

**Risk Assessment on the import of Asian Arowana (*Scleropages Formosus*)
under the EPBC Act, 1999**

Draft

Report prepared for

The Department of the Environment and Heritage

By Linda Do

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The Asian Arowana (*Scleropages formosus*) or better known as the “Dragon Fish” has been regarded as one of the kings in Aquatic world due to its immense popularity, value and great looks. The unique shape, mouth and scales, and air of mystery have made Asian Arowanas so special; they have stolen the heart of many hobbyists. With its close resemblance to the Chinese Ancient Dragon, many Chinese all over the world believed that ‘Dragon Fish’ symbolises luck, wealth, prosperity and strength, thus making it one of the best fish to keep for good feng shui. It is said that water is where Chi gathers and Sheng Chin in an aquarium, is said to be beneficial. However, to ensure that the water has Yang energy, auspicious fish are necessary. This is where the Dragon Fish come in demand, being widely accepted as the symbol of wealth.

In the Asian culture the Asian Arowana is a thing of beauty and splendour and is believed to bring good fortune to its owners. It was due to these very reasons that Asian Arowanas were excessively captured and traded. This rapid depletion of Arowanas in the wild brought the species close to extinction and led to its listing as an endangered species by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1975. The Asian Arowana can now only be traded and sold if they are bred in captivity and are of second generation (F2) and beyond.

The Asian Arowana is four species of closely related freshwater fish in the genus *Scleropages*. They have several other common names including Asian bony tongue and dragon fish. Arowana are freshwater bony fish of the family Osteoglossidae sometimes known as Bony tongues. Osteoglossids are basal (primitive) fish from the lower Tertiary and are placed in the actinopterygiid order Osteoglossiformes. There are ten described living species; three from south America, one from Africa, four from Asia and the remaining two from Australia. *Scleropages formosus* (Asian Arowana) have long bodies, large pectoral fin, dorsal and anal fins located far back on the body and much larger caudal fin than other of their South America relative. *Scleropages formosus* (Asian Arowana) are distinguished from Australian congeners *Scleropages jardini* and *Scleropages leichardti* by having fewer (21-26) lateral line scales (versus 32-36), longer pectoral and pelvic fins and a longer anterior snout. Confirmation has come from genetic studies, which have shown that the ancestor of the Asian Arowanas diverged from the ancestor of the Australian Arowanas, *Scleropages jardini* and *Scleropages leichardti*, about 140 million years ago, during the early Cretaceous period. This divergence took place in the eastern margin of Gondwanaland, with the ancestors of Asian Arowanas carried on the Indian subcontinent or smaller landmasses into Asia.

An application was received under the Commonwealth of Australia *Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection) Act 1999* to amend the list of species taken to be suitable for live import into Australia to include the *Scleropages formosus* (Asian Arowanas).

The purpose of this report is to assess the risk of the *Scleropages formosus* (Asian Arowana) establishing in Australia and the risk these fishes may pose to the environment, should they establish feral populations.

The Terms of Reference for this report have been approved under the EPBC Act. The Terms of Reference for the risk assessment are:

1. *Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).*
2. *Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the proposed activity.*
3. *Provide information on the taxonomy of the species.*
4. *Provide information on the status of the species under the Convention on International Trade in Endangered Species of Fauna and Flora (CITES).*
5. *Provide information on the reproductive biology of the species.*
6. *Provide information on the reproductive biology of the species.*
7. *Provide information on whether this species has established feral populations, and if so, where those populations are.*
8. *Provide information on, and the results of, any other environmental risk assessments undertaken on the species both in Australia and overseas.*
9. *Provide information on all other Commonwealth, State and Territory legislative controls on the species.*
10. *Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control.*
11. *Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia.*
12. *What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports)*

1. INTENDED USE

The proposal is for *Scleropages formosus* to be imported and traded as aquarium pets, due to their high status and value to many hobbyists. The high regard attributed to these fish is due to the various colour varieties. The super red is regarded by many to be of the greatest beauty because red is considered an auspicious colour, according to some Asian cultures. Each colour variety has variation among different localities. Hobbyists consider the highest grade of the gold cross backs to be the full gold cross backs (frameless gold), which originated from Sungai Gedong river system.

