over several years, and, from my point of view, its greatest disadvantage is the potential for the build-up of nutrients which, in turn, makes it practically impossible to control the growth of algae.

A correctly functioning protein skimmer should produce a thick foam which only slowly dissolves into a dark brown fluid in the collection cup.

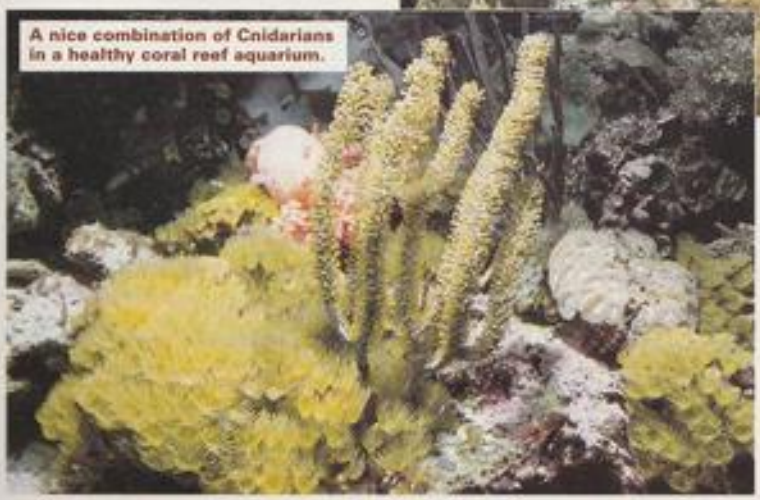
The artistic use of live rock, to make clefts and pillars, makes this coral reef aquarium look particularly interesting.

Defining success

Now, it might be appropriate to define what I mean by "a successful reef aquarium". To keep an animal alive for a few months or a year can certainly **not** be defined as "successful keeping", no matter how proud we were 20 years ago when we first succeeded in doing so with an anemone or a tube worm. The term "successful keeping" can only rightfully be used when the animals **show very clear and measurable signs of growth and/or reproduction and continue to live steadily for years.**

For me, coral reef aquatics really started to get interesting in the early '80s, as another system of technical solution was introduced in reef aquaria, with protein skimming as the main or only filtration.

The skimmer itself was not a new idea — it had been irregularly used since the early sixties — but the context in which it was now used represented something new. When techniques such as the adding of calcareous water (»Kalkwasser«), the use of metal halide lamps (at least, for larger tanks), the use of live rock as decoration and, perhaps, the careful addition of carbon dioxide to control pH were combined with optimal skimming, the successful reef aquarium became a fact.



A nice combination of Cnidarians in a healthy coral reef aquarium.

Reef biology

Coral reefs are among the most diverse ecosystems. It would be easy to believe that this diversity is a result of an abundance of nutrients present in the system. However, just the opposite is true. Coral reefs, in general, are nutrient deserts.

Elements such as nitrogen (N), phosphorus (P) and carbon (C), which are vital to the primary producers, are found

A successful aquarium is one in which all the organisms thrive. This *Acropora gemmifera*, with its pinkish growth zones, is a good example of well-being in a stony coral.

in such minor concentrations on the reef that, theoretically, it should be impossible to keep the ecosystem going. Compared with the conditions in the North Sea areas, where nutrients are supplied by upwelling from deeper waters several times a year (resulting in an instant bloom of algae), a reef's ecology is very different indeed.

The majority of reef corals (and also many other Cnidarians) live in symbiosis with single-celled algae known as zooxanthellae. They are found in billions inside the cells of their coral host. This symbiosis is, perhaps, the major adaptation to the nutrient-poor environment of the reef and the most important reason for the corals' success in shallow tropical waters.

Like all plants, zooxanthellae carry out photosynthesis. This complex chemical process is driven by light and converts carbon dioxide and water into sugar compounds rich in energy. Oxygen is a by-product of this reaction. It has been shown scientifically that many of the organic compounds produced by photosynthesis are translocated from the zooxanthellae to the coral cells.

In addition, several vital compounds, among them phosphate and nitrate, are recirculated from the coral to the algae. In this way, essential elements are used and reused, again and again, instead of being released into the water surrounding the coral.

Reef technique

Unlike the natural reef environment, the marine aquarium is an enclosed system. In most reef tanks, large numbers of organisms are present within a hugely limited space, and unless the utmost attention is paid to water quality, the aquarium water will rapidly attain a large surplus of nutrients. This will be a threat to most reef organisms and will, eventually, possibly kill them. The phenomenon of over-fertilised aquaria is frequently a problem in aquarium systems based on biological filtration.

The most important consideration for successful reef aquarium keeping, is to avoid the accumulation of organic nutrients. Waste products are released into the aquarium water in the form of complex organics produced by fish, dead organisms and decomposing food.

Simpler wastes are produced by invertebrates. Decomposition by bacteria takes place and by-products, such as nitrate, rapidly concentrate in the water. Algae utilise these nutrients, frequently resulting in an uncontrolled growth of various filamentous types.

Waste removal

In my opinion, effective removal of waste products in a reef aquarium can be accomplished only with an efficient protein skimmer in combination with the use of high-quality live rock. The skimmer removes many organics prior to decomposition, which results in fewer compounds to be broken down and less bacterial activity in the aquarium.

However, even the very best skimmer cannot remove 100% of the organic compounds. The live rock, though, acts as an efficient, self-maintaining biological filter, containing a wide variety of micro-organisms and bacteria that carry out several decomposing reactions.

One of these is denitrification, in which *nitrate* (NO_3) is broken down to *oxygen* (O_2) and *nitrogen gas* (N_2). In aquaria with adequate denitrification, there will be minimal levels of nitrate and, consequently, less nutrients for algae to utilise.

The debate on skimmer vs. biological filtration arose together with the increasing use of protein skimmers, and the debate is still going on. Intensive skimming **can**, of course, be negative as it **may** remove essential elements. This has long been the strongest argument against the use of protein skimming in the reef aquarium. However, it is usually no problem to add trace elements through some commercial mixture, in order to replace those that are being skimmed off.

The greatest advantage in the continuous use of skimmers is the possibility of effectively controlling the nutrient level in the aquarium water — an essentiality in the coral reef aquarium.

Calcium role

In addition to several trace elements, *calcium*, (Ca) is vital to the majority of reef organisms. Calcium is present at an average of 400ppm in seawater. Typically, the positively charged *calcium ions* (Ca^{2+}), are bound to negative ions of *hydrogen carbonate* (HCO_3^-).

Stony corals are particularly dependent upon calcium for the building of their skeletons. Due to the laws of chemical equilibrium, the reaction: $Ca(HCO_3)_2 \leftrightarrow CaCO_3 + H_2CO_3 \leftrightarrow CO_2 + H_2O$ shifts to the right when the zooxanthellae use carbon dioxide for photosynthesis. Then *calcium carbonate* ($CaCO_3$) in the structural form of *aragonite*, precipitates out and forms the corals' skeleton.

In the course of years, this simple chemical reaction has built the beautiful coral skeletons and formed the enormous structures we know as coral reefs. The aquarist must ensure that this reaction also takes place in the aquarium.

Using Kalkwasser

This can be done by replacing all the water that evaporates with calcareous water (»*Kalkwasser*«). You can make your own »Kalkwasser« by dissolving *calcium hydroxide* ($Ca(OH)_2$) or *calcium oxide* (CaO) in freshwater. Several brands of commercial mixtures are also available.

Theoretically, you can dissolve about 1.7 grams of calcium oxide, or calcium hydroxide, per litre of freshwater. Mix the chemicals with the freshwater and allow the water to effervesce into it. The reaction will be completed after a few hours, with the white calcium above it. The clear solution is used to replace the evaporated water in the aquarium. For commercial mixtures, you should relate to the producers' advice.

High-quality »Kalkwasser« has a very high pH, measuring approximately 12. therefore, you should never pour large quantities of this solution into the aquarium all at once. The best method is to use a nearly continuous refilling process through a pump controlled by a level sensor.

When too much »Kalkwasser« is added to the aquarium, the pH tends to rise. This can be prevented by an automatically controlled addition of *carbon dioxide* (CO_2), which is the only way to control pH directly. In tanks with a lot of evaporation (in larger tanks it may reach 10 litres or more per day), this pH control can become an absolute necessity.

There is also a very efficient alternative method for adding calcium, which is rapidly becoming more widespread: the *calcium reactor*. This is, basically, a chamber where the aquarium water is mixed

The surroundings of an aquarium are also important. Claes-Göran Malmström, Gothenburg, Sweden, has built this beautiful reef tank into a wall in his several hundred years old house.

with carbon dioxide in order to lower the pH, and then led through a bed of calcareous gravel. As the pH is low, the gravel actually dissolves into the water, thus raising its calcium content.

So far, experiences with this method are restricted; nevertheless, results are promising. The use of a calcium reactor may cost a little more, but it certainly makes the adding of calcium much simpler and less messy.

Light control

Sunlight consists of both visible and invisible radiation. The visible part includes violet, blue, green, yellow, orange and red light waves, whereas the invisible part of the spectrum is made up of ultraviolet and infrared light. The light from the sun is always made up of a very specific mixture of all these parts. Sunlight is, however, filtered as it passes through light-absorbing materials, such as clouds and water.

In the water, particular light components are very rapidly filtered out: red and orange light disappear in very shallow water, while yellow and green light are able to penetrate to depths of approximately 100 metres (330 feet) and blue is the only colour that penetrates to a depth of more than 150 metres (500 feet) — hence the bluish tinge to everything you see underwater when diving. In areas with crystal-clear water, such as the coral reefs, the invisible ultraviolet (UV) light can penetrate several metres.

In the aquarium, it is important to use light sources that match natural light on the reefs as closely as possible, in terms both of quality and quantity.

Fluorescent lights have been used for years in aquaria, and they exist in a wide variety of types and colours. Used in the right combination, they can provide marvellous light, from the quality point of view. Apart from in smaller tanks (up to some 150-200 litres) it may, however, be difficult to get enough light from fluorescent tubes. The quantity simply isn't there, as the output intensity is too low.

Metal halide lamps, also known as Halogen Quartz Iodide (HQI), were introduced as a light source for reef aquaria during the late 1970's. Since then, several varieties of these lamps have been developed, often with the needs of the reef aquarist specifically in mind.

In my opinion, the more sophisiticated, modern metal halide lamps offer the very best illumination for reef tanks. They have a spectrum which closely matches that of natural daylight and include the necessary amounts of UV-radiation. They also produce large amounts of light energy, making it possible to illuminate large tanks adequately.

All metal halide lamps must be mounted in special pendants and always used together with the prescribed filters to block harmful parts of the UV spectrum. The necessary filters are sold together with the lamps, if bought from a reliable aquarium dealer. The output of metal halide lamps, as of all artificial light sources, decreases over time, so they must be changed once a year.

HQI lamps can, when necessary, be combined with actinic blue fluorescent tubes in order to increase the amount of blue light. Such a combination will also make it possible to provide dusk illumination in the morning and evening.

Conclusion

If you are willing to take the challenge of maintaining a coral reef aquarium, the rewards are great indeed.

The results we presently experience, particularly in keeping and growing corals, are something we could only have dreamed about a few years ago. Now we can see invertebrates, including stony corals, **growing** and **reproducing** in our aquaria.

Since it is possible to divide coral colonies, thereby spreading offspring colonies among several aquarists, the serious reef aquarists of the world are therefore in the process of creating a potential for keeping corals without harvesting the reefs.

At the same time, aquarists are becoming more attentive of the splendour and the sensitiveness of the natural coral reefs and the organisms associated with them. The well run reef aquarium creates respect for the living reefs and for nature. Besides, in modern reef aquaria, professionals as well as amateur aquarists, are continuously making observations which add to our sadly-far-too-limited knowledge of reef biology. **AAP**

A coral reef aquarium does not necessarily have to be very big. This is the top view of a 60-litre tank owned by Julian Sprung, Miami Beach, Florida.

FROM ROCKPOOL TO AQUARIUM

Andy Horton supplies expert tips for all would-be native marine aquarists

Photographs by the author

"What have you got in there?" I asked, peering into the bucket that contained a mixture of small fish, crabs and prawns. It was a large 3-gallon bucket with a wire carrying handle, that had been placed in a cool pool in the shade. The water had been collected from the sea below low tide limit, rather than the pools which may have already deteriorated in quality.

This is the most elementary type of temporary aquarium. However, even in short periods of less than an hour, the fish and crabs can succumb under conditions that are not suitable for even the hardy marine creatures that can be found between the tides.

Why is this? After all, it is the same water that the animals were collected from. The answer lies in the changes that occur in the bucket. The two most important factors are:

1 Oxygen depletion

Fish and marine invertebrates obtain oxygen from the water in which they live, and this oxygen is renewed from the atmosphere at the water's surface. Oxygen becomes depleted in a bucket because the animals consume it quicker than it can be renewed from the atmosphere.

The fish will therefore gasp at the surface and eventually suffocate, unless they are returned to the sea or remedial action is taken. This is further compounded by the invisible plankton that dies and puts further demands on the available oxygen.

2 Temperature amplitude

Marine life can only live in a narrow temperature range that varies from creature to creature. However, even the highest temperature that the seas around Britain get to rarely exceeds 19°C (66°F). About 50% of the rock pool fish and crabs are unable to endure temperatures more than a few degrees about this for long periods.

In a bucket on the shore, it only takes a few minutes for the water temperature to rise to the same as the air temperature which, last summer, was much too high at 28°C (82°F), but even temperatures of 25°C (77°F) may be too high for some of the northern species.

Life-support systems

It is unethical to take home creatures from the shore and the sea unless you have a properly set up aquarium to put them in. Without any life support systems, the tank is no more than a giant bucket. It can only really be called an aquarium when the aeration, filtration and temperature control systems are installed.

A step-by-step guide to setting up native marine aquaria is included with this article to help you along. A cooler may also be needed if you wish to keep a wide range of British species.

This is not the only thing to think about, though. Fish and invertebrates have to be fed the correct and sufficient amounts of food, and attention should be paid to the size they will eventually attain.

Compatibility needs to be considered as well. Fish will not only eat each other, but some of the more aggressive animals may also be quicker on the uptake and deprive shyer fish of their share. Finally, the seawater in the aquarium needs to be replenished at monthly intervals.

Common Hermit Crab (*Pagurus bernhardus*) — popular but 'squabbly' among its closest relatives.

Seawater

Tapwater mixed with table salt will not do! Seawater contains a large number of additional mineral salts, of which many are essential to support life. In addition to sodium chloride, these include magnesium, sulphur, potassium, calcium, potassium, bicarbonate and a lot of minor and trace elements.

The aquarist has the choice of buying special proprietary 'marine salts' from aquarium shops and mixing the contents with tapwater according to the instructions on the packet, or collecting the real stuff from the sea.

1 Artificial seawater

These salts (make sure that you explain to the retailer that the salts are required for a marine aquarium) prove to be suitable for keeping British marine life in captivity. The salinity should be 3.4%, which equals a Specific Gravity of 1.025 at 15°C (59°F) and 1.024 at 20°C (68°F). An error of more than .002 should not be permitted.

2 Real seawater

Apart from the heavy weight, the real stuff actually presents problems and is generally only used when an aquarium is started, or for replacements in invertebrate-only tanks.

The following points are worth bearing in mind:

(i) Collection should be from an unpolluted source.

(ii) Estuarine water needs to be checked for salinity.

(iii) Real seawater contains vast amounts of plankton. In times of 'bloom', when the numbers explode, the introduction can cause a serious oxygen shortfall in the aquarium.

(iv) Containers should be clean.

(v) Seawater should be used immediately, or stored in the dark for one month or more. Seawater kept for

The Bullhead or Sea Scorpion (*Taurulus bubalis*): terror of the seapools... and potential terror of the aquarium.

over one day has proved harmful (my own experience). This could be for a number of reasons, including bacterial explosions.

(vi) Pathogens, including free-swimming parasites can be introduced.

(vii) Suspended particles of silt can be present in appreciable numbers, even in water that does not look murky.

Oxygen

Fish and invertebrates respire and like humans, they inhale oxygen and exhale carbon dioxide. Unlike humans, though, they extract the dissolved oxygen present in the water. The oxygen would be all used up very quickly if (in the sea and the aquarium) it were not replaced by oxygen from the air. In still waters like a bucket, this process does not occur very quickly.

Aeration in aquaria is designed to increase this gas transfer. The best way to do this is to increase the surfaces by which oxygen can enter the water, which is done by increasing the turbulence at the water surface. This can be achieved in lightly stocked aquaria by the use of the filtration equipment which circulates the water and can agitate the surface by a variety of methods, including spray bars.

It is also good practice to use an additional powerhead with an air intake tube

The Beadlet Anemone (*Actinia equina*) — which occurs in different colour forms — is widespread on British rocky coasts and is easy to keep.

for the purpose of disrupting the water surface and providing supplementary currents and circulation in the aquarium.

Biological filtration

Wastes are expelled directly into the water in the form of organic compounds like, urea, ammonia, etc. Ammonia is excreted by fish and invertebrates and results from the breakdown of organic matter. Ammonia is toxic to fish in amounts too small to be accurately tested by the home native marine aquarist. In conventional marine aquaria the answer to this problem lies in bacteriological control, whereby a suitable medium is provided as a home for helpful aerobic bacteria, called nitrifiers, which convert toxic ammonia into less toxic nitrites and, thence, to nitrates.

The usual medium is gravel or coral sand used in an undergravel system of filtration where a powerhead is used to circulate the aquarium water by drawing it through the gravel. The nitrifying bacteria in such systems live among the gravel grains. In an external system, the gravel, or alternative medium, is housed in a canister.

Biological filtration should be operated continually, so the filter must not be turned off at night.

1 Undergravel system

Two substrates can be used in undergravel filters, separated by a mesh called a 'Gravel Tidy'. The coarser 'calcium plus', crushed maerl etc. is put underneath, with a layer of coral sand, or even beach gravel, lying on top. The size of the gravel particles should be between 2 to 4 mm (this is the size of coffee granules). The depth should be 40 mm (1.6 in) or more.

This is the simplest type of filtration. One of the main disadvantages of the undergravel filter plate system is the

uneven flow that can occur through the coral sand and the difficulty of cleaning the media. The filter bed is, however, also beneficial, as it acts as a sieve extracting particles from the water and keeping it clear. This dirt, though, remains in the coral sand and, over a period of six months or more, tends to obstruct the flow of water. The remedy is to clean the gravel as part of the maintenance programme using various siphon-like devices.

2 External filter

The filter medium in such systems is kept in a separate canister and the water is pumped out of the tank, through the filter medium and back into the tank again. The pump is usually contained in the canister.

One of the advantages of external filters is that there is very little equipment in the aquarium. In addition, the pump can be disconnected for easy cleaning and the canister can hold a variety of special filtration media. Internal canister filtration is also available.

Adsorptive filtration

Organic waste can be removed directly from the aquarium by adsorptive materials like 'activated carbon' and by the use of the protein skimmer. These are supplementary methods and should be used in addition to biological filtration, not instead of it. The main advantage of such techniques and products is that they delay the build-up of the biomass in the aquarium. They should, however, only be installed after the aquarium has been running for six months, or alternatively, they can be used after feeding only.

Internal changes

In the week of setting up an aquarium, the amounts of ammonia, nitrites, and dissolved oxygen can fluctuate wildly, and only the very hardiest of rock pool animals like Shore Crabs and prawns should be kept. After about three weeks, though, the aquarium will settle down and more animals can be introduced.

After between 3 and 6 months, the filter bed settles down and the nitrifying bacteria operate at their optimum. The tank can then be called 'established'.

Experienced aquarists realise that an aquarium is a constantly changing environment that has to be continually monitored. The following events occur on an ongoing basis.

① Water evaporates and needs to be replaced by tapwater (a hydrometer is required to check the Specific Gravity).

② The pH decreases as a result of actions of the aerobic nitrifying bacteria (the ideal pH is 8.2 which can be measured using test kits).

③ The aquarium water changes, with a build-up of nitrates, a yellowish colouring caused by 'dissolved organic carbon' (DOC) and an altering of the balance of salts. Events 2 and 3 can be best remedied by 25% monthly water changes of seawater.

④ The biomass of the aquarium increases with the growth of animals and multiplying of microscopic organisms and bacteria. If this is not watched and the gravel is not cleaned, thus removing some of the micro-organisms, there is a danger of a dissolved oxygen shortfall.

Lighting & temperature

The seas around the British Isles are often murky and light levels are lower than in tropical seas. For all the fish, and most of the invertebrates, except for a few species of sea anemones, a single 40-watt fluorescent aquarium lamp may be the only (minimum) lighting needed. Aquar-

STEP-BY-STEP GUIDE TO SETTING UP A NATIVE MARINE AQUARIUM

1 Choose a suitable location for the aquarium. It should be out of the line of direct sunlight which would magnify the temperature in the tank above ambient.

2 Check support is sufficient to hold the large weight of water in the aquarium (1 gallon weighs approximately 10lbs). Polystyrene tiles should be placed under the aquarium.

3 Purchase the remaining equipment in the accompanying checklist.

4 Place the undergravel filtration tray in the aquarium (if this system is to be used). Cover the tray to a depth of 4 cm (1.6 in) with washed coral sand, shell sand, or beach shingle. Rocks should be collected and placed in the aquarium.

5 Add real seawater from an unpolluted source, or mix up the artificial salts according to the instructions on the packet. The Specific Gravity at 15°C (59°F) should be 1.025. Place the powerheads or capsule filtration system in place and connect to the electricity supply.

6 If artificial seawater is used, place a piece of mussel (alternatively, 'nitrifying' bacteria cultures can be purchased) in the filled aquarium. A population of filter bed bacteria needs to be established to introduce the 'Nitrogen Cycle'. Wait a week before introducing hardy animals like Beadlet Anemones and Shore Crabs. Stocking should be gradual to full levels after one month.

7 Connect 'cooler' and thermostat and test that it is in working order. The cooler should be put into operational use the day before the fish and other life is introduced. The filter bed bacteria multiply quicker in warmer temperatures.

NB. The first life of interest to the aquarist appears on the shore for most of the length of the British coast in February and March. The cooler may not be necessary until June.

Great Pipefish (*Syngnathus acus*) can be successfully kept, particularly in larger aquaria.

Seaweeds are generally relatively short-lived in home aquaria.

EQUIPMENT CHECKLIST

ESSENTIALS

1 All-glass aquarium. Hood, polystyrene sheet underlay. Minimum size is 36 x 18 x 12 (90x45x30cm). 20 gallon (92 litre). It is not possible to keep seawater in a satisfactory life-supporting condition in smaller tanks.
2 Filtration System Undergravel filtration system incorporating powerheads (2, or 1+ powerful air pump), airtubing, airstones. Alternatively: external power filters.
3 Hydrometer for measuring the specific gravity.
4 Thermometer calibrated) 0° to 26°C (32–77°F).
5 Multiple electric sockets. Plugs, etc. 'Cable Tidy', for lights, pumps and other pieces of electrical equipment.
6 Lighting. A single 40-watt fluorescent lamp is sufficient.
7 Aquarium net.
8 Scraper or sponge to clean glass.
9 Seawater. Real seawater can be used (with caution!) to fill the aquarium. Artificial salts are available from aquarium retailers and are far superior for the water changes and are better when starting up. Specify for marine aquarium use. Ordinary sea salt is not suitable.
10 Plastic drums for collection and mixing of seawater. Beer fermentation bins (10 gall) are ideal.
11 Rocks and seashells for decoration and to provide hiding places.
12 Siphon or Gravel Cleaner to extract detritus and change water.
13 Coral sand or shingle. Size 2mm to 4mm. If an undergravel filtration system is in use, it should be placed to a depth of at least 4 cm (1.6 in) on the floor of the tank.
14 Cooling system. The most popular method involves the use of powerhead pumping the water through a beer cooler. A special thermostat for coolers is available with a power booster. Purpose-built 'cooling units' are also available. They are expensive initially, but cheaper in the long term.
15 Reference books to identify creatures of the seashore, and a tropical marine aquarium instruction book for technical aspects.
16 Spare parts for diaphragm air-pumps, spare pumps and powerheads. Small plastic children's beach spade for removing sand in the tank.
17 Test kits. The pH kit is useful. Nitrite and nitrate test kits are used to monitor conditions in the aquarium.

OPTIONAL EQUIPMENT

18 Additional tanks. This is an early requirement because the aggressive shore animals are notoriously incompatable.
19 Brine shrimp hatchery. Brine shrimp (*Artemia*) eggs can be hatched into larvae for feeding to live food feeders and larval forms.

The above is the minimum list of equipment required. Skimping on any of these items will result in failure. Unfortunately, one item that is often omitted is the 'cooler'. This turns out to be essential in hot summers because the tank temperature quickly equals the ambient temperature. Some aquarists have a cellar, or insulated garage, and are able to keep the temperature down without the need for the most expensive item. The aquarium set-up without the cooler will cost from around £150. New coolers will cost more than this, but you may be able to obtain a secondhand unit from a pub or brewery.

Experienced 'rockpoolers' are able to keep uncooled aquaria only because they have a thorough knowledge of the various fish and invertebrates and the temperature requirements of each species.

Beer cooler (essential sooner or later) connected to an aquarium.

ists, however, often use a combination of a blue fluorescent, like a Triton lamp, in addition to a standard unit.

Native marine aquaria differ from tropical ones in the need to make sure that the temperature in native aquaria does not rise too high (over 22°C –c72°F) during the summer. If the aquarist is not lucky enough to have a cellar, or a cool spare room, or the luxury of 'air conditioning', he or she will have to install a 'cooler', or return the intolerant (about 50%) animals to the sea.

Special 'titanium' coolers are available, but at a high cost. However, most aquarists use 'beer coolers', with a powerhead being used to pump the water through the cooler. For a 4-foot aquarium holding about 15 gallons (68 litres), a single outlet 'cooler' is sufficient. For larger aquaria, a double outlet cooler is necessary; such a model will handle up to 50 gallons (c 230 litres) with a temperature drop of 10°C (16°F).

The thermostats for such units are rarely accurate enough, so for precision, an electronic aquarium thermostat designed for heating equipment can be adapted by the manufacturer, before purchase, for use to control the maximum temperature.

Feeding & health

Rock pool fish and crabs will eschew flake food; in any case, it is unlikely to be suitable as a sole diet. Therefore, the aquarist needs to feed the various fish and invertebrates what they would eat in the wild.

Fortunately, many rock pool inhabitants eat a variety of foods. Mussels, cockles, prawns, shrimps, limpets, ragworm, sandhoppers, small crustaceans, zooplankton, mysids and winkles are regularly collected for food. Mussels are boiled in their shells, and mysids are used as live food.

Pathogens can, however, be introduced with live food and, in this respect, winkles are the biggest culprits.

Wild-caught fish also, inevitably, harbour parasites. Most of these are invisible, and even visible parasites are rarely fatal. Less than 1% of fish caught will die as a direct result of infection.

Small fish will sometimes scratch their bodies on rocks. Recent study has proved that, in many cases, this is not a sign of parasite, and is a form of behaviour that has been observed commonly in the sea.

The trip home

As far as fish and sensitive invertebrates are concerned, the most hazardous part of their existence in captivity is likely to be the journey to and from the shore. Problems critically encountered in the collecting bucket are multiplied the longer the journey. The following tips may help ensure success:

(1) Temperatures can be prevented from rising too quickly by the use of polystyrene boxes.

(2) The problem of plankton blooms and resultant oxygen shortfall can be overcome by transferring the fish to a container of freshly mixed artificial seawater.

(3) Oxygen levels can be increased by the use of a battery-operated air pump and airstone, or a 12-volt 'continuously rated' water pump.

(4) A large container with the greatest surface area of water as possible should be used for transportation purposes.

Captures should not be introduced into aquaria with more than a 2°C (3.2°F) difference in temperature from that which exists where they originated from. Further, fish should not be acclimatised by placing them in floating plastic bags; this is more likely to do more harm than good.

Quarantining of native fish is not normally necessary, although aquarists with several tanks may put new fish into supplementary aquaria, rather than their main display tank. A&P

WANT TO KNOW MORE?

For more information on coldwater marine aquaria, please write to **Andy Horton c/o *A&P*** enclosing a 43p stamp.

The **British Marine Life Study Society** publishes a journal called *Glaucus* which explores the marine world around the British Isles. For details of this publication, contact Andy via *A&P*

SIFTING SANDS:
A 'NATURAL' SYSTEM

We asked Colin Grist of the World of Water at Bristol Zoo Gardens to set up a 15-gallon 'natural' tank as an experiment. Here's how he did it.

Photographs by the author

Marine aquaria based on the natural system are not particularly new. Lee Chin Eng in Djakarta, Indonesia, experimented with collecting 'live' sand and rocks and arranged them in an aquarium setting, but without the aid of filtration or any artificial aids other than an air pump and some diffuser stones to create water movement. He added hard and soft corals, along with all manner of other invertebrate life, and, of course, some suitable fishes.

He was very successful in his attempts and many animals, vertebrate and invertebrate, were happy enough to reproduce in his systems. Mind you, Lee Chin Eng had the luxury of being able virtually to walk out of his backyard onto a coral reef to collect his specimens and seawater, and he was able to take advantage of the naturally warm temperatures and bright sunshine.

The 'ingredients'. New and old equipment is being used here. The lighting canopy houses 2 x 15 watt Aquastar tubes with enhancing reflectors.

The egg crate support is fitted into position.

Early British successes

Mr. Lee's success prompted Englishman R.A. Riseley to try similar projects at his homes in Singapore and in Djakarta. In turn, Riseley's success led to him sending specimens to Derek McInerny in the UK, who at the time was well known on the lecture circuit and had written the book *All About Tropical Fish* where he advocated the notion of keeping things as natural as possible.

Bear in mind that this was back in 1966. Nevertheless, the observations made then were not dissimilar to those made in more recent times. In fact, numerous reports on recent observations have claimed to have discovered something new, but this is often not the case, as you will find out if you can track down a copy of Riseley's own book *Tropical Marine Aquaria — The Natural System*, which was published in 1971 (details at end).

Certainly, Riseley and McInerny discovered aspects of marine aquarium keeping which were ahead of their time, even if they, themselves, did not realise the full implications. Riseley was even quite prophetic in his book when he stated, and I quote: "*There is still, indeed, a great deal to be learned. Nevertheless, we believe that the more artificial techniques for keeping marines must in time give place to simpler methods. These are likely to be based largely upon the 'natural' system.*

It is very doubtful that he had foreseen the enormous boom in hi-tech filtration and electronics for use in marine aquaria before hobbyists started looking at simpler methods once again.

Don't get me wrong, though, because, although Riseley, McInerny and Mr Lee himself had a remarkable insight into the workings of a coral reef, they can, on occasion, be proved incorrect by our now-advanced knowledge of the subject. Riseley did say there was much to be learned!

Actually, we can go even further back in time, as in the earliest days of aquarium keeping people were absolutely amazed how crystal-clear seawater would remain just by simply adding some sand and rocks which had been freshly collected from the shore. Surely, this represents the basis behind all the theories about the natural system.

Temperately natural

Now that we seem, in many ways, to have turned full circle, what are we trying to achieve? The natural system is one which operates, and the inhabitants remain healthy, without the use of conventional aquarium filtration. In fact, only living organisms on natural substrates are used to maintain water quality. However, the word natural may be a bit misleading because artificial means of water movement are still required in this system. Further, in temperate climates, artificial means of heating and lighting will also have to be employed.