Yet another potential use of the Asian Arowana is to be bred for the purpose of commercial trade, and personal enjoyment.

Only captive Asian Arowana, and not wild caught, is allowed to be traded commercially, and even this requires approval from CITES and a CITES certificate. The difference is recognised and any trade of Asian Arowana will be carefully selected from CITES permitted and registered farms. Arowanas have been successfully bred for more than 15 years now: recognised and allowed by CITES since 1990. As with several other countries, the legal trade of microchip Asian Arowanas is now certainly a plausible and safe avenue of fish importation.

2. GUIDELINES ON KEEPING, TRANSPORT AND DISPOSAL

As the Asian Arowana is not currently on the live import list, nor is it native to Australia, there is no specific guidelines on their keeping, transport and disposal. What is outlined henceforth is derived from the guidelines that are applied to other similar freshwater fish.

TRANSPORT

Option 1: Import through a current registered importer of exotic fish, which is or would be approved by AQIS. Therefore, the Asian Arowana would undergo a given quarantine period at a wholesaler's premise as approved by AQIS, and then moved to an appropriate aquarium facility.

Or, import suitable microchipped captive breed Asian Arowana from CITES registered farm, which would then follow the quarantine procedure as above.

Option 2: Allow for the import to be delivered directly to a designated company that will henceforth be preoccupied with the maintenance of the *Scleropages formosus*. This option is more attractive for the reason that this pioneer company and facility would be able to keep the fishes under close maintenance and make suggestions and comments representative of the whole consignment of Asian Arowanas into Australia. This option is particularly practical in the beginning when the first experimenting and monitoring the initial transport of the Asian Arowanas.

DISPOSAL

As with all other dead freshwater fish, the disposal of Asian Arowana would first involve freezing the fish. This is to ensure the elimination of any contaminants to the Australian environment and is a method that is currently being used effectively to rid of other freshwater fish. Then the fish would be removed to a dump site where it can be safely be disposed of.

KEEPING

The housing of the Asian Arowana will be according to the requirements and stipulation of Australian Quarantine and Inspection Service (AQIS). More specifically, it would of course be in accordance with section 46A of the Quarantine Act 1908, and subject to regular audits by AQIS.

The keeping would be in the aquarium shop and then to the home of individual hobbyist.

The Asian Arowana prefers to live in temperatures of 24-30°C and the pH best kept between 7.0 and 7.5. The water stability will be maintained with several water heaters, to make sure that there is backup if one fails since they can be sensitive to lower temperatures.

In keeping the Arowanas, an important point of concern with a mindful consideration of the natural habitat of the Asian Arowana, is lighting. Good lighting is required to get the fish to develop good coloration and sunlight is beneficial to this end. Too much sun light can cause severe algae problems, however.

Effective Biological, Chemical, and Mechanical filtration should be deemed necessary when keeping Asian Arowana. The *Scleropages formosus* are carnivores and will invariably create a lot of waste material which will put a lot of stress on the filters. The most attractive means of filtration would be the Bio-Wheel biological filtering system. This would help clean the aquarium and also assist in oxygenating the water to a small degree, which is good when keeping larger fish. Combined with a good carbon element, this and good gravel at the bottom of the tank should keep the Ammonia, Ammonium and Nitrites down. Added to this, 25% of the tank's water will be changed each week.

When feeding the Arowana, the young and the adults will be fed differently. The young will be fed on a mix of live and frozen brine shrimp, black worms and small fish. The older they are, the fishes will start to be fed on frogs, fish and shrimp.

3. TAXONOMY OF THE SPECIES

Taxonomic Hierarchy

Kingdom	ANIMALIA
Phylum	CHORDATA
Class	ACTINOPTERYGII
Order	OSTEOGLOSSIFORMES
Family	OSTEOGLOSSIDAE
Common Name/s	ASIAN AROWANA (E) ASIAN BONYTONGUE (E) GOLDEN AROWANA (E) GOLDEN DRAGON FISH (E) KELESA (E) SCLÉROPAGE D'ASIE (F) SCLÉROPAGE FORMOSUS (F) PEZ LENGÜIHUESO MALAYO (S)

4. CONSERVATION STATUS

The Asian Arowana are listed as endangered by the 2006 IUCN Red List, International Trade in Endangered Species of Wild Flora and Fauna (CITES), under which it was placed on Appendix 1. However there are 23 breeders in Asia and the specimens they generate can be imported. Trade in wild-caught specimens is prohibited.