In 1979 Jean Jaubert, of Nice University in France, devised such a system. He set up a 2m' tank with layers of calcareous sand on top of a horizontal porous plate, which was raised a little off the bottom of the aquarium, thus forming what is referred to as a plenum. The sand was charged with all manner of burrowing organisms which served to aerate the substrate, as well as feeding on detritus, bacteria and other food matter. In addition, 'living rock' was used for the reef structure and a variety of fishes and invertebrates from the Red Sea were housed in the system.

The so-called living substrate and living rocks provided the only means of filtration, which was achieved through the combined actions of various organisms with complementary functions.

Equilibrium was maintained by these biological actions, along with various chemical ingredients, such as oxygen, carbon dioxide, ammonia, nitrite, nitrate and others, with varying gradients of concentration which cause fluxes across the substrate surfaces by diffusion. This is very different from the situation with similar undergravel biological filters where water actaully moves through the substrate — in a plenum arrangement there is NO water movement through the substrate.

Strong currents in the water column are important in any coral reef aquarium, so Jaubert had to use water pumps to achieve this. Powerful artificial lighting was also incorporated, particularly for the sake of the hard corals housed in the system. Some natural daylight was available for a limited number of hours per day.

Jaubert's success is evident by the fact that, after 10 years of operation, most of the animals which were originally introduced were still alive, and many had actually reproduced.

It is interesting to note that Jaubert's system did not have any water changes whatsoever for at least four years, if ever at all. Topping up with freshwater after evaporation had occurred would have, presumably, been necessary.

Taking on the challenge

Firstly, get the required equipment together.

1 Aquarium

The same considerations must be made as for any marine aquarium, such as only use non-corrosive materials. Use an all-glass, or acrylic, aquarium.

2 Plenum

This can be made from a sheet of egg-crate material which has been cut to fit neatly inside the aquarium. This must be raised about an inch above the base of the tank by sitting it on glass squares of equal dimensions, or, as I do, on short lengths of ½ inch (I.D.) ABS pipe.

Cover the entire egg-crate plate with filter matting so that there are no gaps whatsoever around the edges. Or, you could use some gravel-tidy material. You may find it necessary to silicone around the edges to get a perfect fit.

3 Substrate

Use 'living sand' if you can get it. However, all is not lost if you can't, because good quality 'living rock' will more than likely contain many organisms which will spread themselves out and into the sand, such as worms and sand hoppers etc.. Use fairly fine coral sand as the alternative and be patient.

It can be advantageous to introduce 'living sand' in 2 or 3 stages over a period of time and only when there is no evidence of ammonia or nitrite, otherwise, many organisms may die off.

If clear readings are obtained for ammonia and nitrite, living rock can be introduced. A heater/stat is fitted and three pumps are positioned and connected to a remote surge controller. (Use a large spoon or similar to introduce the 'living sand', thus avoiding clouding of the water).

Filter matting is laid over the egg crate, followed by a layer of clean 'virgin' sand.

Saltwater is poured in... carefully!

The final sand layer should be about 5cm (2 inches) deep for most average aquaria. Larger systems may be able to handle deeper layers. Whatever, any blackening of the sand in the lower levels of the substratum indicates serious lack of aeration due to the layer being too deep. This condition is caused by anaerobic bacteria producing potentially toxic substances and must be avoided at all costs.

4 'Reef' Formation

Use only the best quality cured 'living rock' which is covered with pink coraline algae and, hopefuly, sponges, sea squirts and algae turf etc. Tufa can be used as a base rock, but too much may, in time, produce excess sand from the actions of worms and hermit crabs, or whatever. Make sure the structure forms many openings and passages and nooks and crannies.

5 Water

Use an artificial saltwater mix without nitrates and phosphates, and without added vitamins or the like — we want this to be as natural as possible. If your mains tapwater is of poor quality, it will be necessary to improve it by passing it through either a reverse osmosis unit or a deioniser.

Please take note though, you must **NOT** treat **all** the water by these methods because they can remove everything, including elements which are important to sustain life. Treat about 80% and add 20% of normal water after it has been well aerated or mixed with a dechlorinating solution. It is, however, perfectly safe to use R.O. or deionised water for topping up once the aquarium is running.

Specific gravity should be maintained at 1.022. Lower levels may adversely affect invertebrates, particularly crustaceans, and any higher may, likewise, cause some metabolic problems for small fishes.

'Natural' thoughts

1. Combining the actions of detritus-eating and burrowing animals and others that live upon rocks with the conditions created by the diffusion of various chemical elements across substrates, will help to establish a long-term, low-maintenance marine aquarium system.
2. Essential water movement, heating and lighting have to be provided by artificial means, but no conventional form of filtration is necessary.
3. The environmental conditions created by this type of system have obviously encouraged many marine animals to reproduce. Clearly, this is an indication of the way forward to further captive breeding successes.

6 Water movement

Variable currents are important to the inhabitants of coral reefs. All solid objects in water, whether living or not, have a kind of membrane of stagnant water surrounding them. The stronger the water movement, the thinner the membrane is, and, as you might guess, in slow-moving water, it becomes thicker. Many organisms, particularly fishes, require the membrane to be thin, otherwise their metabolic functions can be seriously impaired, giving rise to all sorts of problems, including the risk of premature death.

Many sessile invertebrates also require strong water movement, but don't forget there are others which prefer calmer habitats. Before purchasing, always research the natural history of any animal you wish to keep to ensure you can correctly cater to their needs.

Therefore, currents of variable strength and direction should be provided. These can be achieved by using 2 or 3 small water pumps or powerheads, which are operated by an electronic surge controller (sometimes referred to as a wavemaker). Surge controllers will randomly switch multiple pumps on and off for variable lengths of time, creating infinitely changing sequences.

Position the pumps around the aquarium at different depths in such a way that on the occasions when two or more switch on at the same time, their flows collide to create additional currents by deflection. It may well be useful to operate pumps of different power ratings as well. Open water areas where fishes are swimming should have strong currents, as should some of the passageways through the rock formations, but don't forget to provide those calmer areas for the animals that require them.

7 Heating

Water temperature should be maintained around 22°C (72°F), certainly no more than 24°C (75°F). A standard thermostatically controlled aquarium heater of the correct wattage for your size of aquarium is all you need.

8 Lighting

Strong lighting with a colour temperature of around 10,000K (check the packaging) should be provided for 12-14 hours per day, but don't make the mistake that many reef aquarists have made after being misled into believing that their aquarium must be flooded throughout with intense lighting. Many sponges, soft corals and other polyp animals require lower levels of light than hard corals do.

If your aquarium is a large one, you will need to use either metal halide lights or multiple fluorescent tubes, or a combination of both. Although not essential, you may wish to add Actinic 03 ultra-violet illumination. Small tanks, particularly shallow ones (less than 18 inches water depth), should only incorporate fluorescent lighting to avoid the risk of over-heating, or at least, uncontrollable fluctuations in temperature.

Essential commonsense

Unfortunately, there is no way we can introduce natural weather and other elements which create the physical conditions of a coral reef, so the above artificial methods of providing water movement, heat and light do have to be employed.

The finished job. After three days of initial running, not a hint of ammonia or nitrite was detected.

When setting up a system such as this, patience is most definitely a virtue. It would be fatal to introduce too many animals at once, and too early. Just like for any aquarium, a careful watch must be made on water conditions and regular tests will have to be made and recorded.

Imagine you have an actual section of coral reef in your tank. The stocking density should, therefore, be very close to that which you would find in a similar sized area in the wild. Obviously, there are physical restrictions dependent on the size of your aquarium which have to be considered when deciding the size of the animals you would like to house, so some commonsense will have to be employed here. Nevertheless, a very realistic scene can be created, regardless of size restrictions.

Especially where small tanks are concerned (less than 50 gallons), never introduce more than one animal at a time, and always leave at least one week between introductions. During that one-week period, make frequent checks for any deterioration in water quality.

The sifters

Polychaete worms, sand hoppers (such as *Gammarus* shrimps), hermit crabs, small sea cucumbers and small digging fishes like Sand Gobies are all excellent workers at keeping the substrate in motion. Try to combine all these animals in your system to ensure the sifting sand theory works efficiently in practice.

The Orange-spotted Goby, *Valenciennea puellaris*, is also an excellent sifter of sand, although not ideally suited to smaller tanks, as it can grow to about 12cm (5 inches) and may well devour most of the useful sand organisms in a fairly short space of time.

Some closing thoughts

It is not absolutely essential to use a plenum arrangement, as success can be achieved with just a layer of sand directly on the bottom of the aquarium. Indeed, I have, in the past, maintained a 200-gallon aquarium in such a manner for more than five years, where many of the fish and invertebrate inhabitants continually reproduced and no water changes were ever made. However, the plenum does seem to provide greater efficiency.

Some aquarists prefer to combine the sifting sand system with a foam fractionator (protein skimmer). This is very similar to what is commonly known as the 'Berlin Method'. You may also wish to incorporate additional filtration such as this in the early stages, disconnecting it from the system once you are confident it is well established. I personally have not, so far, found any need to employ such tactics.

Be confident from the start and go for it. By following these text and pictorial guidelines, you should very easily be able to establish a miniature captive reef habitat (mesocosm) that functions very much in the manner of a wild coral reef and which requires relatively little ongoing maintenance. AEP

Acknowledgements

The Wavemaster Surge Controller, Red Sea Salt, test kits and 'living sand' were kindly provided by **Coral Reef Technology, 62 High Road, Byfleet, Surrey.** Living rock organisms were cultured at **Bristol Zoo.**

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Caribbean Angels:

FOOD & FAMILY RELATIONSHIPS

Professor Peter Wirtz

reports on the specialised diets and social 'roles' of three Caribbean Angelfishes

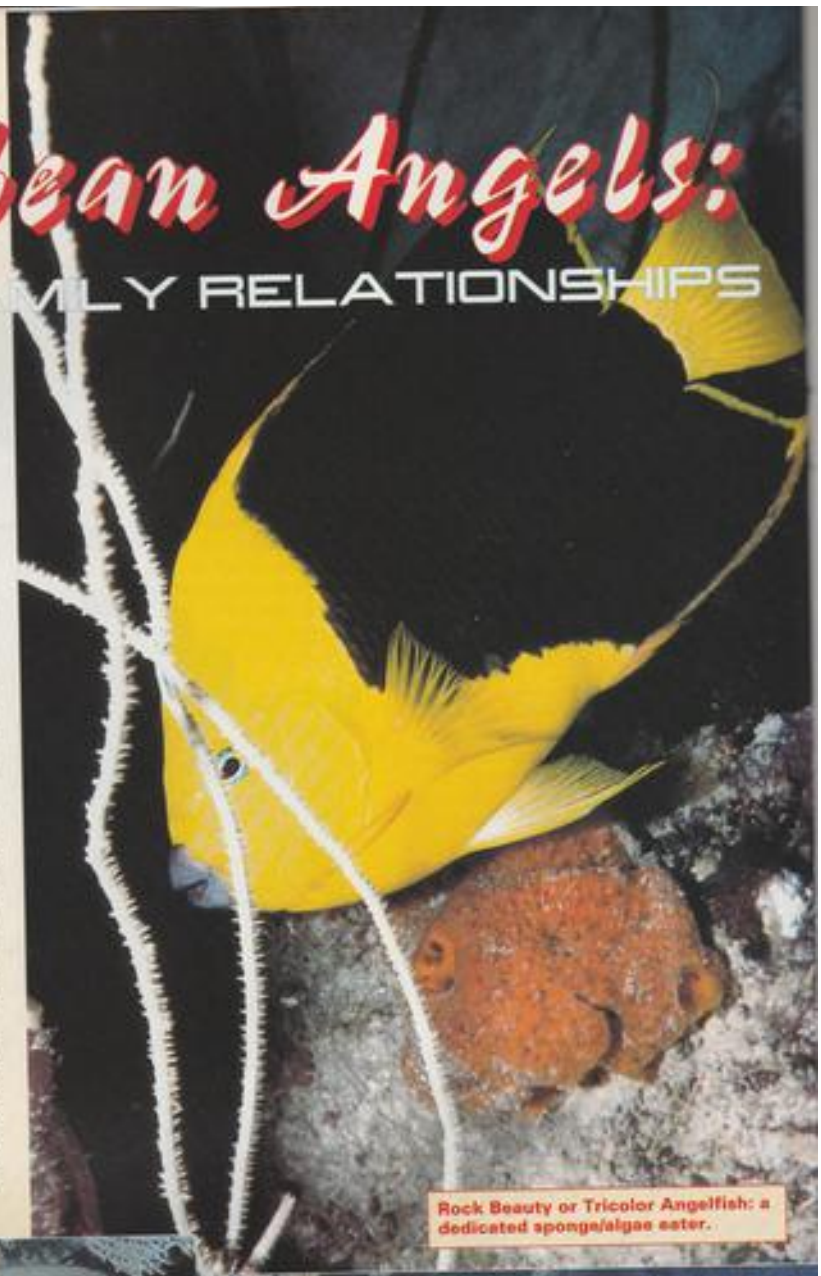
Photographs by the author

The American zoologist Thomas Hourigan, together with several colleagues, has made a study of the biology of the marine angelfishes found at St Croix (American Virgin Islands). The three species — the Tricolor Angelfish or Rock Beauty (*Holacanthus tricolor*) the Grey Angelfish (*Pomacanthus arcuatus*) and the French Angelfish (*P. paru*) all have a rather similar diet: sponges and algae are the chief components.

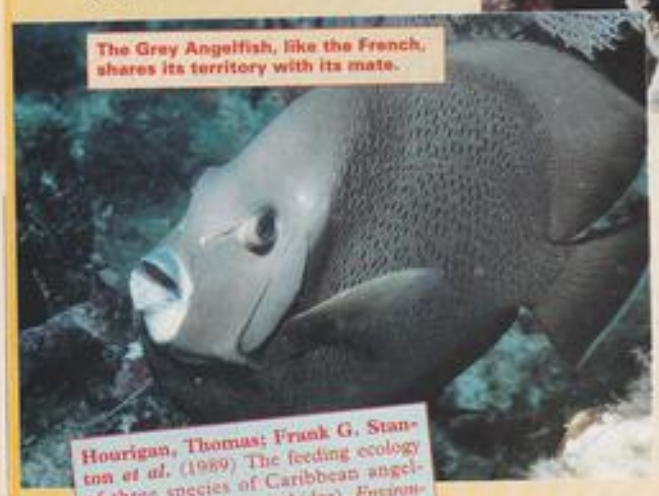
Because the majority of sponges contain poison as a protective mechanism, there are only a few species of fishes that have exploited them as a food source. The two *Pomacanthus* species commonly feed on horny corals as well.

Given that the diet of the three species is so similar, it is hardly surprising that their dentition is, likewise, similar in most respects.

There are clearer distinctions in their social structure: large *Holacanthus tricolor* males defend territories containing the living areas of several females; the latter are, in turn, territorial among themselves. By contrast, the two *Pomacanthus* species are found in pairs which defend a shared territory against other pairs and unpaired conspecifics.



Rock Beauty or Tricolor Angelfish: a dedicated sponge/algae eater.



The Grey Angelfish, like the French, shares its territory with its mate.

French Angelfish and other *Pomacanthus* species, will eat horny corals, as well as algae and sponges.

Hourigan, Thomas; Frank G. Stanton *et al.* (1989) The feeding ecology of three species of Caribbean angelfishes (family Pomacanthidae). *Environmental Biology of Fishes* 24: 105–115.

SEAVIEW

BY GORDON KAY

I know that I've been saying it every year since I started writing this page, but I really can't believe that it's nearly Christmas — AGAIN! This time of year has a habit of taking me by surprise, despite my good intentions to prepare well in advance.

Underwater review

Anyway, I've been asked to review a book which landed on my doormat recently — and I'm intrigued to know why. I say this because it is not an aquarium book, but a work aimed at divers, and Hans Haas, I most definitely am not! Still, I shall do my best.