The Asian Arowana is exclusively traded live for the aquarium trade, which began gaining significant commercial success in the 1980's. Prime specimens are worth up to \$5000 and illegal trafficking has been a documented problem in CITES Parties.

The Asian Arowana was listed in Appendix I in 1975, with a temporary down listing of the Indonesian population for ranching (Res, Conf.7.14) at COP7 and retransfer to Appendix I at COP9. All legal specimens in commercial trade are now captive bred at CITES-registered facilities as per Res.Conf.10.16.

In 1989, at the Rosanne Seventh Review Congress, it was agreed to import farm bred fishes at a restricted level from Indonesia. Although Asian Arowanas were originally listed under Appendix I, it was later recognized that breeding the Arowana can be an economic alternative to domestic livestock production. At the same time, it will provide an incentive for rural populations in those places to develop an interest in its conservation. In line with this, CITES also believes that it should encourage the establishment of captive breeding operations for animals included in Appendix I. Therefore, Arowanas were once again allowed to be exported from its country of origin as long as the exported fishes are of specimens bred in captivity. The number of fishes exported from Indonesia is as follows: 1250 in 1990, 1500 in 1991, and 2500 in 1992. This allowance continues to increase and today there are over 16 CITES registered farms breeding *Scleropages formosus* for commercial purposes.

These days, the trading of Arowanas are once again legal, provided they are from CITES registered fish farms. These fish farms are scattered across Indonesia, Malaysia and Singapore where these fishes find their native habitat. To be able to apply as a CITES certified fish farm is a long and tedious process. Captive-Breeding operations have to be first approved by the Management Authority of each Party, in consultation with the Scientific Authority of that Party. Prior to the establishment of captive-breeding operations for exotic species, a study of ecological risks should be completed, in order to prevent any negative effects on the ecosystem and the native species. When all this is done the breeder has to acquire a breeding stock, and he has to build the facilities to house specimens and successfully breeding the species.

Specimens for the aquarium are no longer acquired in the wild. These fish farms specialize in the production of F2 offsprings, meaning second generation offspring's that can be sold to the market. These fishes are tagged with coded microchips called *Passive Integrated Transponders* (PIT) for identification purposes. These microchips help identify these fishes as a farm bred animal, and if the need ever arises to check its identification, the microchip can be scanned to identify the fish. Aside from the microchip, when one buys a farm bred fish from any of these fish farms, the buyer will receive a certificate of authenticity plus a birth certificate.

The following is the meaning to Appendix I (Article III)

REGULATION OF TRADE IN SPECIMENS OF SPECIES INCLUDED IN APPENDIX I

1. All trade in specimens of species included in Appendix I shall be in accordance with the provisions of this Article.

2. The export of any specimen of a species included in Appendix I shall require the prior grant and presentation of an export permit. An export permit shall only be granted when the following conditions have been met:

(a) A Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species;

(b) A Management Authority of the State of export is satisfied that the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora;

(c) A Management Authority of the State of export is satisfied that any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment;

And

(d) A Management Authority of the State of export is satisfied that an import permit has been granted for the specimen.

Should import of *Scleropages formosus* (Asian Arowana) be allowed the above should be met.

5. ECOLOGY OF THE SCLEROPAGES (ASIAN AROWANAS)

Asian Arowanas are medium sized (maximum 60-90 cm total length) freshwater fish inhabiting large rivers, swamps, and lakes in Southeast Asia. Known natural range includes Cambodia, Lao PDR, peninsular Malaysia, the Philippines, Vietnam and Indonesia (Kalimantan and Sumatra). Some authors indicate the species is also found in east Malaysia, Brunei Darussalam, and Myanmar. Introduced populations occur in Singapore and potentially other countries where they are imported for the pet trade.