The book is from Germany and is called *An Underwater Guide to the Fish of Madeira, the Canaries and the Azores* and is by **Dr Peter Wirtz.** The first thing to strike me about the book was the price — DM 45.80 for a paperback of only 160 pages!! At the time of writing, the pound was worth about 2.5DM, which puts the UK price at approximately £20.

Now, I've recently finished writing a book, so I know the amount of work that goes into producing one. Even so, this does seem expensive for a book that has, when all is said and done, very limited appeal. The book is done in both German and English — I mean in the same volume — so that you have to wade through loads of German text to find the bits that most of us plebs can understand.

Obviously, this is mainly an identification guide and so, like all books of its kind, is rather heavy going. Still, all the information is there and some of the photographs are very good. There are many, however, which are sadly lacking. For instance, how does one identify a Butterfly Ray (*Gymnura altavela*) from a picture of one which is 90% buried in the sand? I have to say, though, that the pictures of Moray Eels are terrific.

The author (I think!) has devised a very easy-to-understand series of symbols, which runs thoughout, to tell the reader the preferred habitats of each species, the time of day they are active and at what depths in the water column they are normally found (full marks for that) and there is an interesting short overview of the history of the area.

Perhaps I am being a little unfair to the book; after all, it must be difficult to photograph a ray which dives into the sand every time you approach it. However, I still say that it is rather overpriced and that, while I can see that it could be useful to a diver who travels a lot to pursue his or her passion, to an aquarist it would hold only a passing interest.

Exotic visitors

Do you remember that lovely summer we had this year? Terrific, wasn't it? Well, according to an article in the *Sunday Times* on 3 September, warm weather and changes in ocean currents have meant that some pretty exotic species have been visiting our waters.

Species such as the Thresher and Hammerhead Sharks, Marlin, turtles and poisonous jellyfishes from the Caribbean have been caught or spotted. For instance, off Cornwall, a fisherman caught a Big-Eyed Thresher Shark and a Saltfin Dory in the space of two weeks at the end of August. Mako Sharks have been spotted in the Irish Sea and, at least, two sightings of Hammerhead Sharks have been reported close to the beaches in Cornwall and Brittany.

Some tropical species have even ventured into Northern British waters. A Marbled Electric Ray and several Bluefin Tuna were caught off the Shetland Islands, and there were several Sunfishes caught in the North Sea.

The biggest threat came from some tropical species of jellyfish, such as the Portugese Man o' War and the Lion's Mane. The Seaton Carew beach, near Hartlepool, had to be closed because a swarm of Lion's Mane Jellyfishes were washed up. Three children needed hospital treatment for stings.

Silja Sweby, a researcher with the **Marine Biological Association** in Plymouth, said that it was unusual to find a new species in every ten years and while 1995 had been remarkable, these species could become regular visitors if the warm weather continues.

Another expert, **John Gould**, of the **World Ocean Circulation Project,** said "We suspect that the North Atlantic is globally important in controlling climate. These changes could be a sign that we are about to go into an ice age or a period of global warming" Interesting? Yes. Frightening? You bet!!

TREVOR MACDONALD

Turtles (this is a Green Turtle — *Chelonia mydas*) have been among the more exotic species seen round our coasts this year.

Christmas wishes

It is traditional at this time of year, for us *A&P* columnists to write a bit about Christmas. You must know what I mean: suggested Christmas gifts for aquarists — or ones for other members of society, that type of thing.

Well, I have to admit to scratching my head somewhat this year. After all, as I inferred earlier, I've been writing **Seaview** for a long time and it's difficult to be original year after year. Still, here goes with a list of things which I would like to see in MY stocking on Christmas morning. None are original, but they are all things I've been writing about for years. Here's hoping...

1. An end to the yearly slaughter of Pilot Whales in the Faroe Islands. I find this carnage the single most despicable and sickening display of Man's total disregard for the animals which share our planet.

2. An end — worldwide — to the cruel and pointless keeping of whales and dolphins in captivity for the sake of "entertainment". If humans want to see tricks, they should perform them themselves. No-one will ever change my mind on this one.

3. A realisation by all newcomers to the hobby that it is a good idea to read a little before starting. If this happened, although it would make me somewhat redundant, it would also mean that thousands of some of the most wonderful animals in the world wouldn't die needlessly.

4. That my new book would be internationally acclaimed and sold millions of copies worldwide. Fat chance!!

5. Another child. My daughter, Lucy, is the best thing that's ever happened to me and to do it all again would be wonderful.

6. That everyone in the world learned to live with each other and that we all had a truly happy and peaceful Christmas and New Year.

Well, that's it for 1995. God willing, I shall be with you in '96.

KOI: guide to su

Probably the best means of aerating the water is by the use of a waterfall, or watercourse where the water is tumbled as it progresses. Here — in my own pond — is probably the best of both worlds: a watercourse and four-step waterfall combined.

PART THREE

THE HARDWARE

After wading your way through Parts one and two of this series, you should have a good idea of the theory and practical aspects of a filter system. This month, in conclusion, I will discuss the various items of equipment that can be used to support its operations.

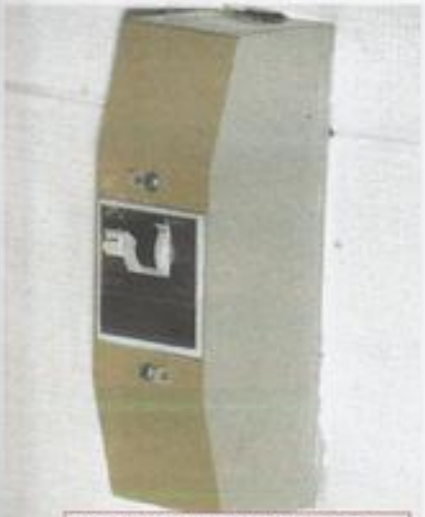
PUMPING CHOICES

The pumping stage of a filter is a lot more complicated than the description might indicate, as it comprises not only the pump itself, but also all the ancilliary equipment that comes after the pump.

I will begin by describing the various methods of pumping and then progress to the other items of equipment in turn.

1 Central heating pumps

The cheapest pumps are central heating circulators, both to buy initially, and in running costs. You must consider, however, that these are not self-priming pumps and will not therefore pump without a head of pressure to supply them.



An RCCB (circuit breaker). This is mounted on the wall in the kitchen and the electrics to the whole garden are run from it.

Central heating pumps are frowned upon by some because of the cast iron construction of the pumping chamber, but there are ways and means of 'circumnavigating' this problem. For example, you can paint the inside before use with a suitable coating, or you can purchase one of the replacement plastic pump housings which are offered for sale by, at least, one firm.

These pumps must be mounted in a well drained, dry chamber, but make sure that they are below the pondwater level to provide an operating head. They may also need foam filters on the inlets as small debris, particularly small insects and baby snails, will soon block the impellers.

C.H. pumps are normally speed controllable and move anywhere between 500 and 4000 gph (c 2,300-18,200 litres/hr).

2 Submersible pumps

The next to consider are the submersible pumps, which are available in a range of wattages and capacities. These are normally operated in a wet chamber situated after the biological filter.

Some of these tend to have rather a short life compared to external pumps, due mainly to water ingress. A good tip here is that if a submersible is to be taken out of service for any period of time, then it should be kept submersed in a bucket of water to prevent the seals drying out.

Some types of submersible have actually been advertised as 'disposable', which speaks volumes for their reliability, but other manufacturers have made great efforts to get things right with some success. (See also **Peter May's** three-part *Pond Pump Ponderings* published in the June, July and August issues of *A&P*.

3 External pumps

Also available are external pumps, being purpose-built with the pond or swimming pool in mind. They are usually very powerful, reliable, of high pumping capacity, and (unfortunately) quite expensive, although given the relatively short life

ccessful filtration

The vegetable filter is half the size of my pond. A filter like this will take care of the nitrate, but needs assisting by UVS as it is to an extent seasonal in its working.

Barry Goodwin's final episode focuses on some of the essential equipment you need to run an efficient filtration system.

Photographs by the author

expectancy of the average submersible, they probably represent much better value.

External models are normally rated by horsepower, rather than gallons per hour, and there are two speed versions of some models. The use of more than one pump in a system is recommended, as in the event of a breakdown, the filter would very soon die without a constant flow of oxygenated water. You could then be faced with a period of partial filter activity while the bacterial colonies re-establish themselves.

OTHER EQUIPMENT

In addition to pumps, there is a range of ancilliary equipment which is sometimes used by the Koi keeper to perform other tasks, such as heating, algae supression, etc. Some of this equipment is covered below.

Two sizes of central heating circulator pump. The big one has three speeds and is capable of pumping up to about 2,000 gph. The smaller one has three speeds and is capable of pumping about 900 gph.

1 Sand filters

One refinement that some Koi keepers add in the system, before their water is returned to the pond, is a sand filter. This acts as a very fine mechanical or 'polishing' filter to remove all traces of suspended matter.

This is an expensive piece of equipment which must be fed by a correctly rated pump and requires frequent back flushing to clean it. Problems can be caused if this is not adhered to, with the result, that these filters have been regarded by some as 'time bombs'. As a consequence, where maintenance proves a problem, they have been removed from the system. Some keepers have emptied out the sand, filled the chamber with alternative media and pressed them into use as biological filters.

Reports from users in hard water areas indicate that calcification of the sand can occur, making back flushing difficult if not impossible.

2 Vegetable filter

Nitrate, as the end product of biological filtration, together with other soluble organic components, feeds algae and blanket weed in the pond. These can, however, be controlled by employing a vegetable filter which is planted with nitrate-consuming plants, usually watercress, Mimulus, or similar.

An alternative method is the use of a watercourse or stream, which can be planted. Be careful to keep the plants under control, though, because the roots will quickly form an impenetrable barrier and interrupt the flow of water.

3 UVS. (Ultra Violet Sterilisers)

Green water, despite claims to the contrary, does not provide the best of environments for keeping Koi in a garden pond. It may be fine in large lakes or clay ponds for a dealer or breeder, but in relatively small recirculative environments, such as Koi ponds, I cannot agree. Observation of our Koi is the most important preventive health measure and to observe you need to be able to see.

Fluctuations of pH due to photosynthesis and respiration of plant life, such as the unicellular algae causing the green water will also be stressful for the Koi. Stress is, in turn, the biggest killer in a pond system.

U.V. was originally employed to kill off

This is the ideal method of heating your pond, a stainless steel heat exchanger plumbed into your central heating system.

harmful bacteria in drinking water to make it fit for human consumption and many such treatment plants operate today in third world countries. As a bonus, it was found that UV will control algae, thereby defeating green water.

The recommended dosage, though, is somewhat higher for the control of algae than for the control of bacteria which, it is now realised, can cause problems for Koi keepers.

As algae reduction is really what pondkeepers buy UV units for, I would advise them to be used if possible in conjunction with a vegetable filter. This means that a lower dose of UV can be used; this is probably the safer option, as current thinking leads us to believe that over-use of UV can destabilise the effectiveness of the immune system of a Koi.

It is said that UV rids the environment of too many organisms that Koi need to be exposed to, and which allow their immune systems to build up to effective levels. I am sure that the longer-serving Koi keepers among us will remember a similar problem with a UV/ozone device called the 'Eyeclean Pia' a few years ago.

The recommendations are now to leave UV switched on only for as long as it takes to clear the water.

It is also advisable that UV tubes be replaced after a season of use.

4 Magnets

These are employed by many keepers to control blanket weed. They are successful for some people and not for others. This depends upon the design and construction of the magnetic unit and the way it is used. Some are more effective than others.

4 Heaters

There are a number of ways to heat a Koi pond:

(i) **Gas boilers**

Some people employ gas swimming pool boilers and, for the majority of people who use them, they have been successful.

There are, however, some potential problems that you should be aware of. Some boilers have copper heat exchangers which, under conditions of low pH, could pollute the pond environment with copper. (Acidic water will take the copper into solution.) There are normally warning notices on such heaters and they should be avoided.

You must always take care that gas boilers are fed with the correct type of pump, as this also can affect the safety of their operation.

(ii) **Electric heaters**

There are electric heaters which range from about 1 to 6 kW. They are efficient but expensive to run. Always pay attention to their safe and correct installation.

(iii) **Heat exchangers**

There are heat exchangers, usually made out of stainless steel, that can be connected into domestic central heating systems. These seem to be the most efficient and safe way of heating a pond and are highly recommended.

The filter is owned by Scottish Koi keeper George Clark. All the essential ingredients can be seen, such as the small vortex at the top, followed by a brush settlement chamber, followed by a 'flocor' chamber. Other essential equipment such as pumps, Hi-Blow and UVS can be seen on the installation. Note the protected and enclosed electrics.

6 Aeration devices

These take several forms, all of which are efficient. There are airstones, air domes and diffusers, all of which can be driven by a 'Hi Blow' pump. Some can be used in the pond or in the filter. If used in the pond, they should be suspended at about half of the pond depth, which will avoid stirring up mulm from the bottom.

Air domes can be used over bottom drains. The current they thus create improves the action of the drain considerably.

Diffusers are very good at supplying a high flow of fine bubbles, but beware that you use only the correct diffusion tubing. There is a similar product obtainable from garden centres which is supplied for greenhouse watering. It is made from reclaimed car tyre rubber and is extremely toxic to Koi.

Venturis are also used on water returns to the pond, but perhaps the most efficient means of aeration is by waterfall. Here the water is tumbled continuously, allowing the greatest gaseous exchange to take place.

Electrical safety

Finally, but most importantly, you must ensure the operating safety of all the electrics on the pond. They should be fed from an approved RCCB (circuit breaker).

This means that any fault on the pond circuits will cause the RCCB to trip, shutting everything down. If you happened to be on holiday at the time, you could come home to a disaster. In view of this, it would be advisable to feed at least one of your pumps from a separate supply, which must be similarly protected, thereby introducing a measure of 'failsafe' into the system. Happy filtering!

AP

"So I corrected the pH, reduced the temperature slightly, fed live food intensively, set up an infusoria culture and separated the breeding pair. Then I..."

TRADE "TALK"

OFI Support Research

Having received several approaches seeking support for research programmes in locations as far apart as the Philippines and the Amazon, **Ornamental Fish International (OFI)** is pleased to announce the following research grants:

① **Dr. Ning Labbish Chao:** ***Project Piaba***

This project is a long-term detailed study of the ornamental fish resources of the Amazon. In particular, its aims include research into sustainable levels of exploitation of fish stocks and the socio-economic factors relating to the aquatic industry. OFI has also published a two-part report on Dr. Chao's research project in the organisation's quarterly *Journal* (Issues nos 12 and 13, August and November 1995).

Allocation: £800

② **Dr. Elizabeth Wood:** ***Sustainable Use of Reef Fish and Invertebrates in Sri Lanka***

Currently, Sri Lankan exporters are being subjected to bans on most species of marine invertebrates, despite the fact that the vast majority are very abundant. Dr. Wood's study (which is receiving support from the **Association of Live Tropical Fish Exporters of Sri Lanka** under the presidency of OFI member **Vibhu Perera** and the **Darwin Initiative**) aims to establish workable and realistic yields of both fish and invertebrates.

Allocation: £400

③ **Ocean Voice International:** ***Haribon — Ocean Voice Aquarium Fish Project***

Among the aims of this long-term project are the eventual substitution of all cyanide-caught fish in the Philippines with net-caught ones. A "sustainable livelihood alternatives fund" is also being created on a pilot scale to help finance the transition from destructive methods of collection to "a more sustainable way of life". This will include the expansion of the existing net-training programme for collectors of aquarium reef fish under the supervision of **Dr. Don E. McAllister.**

Allocation: £400

④ **IUCN Coral Reef Fish Specialist Group:** ***Marine Aquarium Industry Study***

Under **Dr. Patricia Almada-Villela's** co-ordination, this aspect of a much broader project, entitled **World Coral Fish Programme**, will concentrate on determining the scope and extent of the industry, its effects on reefs, plus the developing of "more harmonious and sustainable methods of collecting, shipping and marketing."