NATURAL GEOGRAPHIC RANGE

Scleropages formosus is the most common variety, found in Vietnam, Myanmar, Thailand and Malaysia. It is commonly found in Thailand, Malaysia, Myanmar, Indonesia and Cambodia. Due to its wide dispersion in the region, there can be differences in its appearance and color. Most of the Green Arowana found here has a greyish green body with a dark striped greyish green tail. Shape of this variety is a big difference as compared to other varieties with its head or mouth portion being larger and rounder. It is one of the cheapest types of Asian Arowana, apart from Yellow Tail. However, one particular type of Greens (those with a dark purplish core) is as exotic as any other varieties. The Green Arowana, together with 1.5 or 2 grade reds, is popular among countries like Thailand and Philippines because of its low price. Besides this, many Japanese students also find it more affordable to own them for the purpose of admiring the beauty and for experimental breeding of these exotic fish.

ORIGIN

Asia: Cambodia, Indonesia (Kalimantan and Sumatra), Malaysia, Thailand and Vietnam.

HABITAT

The Asian Arowana can be found in tannin stained backwater streams, slow moving waters flowing through forested swamps and wetlands. In the wild, the Arowana have a tendency to settle in shallow waters (about one and a half meter deep), near riverbanks and in shaded areas due to their feeding habits.

They are native to Southeast Asia.

The water chemistry of the *Scleropages formosus* habitat should have a soft and acidic pH of ideally 7.0-7.5. However, this factor is not as critical as the water quality, which should consist of low nitrates, zero ammonia and nitrite. The dissolved oxygen level should be approximately 5ppm with the temperature ranging anywhere from 24-30 °C.

Arowana prefers soft water and its colour is best when pH is kept slightly lower such as adding black water extract or peat. Sudden change of pH level could be fatal to Arowana as well as other kinds of fish. Therefore drastic water change must be monitored closely.

EAT

The Asian Arowana is known to be a hunting macro fauna, that is, it is a predator. The juvenile Arowana feed on insects at the water surface, whilst the adult fishes are piscivorous; preying on other fishes. In saying that however, the Arowana are not considered to be dangerous.

The range of food eaten includes live crickets, tadpoles, small frogs, small fishes, shrimps worms etc.

SOCIAL GROUPING AND BEHAVIOUR

Asian Arowanas can be kept with other large fish which cannot be swallowed. Sometimes aggressive to other species, probably best kept alone as specimen fish. Groups of similar sized individuals can be kept together, not necessitates huge tanks which are beyond the mean of most home aquarists. They are also excellent jumpers, it has been reported that *Osteoglossum* species have been seen leaping more than 6 feet (almost 2 metres) from the water surface to pick off insects from overhanging branches in South America.

6. REPRODUCTIVE BIOLOGY

The Asian Arowana, like all other Arowana species, is paternal mouth brooders. Generally, they are slow to reach sexual maturity. The time that it takes for the Arowana to mature depends on the condition they are growing in. Generally however, the female takes two to three years and the male four to five years to reach maturity.

In the wild, the Arowana pair themselves up for natural selection. The Asian Arowana are sexually dimorphic, however, it may sometimes be hard to distinguish between them. They are not known to be able to change sex. Weeks, and even months are spent courting and when the time is right, the female will then lay eggs on slow stream riverbed and the male simultaneously release his sperm to fertilize them. The number of eggs laid can range from 50-80, each measuring around 12-15mm in diameter. The male immediately scoops up as many eggs as possible. The remainder is usually eaten up by the female to regain nutrients. Eggs will be hatched in about two months, and when this happens, the fry, as it is called, will then leave the father's mouth, initially for a brief time only and slowly increase the duration. The yolk sac is used up in 2 to 3 weeks and after that, the fries will then venture out to feed on micro-organisms such as algae, tiny crustaceans, and insects. When there is any danger, the fries will be alerted with the male's chin barbells and they will immediately swim back for refuge. The fries will leave the father once they are able to survive by themselves.

Observations have shown that the female Arowana spawn once a year and each successful spawn produces between 30 and 80 young.

No information is available to suggest that the female can store sperm.