Allocation: £400

OFI is a worldwide organisation (with members in over 30 countries) representing the aquatic industry in all its aspects, from the import/export of livestock, to the manufacture and distribution of equipment. The organisation believes in the sustainable use of aquatic resources and in developing the most humane methods of collection and transportation. It therefore intends to develop its research support programme further as funds permit, and is already devising methods of boosting the level of finance that can be made available for such projects.

For further details about OFI, please contact: **Ornamental Fish International, P.O. Box 445, Corsham, Wiltshire, SN13 0RQ. Tel: +1225 810084; Fax: +1225 811215.**

King British goes 'into battle'

Aquatic equipment manufacturer **King British** continues its assault on the aquatic market with more fighting talk, as managing director **Michael Sinclair** announces his "aggressive battle plans", which include the launch of several new products and an "all-out assault" on foreign markets.

Michael Sinclair, who took over the company this year, said: "Careful research and strategic planning during my first six months as managing director, have allowed us to prepare an innovative and very aggressive marketing plan."

He added; "Our new product development programme is already bearing fruit with a new range of Pond Pride food and water treatment products. Initial indications are that the range will be highly successful in the market. Strong evidence of the importance we place upon innovation is clearly shown by the introduction of Immuno-Health Booster in our recently-launched Pond Pride 'Ultimate Koi Food.' Michael regards this product as "one of the most important developments in fish feeding technology this century".

A range of water treatment products have been launched for next year, and these include Pond Pride Floating Sticks, Pond Pride Ultimate Koi Food and a range of six Pond Pride Water Treatments. Among the products said by the company to have been successful in 1995 was the water treatment Safe-water, a concentration of live 'nitrifying' bacteria which convert liquid ammonia into nitrite.

King British's Pond Pride: Ultimate Koi Food — just one of a number of products launched as part of the company's latest campaign.

Michael Sinclair concluded: "The launch of the Pond Pride product range was only the first stage of a carefully prepared plan designed to take us into the position as aquatic market leaders. It will be a tough fight, but we fully intend to win."

For information, contact: **King British Aquatics, Haycliffe Lane, Bradford BD5 9ET. Tel: 01274 573551; Fax: 01274 521245.**

Livestock imports via Manchester Airport

At the end of September, the media announced that Manchester airport were to cease handling livestock. **OFI (UK)** rang the airport to seek clarification and it appears that this will not affect private movement of pets or the ornamental fish industry. Apparently, to provide the facilities required by the Veterinary Checks Directive for larger animals would cost the airport an enormous amount of money. However, there wasn't such a cost implication for the import of ornamental fish.

Keith Davenport of OFI(UK) commented "Sometime ago, we negotiated the exemption from individual veterinary examination of each fish imported at British airports. Had this not been achieved, then special facilities would have had to be constructed at airports where these examinations could be carried out. The expense of installing such facilities might have seen airports, such as Manchester (which handles around a quarter of UK ornamental fish imports), discontinue imports."

He concluded "It staggers me that with such clear examples of the benefit of OFI(UK)'s work to the industry, some importers are still unwilling to pay our levy. I am certain that the cumulative benefit of our activities exceed £35 million this year alone. This equates to a return of almost £400 for each £ of levy or subscription we receive."

For further details contact: **Ornamental Fish Industry (UK) Ltd., Unit 5, Narrow Wine Street, Trowbridge, Wiltshire BA14 8FJ. Tel: 01225 777177; Fax: 01225 775523.**

Out & About

EXTINCT AFRICAN FISH ALIVE AND WELL IN S.E.23

By Chris Rosom
Photographs by the author

A journey around London's South Circular road can be a wearing experience as the traffic is often slow-moving and congested, since it weaves its way through many of South London's suburbs. One could be forgiven for thinking that these highly urbanised surroundings are a cultural desert, but if you look up from the bumper of the vehicle in front, you could be in for a surprise or two.

Standing proudly at the top of London Road on the eastern approach to Forest Hill in south-east London, is the Horniman Free Museum in all its

The reef aquarium at the Horniman Museum.

Art Nouveau splendour. The Horniman museum was opened in 1901 and has always housed a public aquarium, which, in the past few years, has undergone total refurbishment and now given the title of 'The Living Waters'.

It must be said that the location of the aquarium within the building is far from ideal, as it is situated in a narrow gallery at the top of a long flight of stairs. As the building is subject to preservation orders, structural alterations were out of the question, forcing the designers of the refurbishment to work within the area available.

For all these limitations, they have managed to achieve a wonderful result. The space at their disposal has been used to the full, including the staircase where a series of sideways 'S'-shaped acrylic tanks have been arranged down the stairs by the ballustrade with water flowing from one to the next.

The effect mimics the course of a river, from youthful stage at the top of the stairs, to maturity as it travels down and, finally, to estuary as it reaches old age. The various tanks on the way down are designed to hold fast-moving or slack waters. These are stocked with tropical freshwater fish that correspond to the water speed: Danios in the fast waters, Discus and Angels in the slack waters. Archer Fish and Puffers can be seen in the brackish estuary.

For anyone with mobility difficulties, a chair lift has been installed opposite the cascade. The floor-to-ceiling arrangement of the tanks in the main gallery ensures that everyone can see something, no matter what their height. Much in contrast with many public aquaria, all the tanks are well illuminated, except where the habitat they depict dictates low lighting.

The aquarium exhibits in the main gallery are divided into four main types to house and display fish from differing water types: tropical freshwater, native marine, tropical marines and an area showing the sad state of London's wetlands.

As you admire the exhibits and begin to read the public information notices adjacent to each tank or display, you become aware that the whole exhibition is underpinned with a serious conservation message. Not only do the various aquariums give the visitor an insight into some of the varied habitats of aquatic life, but they also demonstrate how these environments are under threat from a plethora of pressures.

None of the exhibits bring this point home clearer than that illustrating the plight of the Lake Victoria Haplochromine Cichlids, some of which are now thought to be extinct in the wild and only surviving in aquaria.

The commentary explains how the native people around the shore of Lake Victoria traditionally caught the Haplochromines and dried them in the sun, before selling or eating them. In the 1960s in an effort to provide larger fish for consumption, the Nile Perch, was introduced. For the indigenous Haplochromines this proved a disaster as the Nile Perch made short work of devouring them.

Sadly, the implications of this disastrous introduction go further. The Nile Perch requires smoking, rather than sun drying, forcing the locals to cut down savannah trees for fuel. The loss of the trees means that the thin top soil is easily washed away by the rains, leading to agricultural problems. Regrettably, this is an all-too-common story and a classic example of how easily ecological balances can be upset.

As the visitor soon discovers, the Horniman is doing more than just highlighting this problem, as behind the scenes there is a busy conservation centre. Here, they are breeding the endangered Haplochromine species and distributing the young to similar conservation centres in the UK, Europe and North America. The adult and young fish can be seen in the main gallery.

Thanks to the work of the Horniman and other institutions, the survival of these species is, for the time being, assured, although there are no plans to reintroduce them to their natural habitat.

As if to mirror the public gallery, the conservation centre is also narrow and accessed by a staircase. Nonetheless, it is packed with aquariums and vivariums, the technicians making use of every available space. Much of the filtration and water treatment for the aquarium is also housed here.

In addition to their success with the Haplochromines, the technicians have been successful in breeding and rearing two species of marine clownfish, the young of which can be seen in the main aquarium. Many of them still sport their juvenile stripes, and despite being in the company of an anemone, of a group of some 20-30, only one had taken up residence with the anemone at the time of my visit.

Although the Museum does not currently display any live reptiles, good conservation work is still going on behind the scenes particularly in the breeding of endangered European lizards.

Not surprisingly, the tropical marine aquaria make up the most colourful display, and are clearly popular with visitors. Several of the tanks hold a mixture of invertebrates and fish, including an unusually wedged-shaped aquarium that juts out of the walls offering an aerial view of the clownfish and invertebrates inside.

No display of this type would be complete without a mini-reef, and this one is no exception, with a fine example of show. The brightly illuminated reef teems with small compatible fish like the Psychedelic Fish, small gobies and *Pseudochromis*.

Invertebrate life includes both soft and hard corals, all looking wonderfully healthy. Growing particularly well is a Pulse Coral, *Xenia elongata*, which has budded and expanded since its introduction. In addition to the strong lighting the corals receive from 650 watts of metal halides, the invertebrates are fed on newly-hatched brine shrimps. The Pulse Coral appears to whip at these when they venture near.

Other invertebrates like Cleaner Shrimps and nudibranchs can be seen in a lower tank. In the fish-only marine tank, visitors can feast their eyes on the gorgeous colours of angelfish, butterflyfish, tangs and wrasses, or if they have an eye for the unusual, see the queer-looking boxfish, an ugly pinefish, hawkfish and the ever-popular seahorse.

Often in pallid contrast to their colourful tropical cousins are the native marines, but at the Horniman, they have gone to great lengths to ensure that the native display is just as impressive.

A rockpool has been created in a floor-standing aquarium, complete with a cliff background made from a cast taken from an actual south coast cliff. Add to that a water level that rises and falls to mimic the tide, and a dumpbucket-type wave effect, and you have a very realistic exhibit. The rockpool and two other large native marine tanks are stocked with fish and invertebrates typically found

Happy to be alive! Adult Lake Victoria Haplochromine: *H. nigori*.

around the British coast.

Most serious aquarists will already be aware of the conservation message. Hopefully, the visitors to the Horniman Aquarium will marvel at the colours, variety and exuberance of the aquatic life, and will come to realise how important it is that we ensure their habitats are left intact and unpolluted. Only then can we be assured that the Haplochromine story is not repeated.

So, how much does it cost to visit the Museum and its aquarium? Nothing! It's FREE!! And for that, you can visit the rest of the museum, several acres of landscaped gardens, water gardens and the Conservatory. Well worth a visit.

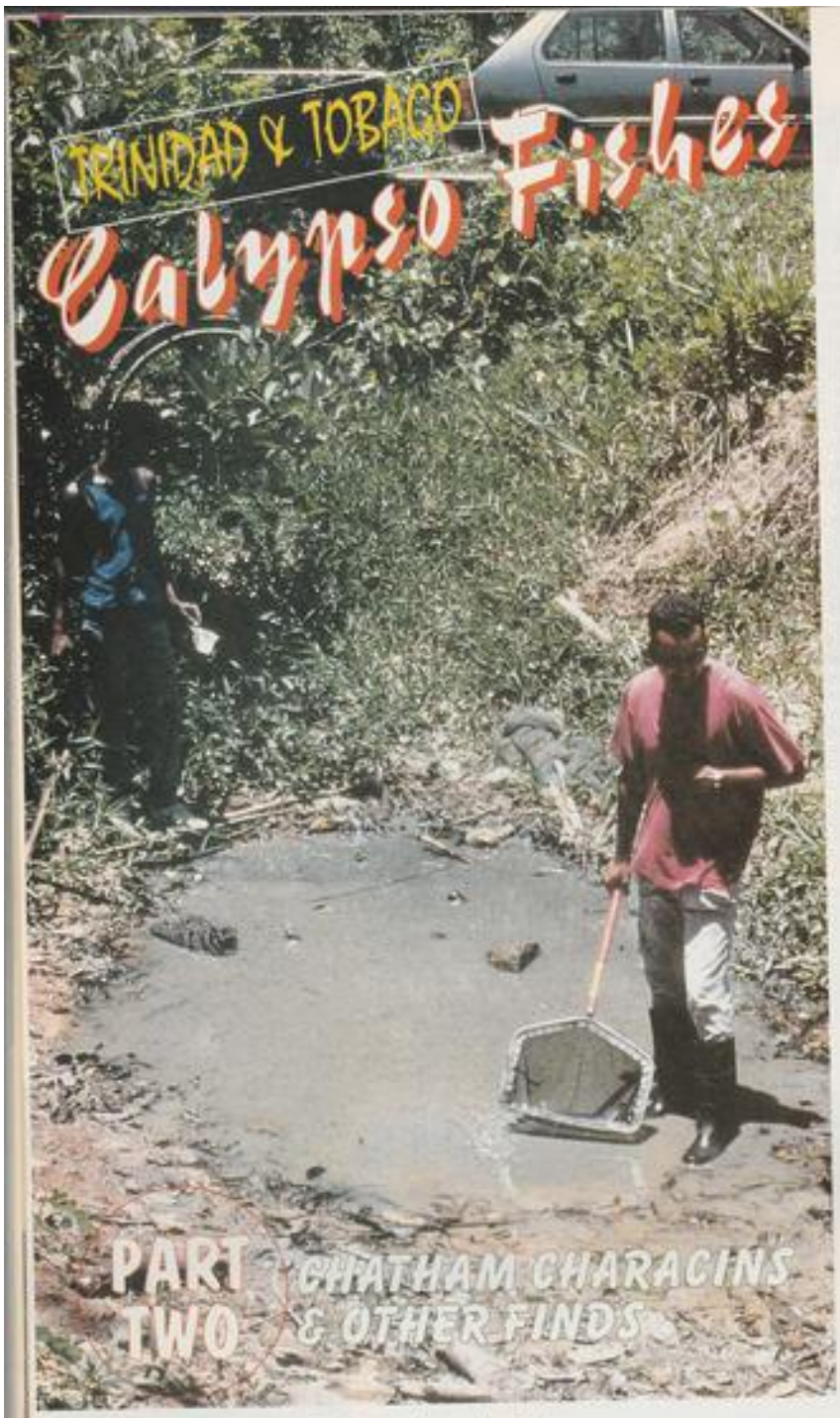
The Horniman Museum is open daily Mon-Sat: 10.30 am-5.30 pm; Sundays: 2 pm-5.30 pm.

It is located at: **100 London Road, Forest Hill, London SE23 3PQ.**

The river cascade that runs down the main stairway. At the Living Waters exhibition every available space is used.

TRINIDAD & TOBAGO Calypso Fishes

PART TWO: CHATHAM CHARACINS & OTHER FINDS



Neil (blue shirt) and Raj fishing at the small pool.

A Two-spot Cichlid from the tiny pool near Chatham.

Dr Peter Burgess and Stan McMahon find more great T&T fishes, some in the most unlikely places. *Photographs by the authors.*

Following our failed attempt to see *Hoplosternum* catfish in the wild, we moved on to another locality which was situated a couple of kilometres from the Chatham Road in the southwest of Trinidad. Here we sampled a series of forest pools situated alongside a coconut plantation.

The first we visited was very small, just a few feet across, and its substrate thick with leaf litter and rotting branches. Racing the handnets through its yellow-tainted water, we harvested Guppies and our first tetras — Featherfins (*Hemigrammus unilineatus*), a species which resembles the popular X-ray Tetra (*Pristella maxillaris*). Our fortunes had improved dramatically!

A richer find awaited us at another pool some hundred metres further down the track. Here, the water was about five feet deep, enabling us to use the seine net. After several sweeps, we caught a fine assortment of fishes: more Guppies, plus three species of characin — Featherfins, Swordtail Characin (*Corynopoma riisei*) and an impressive 10cm (4in) long *Astyanax bimaculatus*. The last species is commonly known as the Two-spot Astyanax and is a close relative of the Blind Cave Tetra, *Astyanax fasciatus*.

This pool also yielded two Bronze Catfishes (*Corydoras aeneus*), both mature specimens and each a beautiful golden yellow and green. We couldn't resist keeping them.

Raj and Neil took us to one other very special forest pool in the area, which apparently contains the island's only known population of Hatchet Fish (*Gasteropelecus sternicla*). Although we had no intention of removing specimens, we wanted an opportunity to observe this fish in the wild, but alas, we were to be disappointed — not a hatchet in sight.

Freshwater oasis

Along a small side road near Chatham, we chanced upon a shallow pool within an otherwise bone-dry river bed. A few feet across and about ten inches deep, it probably held less than a thousand gallons. The water was fairly clear and absolutely teeming with tadpoles. Probing the thermome-

ter near the muddy substrate we got a reading of 39°C (102°F). The pH was 7.1.

Being too shallow to seine, we resorted to using handnets which, unfortunately, stirred up the sediment, causing the water to turn milky white. Despite the high water temperature, this small body of water contained a few Guppies and, more surprisingly, cichlids (probably *Cichlasoma bimaculatum*).

Being the dry season, the pool was an important freshwater oasis for local wildlife, including nearby colonies of bright yellow Oropendula birds, but it was nothing less than an inescapable prison for its captive fishes and other aquatic life. With no shade and no signs of rain, the water level would continue to fall and its temperature rise; ultimately, the pool would disappear completely.

Out of compassion, rather than need, we decided to rescue the cichlids and Guppies and bring them home with us. (Back in England, the cichlids rewarded us by spawning and raising fry).

One of the two beautiful Bronze Catfish.

Fishes galore

We had achieved far more than we could ever have imagined. In just a few days collecting we had managed to sample and photograph over half of the island's fish species, including cichlids, catfish, killifish, gobies, and several characins.

We had also collected three of the island's four known poeciliid livebearers: the Black-barred Livebearer (*Poecilia picta*), Guppies (*Poecilia reticulata*) and Mollies (*P. sphenops*). Only *Poecilia vivipara* (the One-spot Livebearer) eluded us.

A shower of fishes

The fishes we caught had to be maintained in large polythene bags in our Tobago hotel room until the homeward flight — not a simple task. We were both impressed and relieved by the way our wild-caught fishes quickly adjusted to captivity, feeding on flake food almost from the day of capture. This rapid adaption to a completely alien environment and an unfamiliar food source was quite remarkable.

As all aquarists know, creating the right water conditions is the key to successful fishkeeping, but this can pose difficulties during collecting trips. In our hotel, we faced the problem of preventing the fish from overheating. We soon discovered that our shower made a perfect, albeit temporary, fish house. We stood the fish bags on its tiled base. With the drain plugged, the base could be filled with a few inches of water, creating a cool jacket. It worked very well, but did present logistic problems when it came to the morning ablutions!

On very hot days, when temperatures climbed to the upper 30's °C (around 100°F) a few ice cubes were added to the shower base. The requirement for ice made the perfect excuse for a visit to the beach bar; strangely enough, we bought a lot of ice — much more than we needed!

An unidentified characin from Southern Trinidad.

Daily routine

We soon established a daily routine: a flake food breakfast for the fish, followed by water changes an hour later, then repeating the sequence in late afternoon. A polystyrene food igloo made an ideal container for storing tapwater overnight; sometimes we used a battery powered air-pump with diffuser to help drive off any chlorine in the standing water.

After a few days, some of the other guests would assemble at our balcony to watch the feeding shows. We had become part of the hotel's entertainment!

The incredible Swordtail Characin (this is a male).

Maintaining good water quality for the fish was helped considerably by the inclusion of a small square of Poly-filter (made by Poly-Bio-Marine, USA) in each fish bag. The Poly-filter did a great job in preventing the build-up of ammonia and other toxins. All in all, we kept the fish in good health and got them safely back to England. (In fact, the majority of species that we brought back have subsequently bred in captivity).

Orinoco flow

Our collections had yielded fishes which are typical of the South American fauna: tetras, poeciliid livebearers and callichthyd and loricariid catfishes. Actually, the majority of Trinidad's native species also occur in South America, which is hardly surprising, given the close proximity of Trinidad to the Venezuelan coast. But how did freshwater fishes arrive on these islands? There are two natural routes:

1 Trinidad is separated from Venezuela by the Gulf of Paria which is generally less than 30 metres (c100ft) deep. However, during the most recent glacial period, the sea was 100 metres (c330ft) below present levels, such that Trinidad and Tobago were connected to Venezuela. It is likely that many freshwater fishes were already established on "Trinidad" when it was part of the continent and here they remained as the rising sea eventually isolated Trinidad some 1,000 to 10,000 years ago (which, geologically speaking, is extremely recent).

2 There is, however, another (and highly formidable) route by which South American fishes might still reach Trinidad. The shores of Trinidad are influenced by Venezuela's Orinoco River which discharges its freshwater into the Caribbean. During the rainy season, the Orinoco's increased output significantly lowers the salinity around the Gulf of Paria from around 35mg/litre to between 18 and 20mg/litre (see Laydoo, 1991).

It seems likely that many Orinoco fishes get swept out to sea, some surviving a brief exposure to the low salinity. The river's massive outflow probably helps to propel the fish towards the islands, where, possibly attracted to freshwater at the mouths of Trinidad's rivers, some finally set foot (or rather fin!) and colonise inland streams and pools

Scientists believe that certain populations of Trinidad's Guppies and characins have taken this sea route from South America. Indirect evidence for this stems from wide genetic differences observed between geographical populations of certain species of Trinidadian fishes, suggesting two distinct origins. Direct evidence would require actual sightings of freshwater fish within the Gulf of Paria. Imagine swimming in the Caribbean sea and coming face to face with a characin!

Stan feeding fish and carrying out water changes on the hotel balcony. (The Carib beers are only there for effect, of course!?)

AQUARIUM FISHES FROM TRINIDAD

(* = also found on Tobago; @ = possibly now extinct)

CHARACINS
Silver Hatchet (*Gasteropelecus sternicla*)
Elongate "Hatchet" (*Tripothesus elongatus*)@
Featherfin (*Hemigrammus unilineatus*)
Swordtail Characin (*Corynopoma riisei*)
Calypso Tetra (*Megalamphodus axelrodi*)
Frideric's Leporinus (*Leporinus friderici*)@
Two-spotted Astyanax (*Astyanax bimaculatus*)
Straight-finned Black Tetra (*Gymnocorymbus thayeri*)

CATFISH
Hoplo (*Hoplosternum littorale*)
Bubble-nest Catfish (*Callichthys callichthys*)
Bronze Catfish (*Corydoras aeneus*)
Pleco (*Hypostomus robinii*)*
Bristlenose Catfish (*Ancistrus cirrhosus*)

LIVEBEARERS
Guppy (*Poecilia reticulata*)*
Sphenops Molly (*Poecilia sphenops*)
Black-banded Livebearer (*Poecilia picta*)
One-spot Livebearer (*Poecilia vivipara*)

CICHLIDS
Blue Acara (*Aequidens pulcher*)
Keyhole Cichlid (*Aequidens maroni*)@
Two-spot Cichlid (*Cichlasoma bimaculatum*)
Pike Cichlid (*Crenicichla alta*)

KILLIFISH
Hart's Rivulus (*Rivulus hartii*)*

LEAF FISH
Schomburgk's Leaf Fish (*Polycentrus schomburgkii*)

KNIFE FISH
Banded Knife Fish (*Gymnotus carapo*)

Future conservation

Four of Trinidad's native fish species are believed to be extinct: the characins *Brycon siebenthalae*, *Leporinus fridrici*, and *Tripothesus elongatus*, plus the Keyhole Cichlid, *Aequidens maroni*. The reason for these extinctions are not precisely known.

Both Trinidad and Tobago are trying to be environmentally conscious, but fishes tend to get overlooked when it comes to conservation programmes. Dr Ben Seghers (Seghers, 1992) has listed several man-made threats to Trinidad's freshwater habitats including logging, agriculture, pollution, quarrying, dams, water removal, overfishing and the introduction of exotic species such as Tilapia (an African cichlid which is farmed for human consumption).

On a smallish island, any disturbance to freshwater habitats could prove disastrous. Clearly the fascinating Calypso fishes need all the protection they can get.

AEP

References

Laydoo, R.S. (1991) *A guide to the Coral Reefs of Tobago*. Published by : **The Institute of Marine Affairs and the Asa Wright Centre, Trinidad.**

Seghers , B.H. (1992). The rivers of northern Trinidad: conservation of fish communities for research. In: *River conservation and management* (Eds: Boon, Carlow and Petts). **John Wiley and Sons.**

DAVID TWIGG'S

KOI CALENDAR

Jobs for the month

December is the month when all should be quiet out in the pond (but don't neglect it) and we turn our thoughts to Christmas. As Koi keepers we are continually striving to better the lot of our Koi and the specialist Koi dealers are always trying to satisfy our needs.

I have been keeping records about my fish on a computer (in those early days an Exidy Sorcerer) ever since I started Koi keeping. These days the technology is far advanced, but it still carries out the same function, just a thousand times (for instance) faster. Until I get fully 'multi-media-fied' though, it can't really be bettered other than by pencil and paper!

Croft Video Services are offering, alongside their selection of Koi videos of course, a Koi Record Binder. This is hard backed and carries 50 'sewn in' plastic wallets, 40 of which are for recording details of each of your Koi and include space for a photograph. The remaining 10 sheets are for keeping tabs on your water quality checks and pond medications. The binder costs £14.95+ £3 p&p from **Croft Video Services** who can be contacted on **0161 643 9107**.

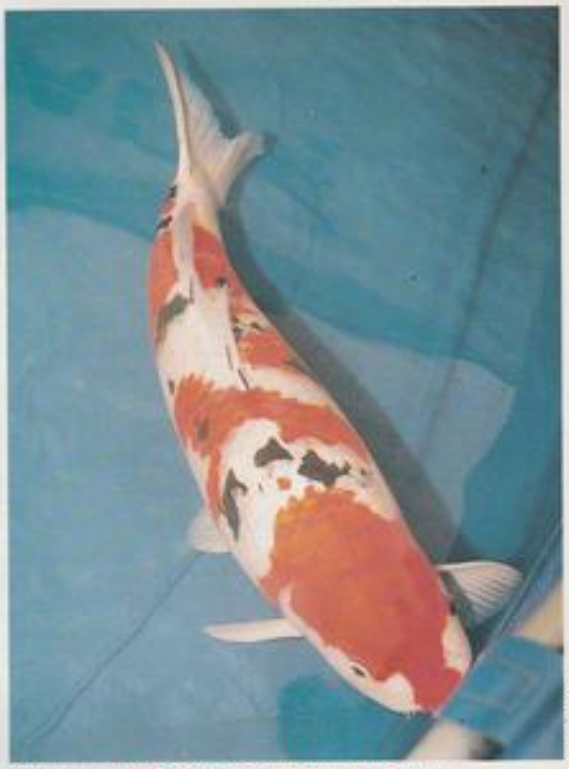
Also producing a range of exceptional Koi videos are **New Vision Video Productions**. Their latest offerings are *Koi — The Living Jewels Part 4* and the *Koi '95 National Show Video*. **New Vision** can be contacted on **01206 827338**.

NKC success

The first weekend in October saw Lyn and me heading off up the M6 and M62 to **Cascade Water Gardens**, Bury, where the **Northern Koi Club** held their 3rd Annual Koi show. No fewer than 29 exhibitors entered 143 Koi into this Japanese-style show. Among these Koi were some of the best I have seen on the show circuit this year and the overall standard was very high indeed.

Being a Japanese-style show made the judges' task much easier and, indeed, judging was completed more quickly than is the case in the English-style show. It also makes it easier for the viewing public to 'judge' the relative merits of each Koi as it swims alongside another in the same variety class.

Judging, viewing, presentations and de-benching over, brought the NKC members, who had worked hard, under the leadership of show Chairman **Derek York** to put on this show, to a relaxing time over wine and Lancashire hot-pot. Lyn and I were invited to stay and thoroughly enjoyed the meal just as much as the show itself.



Paul James' NKC show Grand Champion Sanke.

Judges **Liz Donlan, Nigel Caddock** and **Phil Edwards** awarded the following major prizes:

Paul James, Grand Champion (Size 6 Sanke), Best GinRin and Judges Special Award, Best Koromo' **George Clark**, Supreme Champion Adult Koi and Tateigoi Champion and Best in Size 4 (Kohaku), Best in Size 3 (Kohaku); **Pam Kirkland**, Supreme Baby Champion and Best in Size 2 (Showa); **Maureen Howcroft**, Best in Size 1 (Kohaku); **John Fallows**, Supreme Mature Champion and Best in Size 5 (Showa).

Other major winners were **Shelley York**, Best Kawarimono; **Mr. Nutter**, Best Hikarimuji; **Gordon Young**, Best Hikari Utsuri; **Linda Mouat**, Best Asagi/Shusui; **Harry Green**, Best Tancho; **Peter Stokes**, Best Utsurimono;

Our thanks to Chairman **Tony McCann** and is team for making our trip to Manchester well worthwhile; it was great pity that the journey home down the M6 took 3½ hours instead of the normal 2½ hrs due to volume of Sunday evening traffic.

WHAT'S ON IN DECEMBER

7 — Suffolk & North Essex Section BKKS. *Monthly meeting*, Stanway Rovers Football Club. Contact **Alan Carter**, 01206 866011.
9 — Heart of England Koi Society *Christmas 'DO'*. Contact **me** on 01926 495213.
— Leicestershire Koi Section BKKS. *Christmas Celebrations*, The Royal Oak, Great Glen, Leicester. Contact **Mick Reffin**, 0116 2712517.
10 — Mid-Somerset Section BKKS. *A.G.M.* Contact **Alan Purnell**, 01458 272132.
13 — Merseyside Section BKKS. Speaker is **Peter Waddington** of **Infiltration.** Contact **Phil Adamson**, 0151 2202970.
17 — Northern Koi Club. *Monthly meeting in Manchester area.* Contact **Tony McCann**, 0161 794 1958.

WHAT'S ON (LATE NOVEMBER)

19 — Northern Koi club. Colin Bragg of **Lakeland Landscapes** is the speaker. Contact **Tony McCann**, 0161 794 1958.
22 — London Section BKKS. *'Christmas Fun Night'*, Ruskin House, Croydon. Contact **Keith Nind**, 0181 673 3574.

DAVID TWIGG

Peter Waddington at the launch of his book *Koi Kichi*

Koi Kichi launch

Another 3½ hour venture up the M6 the following weekend took us to the home of **Peter Waddington's Infiltration.** This was to the launch of Peter's new book *Koi Kichi*. Peter, a Koi keeper for many years and a dealer in them for over 15 years, has built up a vast knowledge about this hobby of ours and has, obviously, spent a lot of that time putting this information onto paper.

Koi Kichi is a collection of books, brought together under a single cover, that span the whole range of subjects associated with Koi keeping. Everything from the origins of Koi, to building and maturing purpose-made Koi ponds, is covered, and for anyone requiring a comprehensive and authoritative guide to Koi varieties, they need look no further. The various diseases of, and treatments for, Koi are covered and they are accompanied by excellent photographic illustrations.

As a Koi keeper who has not yet managed to find his way to Japan to see at first hand the environment in which these lovely fish are bred and reared, I found the 'books' on this subject and that relating to the Japanese Koi people, to be fascinating reading, with the photographs of people and places quite superb illustrations for the text.

Koi Kichi, printed in an easily readable font and size, is written by Peter in his own inimitable, entertaining and informative way and is really one of those items that is a must on any Koi keeper's bookshelf. It would most certainly be a wonderful present to wake up to on Christmas morning!

Koi Kichi is available at £39.95+£3.95 p&p from **Infiltration, Unit 13, Millingford Industrial Estate, Golborne, Warrington, Cheshire, WA3 3QE.** Phone or Fax your order on **01942 724896** or **721525** respectively.

My thanks to **Kevin Partridge** for his call. Kevin, in the process of designing a Koi pond, took me up on my offer to put people in touch. I hope that you are by now well established in a group of like-minded Koi keepers in your area Kevin. I look forward to meeting you sometime.

Water's Edge

By Dick Mills

Chips for fish

Putting an octopus in control of your aquarium could, with a stretch of the imagination, seem just about plausible: after all, it's got enough arms to manage most things at once. However, the title refers to the OCTOPUS CONTROL UNIT from **TROPICAL MARINE CENTRE.**

This microchip, computer-controlled device can control all the main parameters required — heating, lighting, feeding — without any effort. Add to these duties the extra ones such as pH control, wave action, Redox levels, and so on, and you've got a very willing automatic aquarium-minder.

It will even tell you when things are wrong with audible alarms and, if you are well beyond earshot, then it could conceivably page you on your paging device! OK, so you don't trust these modern gadgets? The unit also has a self-examination mode and will inform you when its sensing probes need re-calibrating or cleaning.

So far, reports do not indicate whether the unit gets as much enjoyment out of fishkeeping as we do, but who knows what's programmed for it in the future? There is, however, no danger of it completely taking over, for you need only add extra devices to it as and when you need them. For starters, the **Base Model** will suffice for quite a long time until you get used to not doing everything yourself.

Details from: **TROPICAL MARINE CENTRE LTD, Solesbridge Lane, Chorleywood, Hertfordshire WD3 5SX; Tel: 01923 284151; Fax: 01923 285840.**

Sanke Angels on video

Yes, you've read it right: Sanke Angels! A Sanke, in Koi terms, is a tri-colour fish with white, red and black on its body. Similarly, a Sanke Angel is, basically, a white-bodied Angelfish, but it has some black patches and (the key factor) a red patch in the head region.

These fish are quite rare, as you might expect. However, **Stan Kemp** of **KINGFISHERIES LTD.** has tracked down the farm where they are being bred in Thailand... and captured them on film as part of his latest video.

This film, No. 15 in the Kingfisheries series, is the fourth concentrating largely on THAILAND DISCUS and, like its predecessors, is produced in Stan's now-traditional laid-back style in which the comments are honest impressions of what he sees through the viewfinder, and the images present a no-frills, but fascinating, picture of the *real* world of fish breeding and the tremendous skills of the practitioners involved.

Most of the video concentrates, as the title implies, on some stunning Discus, including some of the latest varieties. There's even part of a spawning sequence, plus quite a few shots of parents with their fry, all in the rudest of rude health. There is also some footage showing how Oscars are bred in Thai farms. Very interesting!

Then, of course, there are the Sanke Angels themselves, which presented a real challenge when it came to filming them, owing to their shyness. But they are there... captured for posterity.

Thailand Discus (IV) costs £9.95, plus 70p postage and packing, and is available from: **KINGFISHERIES LTD., 308 Croydon Road, Beckenham, Kent, BR3 4HR. Tel: 0181 650 3716.**

OSI supplies

The popular, very high quality range of Flake and Pelleted foods by **OCEAN STAR INTERNATIONAL (OSI)** has recently been extended to include SPIRULINA and MARINE PELLETS.

Should you have difficulty in obtaining any of these excellent foods, please contact **Sarah Major** at the distributors of OSI products: **CORAL REEF TECHNOLOGY, 62 High Road, Byfleet, Surrey KT14 7QL. Tel: 01932 355121; Fax: 01932 349718.**

Prizewinning babies

When recently imported fish begin taking awards at shows within months of their arrival, you can bet they must be something special. A top Kohaku producer is **Maruyama** in Japan, and a hundred or so of their TOSAI (one-year-old) KOHAKU have been imported by **SELECTIVE KOI SALES** since May this year. No fewer than three Maruyama Kohaku supplied by SKS have already taken **Supreme Champion Baby Koi** awards at major Open Shows.

Isawa (also famous for its hot springs and ski resorts) is the home of some of the very biggest and best names in Koi, including **Sakai, Sakuma, Gamo** and **Hirai.** The unique geology of the area combines to ensure water temperatures never drop below 60°F (15.5°C) and provide ideal growing conditions for Koi. Being close to Tokyo makes for convenient transportation (and exportation) too.

Details from: **SELECTIVE KOI SALES, Beech Croft, Waterloo Road, Hainford, Norwich, Norfolk Tel: 01603 897453.**

Filtration made easy

Most aquariums do their job efficiently, but it's the small things like ease of use (or otherwise!) which make all the difference between overall performance and outright satisfaction.

Hands up all those who haven't ever got a mouthful of aquarium water when starting a siphon to an external filter. Well, to be fair, the numbers have dwindled since the introduction of the PRIME range of filters from **INTERPET.**

The latest addition to the range, the PRIME 20 carries on the tradition for well thought out features — swivelling taps, 'snap-on' clips and an integrated sealing 'O' ring. A multi-directorial diffuser on the outlet pipe ensures aesthetic water return without disturbing the tank decorations, while the visible flow indicator shows just when the filter medium needs changing or cleaning.

Water cannot help but flow through all the filter media and a carrying handle makes removal to the sink for cleaning an easy task. Carbon and coarse foam filters, polymer wool and interpet's own **Bio-Media™** filter medium are all included to provide mechanical, chemical and biological filtration right from the start.

The PRIME 20 filter has a flow rate of 600 l/hour (132 gph) and is suitable for aquariums of between 150 and 300 litres (33-66 gallons) capacity. The PRIME 10 filter has a flow rate of 300 l/hour (66 gph) and is suitable for aquariums of between 75 and 150 litres (16-33 gallons) capacity. The PRIME 30 filter, at 900 litres/hour for aquariums between 225 and 450 litres (50-99 gallons) capacity, is expected to be released by the end of the year.

A six-page gatefold colour leaflet *Aquarium Filtration Made Easy* is available free from all good pet shops or direct from Interpet for those aquarists who feel the subject of external filtration is worrying, technical or over-complicated (it isn't).

'Keeping hold of your other half' might sound like marriage counselling, but it could equally be applied to a design feature found in the latest AQUARIUM MAGNETIC CLEANERS. Available in three sizes (the largest is powerful enough to work through 10mm thick glass), each half of the cleaner is attached to the other by a string, so you don't get a wet arm when retrieving the half that all too often drops from the glass down onto the tank floor.

Details of all **Interpet** aquarium products from: **INTERPET LTD, Vincent Lane, Dorking Surrey RH4 3YX Tel: 01306 881033; Fax: 01306 885009.**

FROGS AND FRIENDS

By BOB and VAL DAVIES

Thinking about Christmas

With the approach of the festive season, we would like, once again, to remind readers to think carefully before buying reptiles and amphibians as Christmas presents. The novelty may soon fade when the recipient is faced with the mundane tasks of feeding, cleaning etc. The animal then becomes neglected and either dies or is taken back to the local petshop to be sold. At the same time the erstwhile keeper becomes disillusioned and turns away from what could be a fascinating lifetime's hobby.

Points to consider:

1. Does the intended recipient have sufficient knowledge of the animal's requirements?
2. Can the animal be properly housed? What is needed to house it?
3. Has the full cost of housing, feeding etc. been taken into consideration?
4. Will the animal eventually outgrow its home and the ability of its owner to handle and feed it? (See November **F&F: Discarded Turtles**).
5. Can the recipient obtain expert advice if problems arise?
6. Some creatures need a considerable amount of experience, so it's advisable to start with something which is relatively 'easy'.
7. Bear in mind the possible cost of vets' bills, which may well be more than the cost of the animal.

A good starting point to gain knowledge is from books, but these vary in the quality and the amount of information. Before choosing a book, try to ensure that it contains what you want.

Books on general vivarium keeping:

1. *The Macdonald Encyclopedia of Amphibians and Reptiles*. Over two hundred species, most of them illustrated, with details of habitats, biological cycles and habits.
2. *The Care of Reptiles and Amphibians in Captivity* by Chris Mattison. Published by **Blandford**.
3. *Reptiles & Amphibians — Care, Behaviour, Reproduction* by E. Zimmermann. Published by **T.F.H.** (See **Question Time** July 1996).
4. *Keeping Reptiles and Amphibians* by Johann Krottinger published by **T.F.H.**
5. *The Completely Illustrated Atlas of Reptiles and Amphibians for the Terrarium* published by **T.F.H.**. A massive and expensive volume measuring 32cm (12½in) x 24cm (9 ½in) with 800 pages and almost 2,000 illustrations. This book helps with identification and recommendations for keeping many of the species in captivity is given.

Specialised books

Having read as much as possible on general subjects, try reading more specialised books on the particular creatures which interest you. There are too many to list but the following may prove useful:

1. From publishers **T.F.H.** the *R.E. series in Herpetology*. About thirty topics are covered. Price now is £6.95 each.
2. *Advanced Vivarium Systems* — Series 100 contains 10 books; series 200 2 books; series 300 1 book; series 400 7 books. Although published in the USA, many good reptile outlets stock them.
3. *Keeping and Breeding Snakes in Captivity* by Chris Mattison. Published by **Blandford**. This book provides basic information on many commonly kept snakes, including details on breeding i.e. whether or not hibernation is necessary etc. Much of the species data is based on breeding records gathered over a number of years from some of the top breeders in the USA.

There are companion volumes by the same author and publisher: *Keeping and Breeding Lizards in Captivity* and *Keeping and Breeding Frogs and Toads in Captivity*.

4. *Keeping and Breeding Geckos* by H. Seufer published by **T.F.H.** A very attractive book giving information on a wide range of gecko species.

Societies

An equally good source of knowledge is other keepers. A subscription to a society would be a useful present, and the recipient would gain contact with experienced keepers and access to a lot of accumulated experience, as well as various publications and captive-bred specimens. The two main societies are:

1. **The British Herpetological Society, c/o Zoological Society of London, Regent's Park, London. NW1 4RY.** Enclose S.A.E. when sending for details.
2. **The International Herpetological Society, c/o Mr. J. Coote, 195b College Street, Long Eaton, Nottingham NG10 4GF.**

In some parts of the country there are regional branches of the above societies — regular meetings for lectures, sale/exchange of specimens etc. are held. The B.H.S. supplies care sheets on common species, has published several comprehensive books on care and breeding and runs a section for younger enthusiasts — the Y.H.C. Other interests, such as conservation, are also catered for.

Other gift ideas

Rather than an animal, a complete or partial set-up would be more suitable (if less exciting). A vivarium of adequate size, heating and lighting equipment appropriate to the creature's requirements and the necessary accessories, such as substrates, drinkers, hides, thermometer etc. would be useful presents.

The cost of these items can vary depending upon, say, the sophistication of thermostats. Full-spectrum lighting is more expensive than ordinary fluorescent tubes, but it is beneficial for many species.

Ideally, a vivarium should be set up and the temperature ranges monitored for several days and nights before introducing the inhabitatns.

The number of retail outlets has increased in recent years but the quality of advice — although it can be excellent — can vary, so reading up beforehand is therefore useful.

For readers who already keep reptiles and amphibians, a timely reminder that shops and livefood suppliers also take a holiday — stock up with food well in advance. Postal supplies may be suspended in very cold weather.

Don't forget your animals will need spraying, feeding and cleaning even over the holiday.

Best wishes for a Happy Christmas and a successful New Year!

BOB & VAL DAVIES

Equipment makes good Christmas presents, but check that you buy appropriate items.

CLUBS

LIVE IN ESSEX and interested in reptiles/amphibians? E.R.A.S. meet in Witham on the second Thursday of each month. Contact 01621 819675 for further information.

If in doubt, though, ask.

Goldfish fanciers, in particular, are extremely critical of their stock. What to you looks like a first class Calico Fantail could, to a breeder or exhibitor of this type, be quite worthless. The same applies to all fish, of course, when offered to someone who specialises in the chosen variety.

If you are still determined to buy fish for someone else, why not take that someone with you? The element of surprise may be lost, but the outcome will be overwhelmingly satisfactory. You can always, of course, still produce a bottle of aftershave or cologne to surprise him or her on the day. Who knows what you could receive in return?

Safe havens

Those who are fortunate enough to practise their hobby in outside structures used solely for the purpose, are usually spared the censure which can arise at this time of year.

Long periods of observation have led me to realise that these areas are rarely visited by humans until the warmer weather returns. Consequently, nobody gives a hoot what state your fish house is in. Whatever the size, and no matter how humble, these sanctuaries will sustain, not only the fish but, the fishkeeper as well.

Picture for a moment the mayhem which can be generated by family and friends during this season of goodwill. When things get really frenzied, locking oneself in the fish house may be the only way to restore your own goodwill!

The fishhouse is not just a refuge in times of stress. Short days and long winter nights curtail many activities, resulting in more hours spent 'around the house'. There will therefore be times when you feel your presence is not required. At such times, urgent business among the fish tanks may be very prudent.

Jobs for pondkeepers

Pondkeepers, unfortunately, don't have this facility. Sitting like a garden gnome staring into an iced-up pool is neither satisfying nor comfortable. If you did your pond maintenance in late autumn, there is nothing for you to do except leave well alone. Unlike us, the fish are resting and should not be disturbed. Winter for the pond owner is best spent servicing any equipment and planning for next season.

Why not look at the possibilities of another pond? Stomping about in the snow, making various designs, will at least keep you warm. If there is no snow, use the garden hose to lay out a pattern, then mark it with sticks. You can change the shape as often as you like until the ground is soft enough to dig.

If you think gaining 'management approval' might be a bit tricky, suggest some landscaping and a garden seat. Conjure up images of warm summer evenings with a gin and tonic by the pool. Agreement will cost you, of course, but you were going to redecorate the hall anyway.

Mythical inactivity

The idea that winter is an inactive period for the fishkeeper simply isn't true. If you are a 'community tank' hobbyist, little is going to change, whatever the season.

Amateur breeders, however, can find themselves growing on youngsters from previous spawnings and conditioning adults for future ones. This often entails live foods, such as *Daphnia* and mosquito larvae, which are hard to find at present, so alternatives will be required.

Modern frozen foods have, in some respects, made cultures of white worm and the like unnecessary, but even so, many hobbyists still prefer to grow their own. Keeping cultures from running amock and being discovered in places where they shouldn't be, is an art in itself. I have found that allowing micro-worm to proceed up the walls of the airing cupboard does not help your case when you come to negotiate for more tank space.

All in all, the winter months can be a harrowing time for the aquarist. It might therefore help if you can share your troubles with other sufferers. Why not join your local fish club, where group therapy is available. Have a great Christmas! **AAP**

SOCIETY WORLD

New NEFAS secretary

John Duffill has been elected secretary of the **North East Federation of Aquarist Societies (NEFAS).**

All correspondence relating to NEFAS should be addressed to John at **4 Maxwell Place, Dormanstown, Redcar, Cleveland TS10 5LE.**

Annual membership of NEFAS is only £8 per year for societies (or individuals can join for only £2 per annum); member societies receive a pack of reference books. Meetings are held on the first Wednesday of each month, at Billingham Community Centre, Billingham, Cleveland.

DIARY DATES

DECEMBER

Tuesday 5

Gloucestershire AS — *Meeting*, with viewing of the latest FBAS library video on *Thailand Discus*. For information, contact **Andy Ramsbotham**, Tel: 01452 521609, or **Clive Norris**, Tel: 01453 755450.

Sunday 10

Northern Area Catfish Group — *Talk*: speaker to be announced. Boys Brigade Hall, Bryn, Lancs. Details: **Mrs S. Pye**, Hon Secretary, Tel: 01942 707774.

WINNERS

CYPRIO POND EQUIPMENT COMPETITION

As promised in our **September** issue (p.41), here are the lucky winners of our **Cyprio**-sponsored competition.

FIRST PRIZE: **Planter Filter 1200, Plinth, UVC 2000, Prima 800 Pump.**
Mr. K.L. Hayes, Romney Marsh, Kent

SECOND PRIZE: **Filterfall 100, UVC 2000**
Paul Ingall, Huntingdon, Cambs.

THIRD PRIZE: **Green Machine 1500, UVC 2000**
Mrs. V. Wills, South Milford, Leeds

FOURTH PRIZE: **Prima 1000 Pump**
Mr. A.M. Watkins, Tamworth, Staffs.

FIFTH PRIZE: **Futura 270 Fountain Pump, Bio Compact 700**
Mrs. Grace Marshall, Goole, Yorks.

Congratulations to all our winners and a big 'Thank You' to our sponsors **Cyprio Ltd. (Tel: 01778 344502).**

East African Annuals

PART TWO The Breeding Challenge

Dr Robert Goldstein focuses on the unique breeding strategy adopted by the beautiful *Nothobranchius* killies.

Photographs — unless otherwise stated — by the author.

BILL TOMEY

Few freshwater fish can match the spectacular coloration of Nothos (in this case *N. patrizii*).

Nothos are the right size and colour to be excellent tropical aquarium fish, but they do require special care. Because they have a brief lifespan (typically, six months or less), breeding the ones you have now is the only way to guarantee that you'll have them later.

Conditioning

Breeding Nothos is as complicated as it is fascinating.

A pair can be spawned in a gallon jar, two-gallong drum bowl, or five-gallon aquarium. A group can be spawned in a ten-gallon tank.

The container should be aerated and filtered with a sponge filter, and inlcude a dense clump of vegetation, such as *Nitella* or Java Moss (*Vesicularia*) in which the female can hide should the male become too persistent. Nothos are not jumpers, so a cover is unimportant.

Three kinds of foods should be offered, live, live, and live. Nothos will take frozen bloodworms (chironomid midges) or adult brine shrimp, but leftover dead foods rot, and the decay bacteria will release endotoxins from their broken cell walls that kill Nothos quicker than you can change water.

I culture *Daphnia magna* and *Ceriodaphnia dubia*, feeding my fish with these cladoceran crustaceans a couple of times a week, newly hatched *Artemia* nauplii daily, blackworms (coldwater tubificids) as available from my local pet shop, and occasional treats of live mosquito larvae, especially when a squirrel has fallen into one of my rain barrels and drowned, creating a stinking, bloated mess. Glassworms, ants, fruit flies, *Tubifex*, and white and grindal worms are all excellent foods.

Peat precautions

In nature, Nothos lay eggs in the pond's silt. In captivity, you can use garden soil, silica sand, or (the favourite) peat moss. Some people buy large bales of milled Canadian peat moss, while others (including me) opt for the convenience of compressed pet moss pellets. Your garden supply store will have a selection, and anything will do, as long as it doesn't have added fertilisers.

Peat moss should be soaked before use for two reasons: first, to leach out any possible noxious additives, and second, to get it to sink rapidly in the aquarium. I keep a couple of dozen peat moss pellets in a gallon of water so they're fully saturated and ready to plop into an aquarium. When I use peat by the bale, I keep a supply in a barrel of water.

For small aquaria, I cover the bottom in about a half inch of peat moss. For larger tanks (fives and tens), I place the peat moss in a covered plastic margarine container weighted with a stone and with access provided by a hole cut in the lid. This enables the fish to find the peat moss, while confining the peat so that it is easily harvested without disturbing the tank. I recommend this method for planted combination show and breeding tanks.

Easy breeding

Nothos would spawn all the time if it were up to the males. The females, though, can quickly become exhausted and a spent female who runs from an amorous male will be fin-nipped or even killed if denied a hiding place.

Typically, one pair is set up per aquarium, but group spawning of Nothos can occasionally be successful. I've had good results at times, while at other times the males would kill each other off. I've also had tanks where the females killed each other off. And I've had varied results with the same species, so it is not a characteristic of only certain Nothos.

Breeding is the easy part. Put two Nothos together, and they'll spawn. I've had male Nothos try to spawn with Zebra Danios, Guppies and, in fact, just about any fish with a swollen abdomen. Oh well, different strokes...!

There's a lesson here, of course: never mix species of Nothos. Firstly, you cannot tell the females apart (except for *Nothobranchius melanospilus*, in which the female is black-spotted). Secondly, the last thing you want is to produce hybrids and lose your original stock.

Serious killifish aquarists label their stocks with the localities from which the original fish were collected, in order to avoid mixing populations that could be different species, or could be the same species that are reproductively incompatible. (Eventually, DNA analyses will be

Suitable polystyrene box for shipping killies.

used to clarify relationships within *Nothobranchius*. For now, it's necessary to keep our strains isolated to protect their genetic integrity for future analyses.)

Egg harvest/storage

The peat moss should be harvested at one- or two-week intervals, never any longer. Eggs in peat moss in the aquarium are at risk from water pollution or anoxia (oxygen depletion) or being eaten by the parents. Despite the best tank husbandry, the bottom will contain droppings that change the water chemistry and do the eggs harm.

Labelled egg batches are stored in damp peat moss during incubation.

Harvested peat moss should be poured through a net, then rinsed in tank water (any tank of dechlorinated, warm, fresh water will do) to wash out fine particles and rinse away toxic levels of stagnant water. Some aquarists place the peat moss for a day or two in a gallon of water with violent aeration, hoping that aerobic bacterial decomposition of any wastes will be accelerated and the waste products driven off into the atmosphere.

After the peat moss is cleaned, it is placed on layers of newspaper for drying, typically for 24–48 hours. The peat moss should still be dark-coloured and moist, but not so wet that you can squeeze water out of it, and not so dry that it becomes light tan, like cigarette tobacco. The moist peat moss is then packed in a plastic bag or glass jar and stored in a **warm,** dark place for incubation.

Note the term, warm. Nothos do well in warm tanks, but more importantly, their eggs require warmth. Many breeders store the eggs at 80°F (27°C) or the warmest part of the fish room. One very successful breeder keeps a thermostatically controlled heater in a gallon jar of water inside a 20-gallon tank, which is darkened and covered. The heater heats the water which, in turn, heats the atmosphere in the tank, and there is where he stores his bags of eggs.

Hatching tips

A dissecting microscope or hand lens will allow you to see the 1mm eggs. Eggs ready to hatch will be black with silver-rimmed-black-eyed babies winking and rotating inside. Eggs not ready to hatch will be clear yellow, or have motionless babies with eyes no more than black pin-points.

When ready to hatch, place the peat moss and eggs in a wide, flat container, and use no more than three quarters of an inch of room temperature, dechlorinated water; green water is best because of the motile algae and protozoans it contains, but old tank water, or even rain water, is fine, as long as it's not chilly.

The fry will begin to hatch within hours, and all should be hatched by the second or third day. They should be removed with a spoon or eye-dropper to clean (green or old) water, still less than an inch deep, for the first week. After then, you can increase the depth.

Fry hatched in water too deep sometimes fail to get air into their open-to-the-gut swim bladders within the critical first hours and become crippled belly-sliders unable to maintain neutral buoyancy. (In some fishes, the swimbladder is filled by gas extruded from the tissues. In Nothos and similar fishes, the initial swim bladder gas must be swallowed and transferred to the swim bladder in the critical few hours before the bladder is walled off from the intestinal tract.)

Many Nothos take *Artemia* nauplii as a first food, but others require something smaller. Green water is ideal, as are *Paramecium* culture (infusoria) or rotifer culture; vinegar eels or microworms are also useful first foods. When the babies are all up and swimming, I add snails for scavenging dead brine shrimp.

You'll get the best growth with frequent partial water changes, as much as 75% of the water every day.

Nothos grow evenly, so one doesn't constantly have to separate the young by size. When they start to sex out, at about the third week of age, the males should be placed in a separate tank where they'll pretty much ignore each other in the absence of females. This allows both sexes to put their energy from food into growth, rather than into spawning. When the fish are fully coloured up at four to six weeks, they should be allowed to spawn.

Health matters

Let's talk about diseases, because Nothos have some special problems. They are, for example, particularly susceptible to Velvet Disease caused by *Amyloodinium* (*Oodinium*). It's a parasitic algal disease often affecting small fishes confined to a small area and heavily fed, where the habitat gets lots of light and ammonia wastes build up rapidly (ammonia is a plant fertiliser).

Nothobrachius symoence — yet another striking Notho.

Velvet seldom kills adult Nothos, but will destroy a tankful of fry. It's curable, in adults, with copper sulphate, but the disease is easier to avoid than to cure, since *Amyloodinium* is intolerant of salt.

You should therefore always keep salt in Notho tanks. The recommended dose is a teaspoon of uniodised salt per gallon. I use about eight ounces of old synthetic sea water per ten-gallon tank or a baster-full of sea water per gallon jar. I always have a couple of barrels on hand, because I use waste sea water for hatching *Artemia* eggs.

In recent years, a devastating disease of Nothos entered the United States from Germany on *Nothobranchius eggersi*. It spread to other species and has wiped out entire collections in the States. It is spread by uninfected fish feeding on infected dead carcasses, and the spores can survive in damp peat moss.

Dr. Ed Noga at North Carolina State University Veterinary School has isolated the parasite and identified it as a *Glugea* species of microsporidean. Jiri Lom of Czech Republic is looking at it now as well, and both are trying to determine if this is the well-known *Glugea anomala* of Sticklebacks. We should know within the next year or so. Isolation is necessary to control epidemics, for there is no cure. AKP

Want to know more?

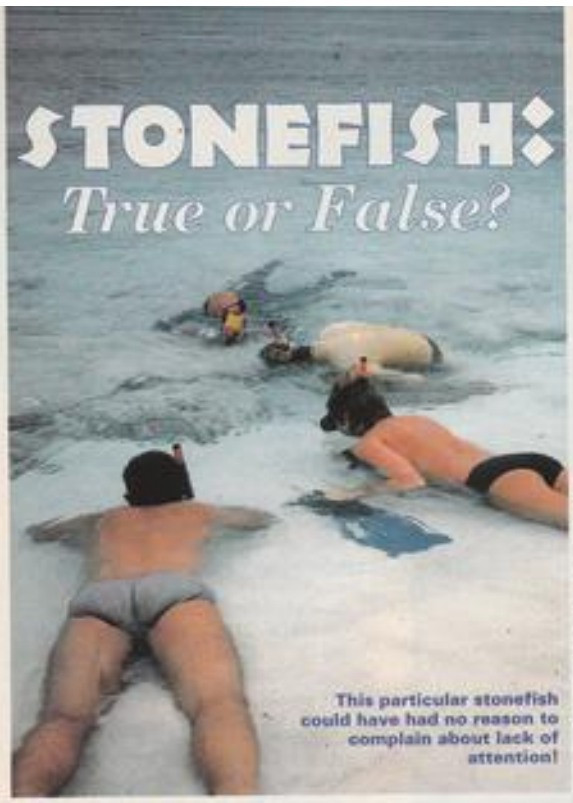
How do you get Nothos? Few pet stores carry them, unless a hobby breeder lives nearby and provides excess production. You should therefore join a speciality society, such as the British or American Killifish Association. Both organisations offer excellent literature, and the members trade and sell eggs in peat and fish in water to one another using the postal service.

1 Membership of the **British Killifish Association (BKA)** costs: £15 (UK), £18 (Europe) and £28 (other countries). For details contact: **Cliff Griffiths, Registrar — BKA, 8 Cropthorne Close, Woodrow North, Redditch, Worcestershire B98 7SJ. Tel: 01527 523635.**

2 Membership of the **American Killifish Association (AKA)** is $24 (USA), $30 (Canada/Mexico) and $40 (all others). Send a cheque (US) or postal money order (all others) to: **Ronald Coleman, Membership Chairman, 903 Merrifield Place, Mishawaka, Indiana, USA 46544.**

STONEFISH: *True or False?*

DR PETER WIRTZ



This particular stonefish could have had no reason to complain about lack of attention!

A False Stonefish, *Scorpaenopsis diabolus*.

DR PETER WIRTZ

Dr Peter Nahke meets the most poisonous fish in the world... or is it an almost-perfect imitation of one?

"There is a stonefish in the shallows right next to the landing place!" The grapevine spread this news all over Bathala, a small island in the Ari Atoll in the Maldives.

The fascination which the word "stonefish" arouses in snorkellers and divers is immense — as was evident on the afternoon in question. A group of sightseers had rapidly assembled on the beach, eager to see this, the most poisonous of poisonous fishes, at close quarters.

During the hours that followed, the appeoximately 20cm (8in) long, grey-green fish had no cause to complain about lack of attention. At any one time, there were up to six snorkellers lying in a close-packed semicircle around the fish, which was subjected to a positive barrage of camera flashes. But the entire hullabaloo left it apparently unperturbed. Only when someone poked a snorkel (as a substitute for a stick) too close, did it slowly move a little to one side, using its broad pectoral fins as 'legs'. We never saw it swim in all the time it was there.

Questionable identity

Before long, an argument arose: Was it *really* a stonefish, or 'just' a dragonhead? The dragonheads and firefishes, members of the scorpionfish family (Scorpaenidae), are often seen by divers and snorkellers. Stonefishes (family Synanciidae) are, in fact, not uncommon in the Indian Ocean, but are so well camouflaged that they are rarely spotted.

Obviously, there is no likelihood of confusing a stonefish with the eye-catching firefishes, but among the dragonheads there are several species which are deceptively similar to stonefishes.

The debate on the beach continued unabated. Stonefish or not? The chalets were only a stone's throw away, so it was not long before several people arrived with their identification books. Randall's *Red Sea Reef Fishes* was consulted, together with Debelius' *Fischführer Rotes Meer* (*Guide to the Fishes of the Red Sea*), Carcasson's *A Field Guide to the Reef Fishes of Tropical Australia and the Indo-Pacific Region*, and Smith's *Fishes of the Seychelles*.

Yet again, it became clear that a single book is inadequate when dealing with such difficult problems. Even using the various identification keys it is not easy to find an answer to the question "Stonefish — yes or no?"

The fish, meanwhile, proved more than cooperative. It remained in almost exactly the same spot where it had been discovered half an hour previously, and permitted itself to be studied from all angles.

Distinguishing features

What are the external characters which distinguish a stonefish from a dragonhead? An important criterion is the position of the mouth. In all stonefishes it is angled steeply upwards. Only a very few dragonheads have a comparable mouth position.

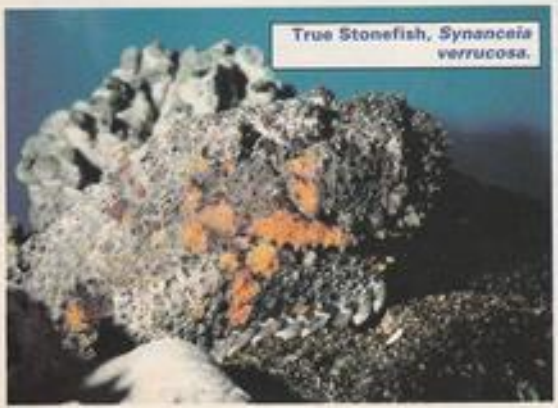
An even more reliable character is found in the pectoral fins, which are used for 'running around' by stonefishes as well as dragonheads, which swim for only short distances, and then, only infrequently. In stonefishes, the pectorals are appreciably broader than in scorpaenfishes, and lie either side of the plump head like two huge fans.

Another distinguishing character is the deep pit behind the eye in all stonefish species, which is nothing like as pronounced in the scorpionfishes.

Dragonheads are repeatedly mistaken for stonefishes, rather than vice-versa. In fact, the frequent misidentification of the dragonhead *Scorpaenopsis diabolus* as a stonefish has earned this species the English common name of 'False Stonefish' — and the resemblance could hardly be more striking! It was indeed this same False Stonefish which we now had in front of us.

There is one considerable difference between stonefishes and dragonheads, no matter how great the external similarity: their degree of venomousness. Both belong to the group known as "actively venomous fishes". They utilise a complexly-structured system consisting of glands, to manufacture their poison and fin rays modified into 'hypodermics' capable of effortlessly penetrating even the soles of shoes.

Both scorpionfishes and stonefishes use their fearful poisonous weaponry solely for their own defence and not for the capture of prey. Very few members of the animal kingdom possess a poison fatal to humans: out of the approximately 30,000 fish species known, only the stonefishes belong to this 'poisonous elite', and many people have fallen victim to their stings. They are more of a threat to unwary bathers than to divers, who are aware of the danger. **MP**



True Stonefish, *Synanceia verrucosa*.

DR PETER NAHKE/HAUSENBECK