7. ESTABLISHED FERAL POPULATION

The Asian Arowana is distributed in East Asia Cambodia, Peninsular Malaysia, Sumatra and Borneo. There had been local extirpation of *Scleropages formosus* in some drainages in Peninsula Malaysia and Sumatra due to over-collecting, but is still relatively common in some areas. The high cost of each fish even juveniles, mean that it is not a species which is exported in larger number and to average aquarists. For many years, the Asian Arowana was only occasionally seen in the aquarium trade and the species appeared regularly in markets as a relatively cheap food fish. Its sudden popularity was basically an Asian phenomenon. At some stage, Chinese superstition had it that keeping this fish gave its owner good luck and prosperity. This belief probably partly arose by chance and partly because of the bright red and deep gold colours of some Asian Arowanas, which Chinese and Japanese associated with luck. Suddenly people (especially businessmen) were paying incredible prices to own an Arowana so as to have good luck charm. In the west, the Southeast Asian Arowana is much less popular, although they appear in the trade occasionally.

The large size, mouth-brooding behaviour and high price of Arowanas have also spurred efforts for their culture relatively early. In Indonesia, large farms have been established where the Arowana has successfully being bred. Under CITES guidelines, once an endangered species can be bred in captivity, applications can be made for its trade to be allowed on a controlled basis. In Singapore the successful spawning of the second generation of *Scleropages formosus* by Rainbow Aquarium Pte Ltd and the Primary Production Department (PPD) of Singapore has also lead to the controlled sale of this species. The usage of microchip implantations into these Singapore offspring's aids in the identification of legal stocks in the trade.

There are numerous commercial breeding operations in the species range countries successfully producing this species together they produce annually thousands of specimens

Wherever it occurs, the species may be naturally rare with each spawning population probably containing 100 – 200 individuals and entire watersheds supporting populations of thousands of individuals. There are no systematic survey work or quantities assessments on wild population, but it appears that watersheds and river systems within the species range may support several allopathic subpopulations. The Asian Arowana does not migrant extensively or congregates in one sub-population.

On a range –wide scale this criterion may not apply to wild population, which may exist in thousands or millions of watersheds. However each water body apparently has breeding demes that consist of only 100-200 individuals. These populations are small for commercially exploited finfish and even national populations may

only number in the thousands. Therefore, this criterion could be applied to national population and perhaps range-wide if there is a better understanding of global population size.

Specifically to Australia, the Asian Arowana has not had any so much as established a feral population, although recordings have been made of their existence in the Christmas Island waters.

There have been recordings of Arowana release into the environment in other countries. In California, USA a single fish was taken from Lake Berryessa, Napa County by an angler in 1972. A second specimen was caught from Lake Merced, San Francisco County by anglers in 1994. A third was netted from Adobe Creed in Petaluma in July 2000. The species was introduced at Forest Spring in Ash Meadows, Nye County, Nevada during the early 1960s, but did not flourish.

8. RESULTS OF OTHER ENVIRONMENT RISK ASSESSMENT

There has been no record that *Scleropages formosus* (Asian Arowanas) causing any environment risk, both in the wild and as aquarium pets nor the caring on disease on to human or other animals. Even on a breeding farm they are very carefully monitor as the farmer are afraid of them not surviving. However, there has been no environmental risk assessment conducted for Asian Arowanas.

9. COMMONWEALTH, STATE AND TERRITORY LEGISLATIVE CONTROLS

Currently *Scleropages formosus* (Asian Arowana) are not listed under *Commonwealth Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection) Act 1999*. This goes for all the State and Territory as well. However under the *Environment Protection and Biodiversity Conservation Act 1999* as long as they meet the requirement of the *Quarantine Act 1908* that is specimens of CITES listed species may be imported for commercial purposes provided they have been derived from an approved CITES registered captive breeding program (Appendix I animals), animals bred in captivity or imported for commercial purpose provided a relevant CITES authority in the country of exports has given permission for the export. *Scleropages formosus* (Asian Arowana) under the CITES is placed as Appendix I in 1975, under the EPBC Act 1999 *Scleropages formosus* (Asian Arowana) are allowed to be import under a permit and provided that it meet the requirement of the *Quarantine Act 1908*. This applies also to all State and Territory legislative, which are controls under the EPBC Act 1999 and *Quarantine Act 1908*.

10. ASSESS THE LIKELIHOOD THAT THE SPECIES COULD ESTABLISH A BREEDING POPULATION IN THE AUSTRALIAN ENVIRONMENT SHOULD IT EVER RELEASED FROM EFFECTIVE HUMAN CONTROLS.

Scleropages jardini and *Scleropages leihardti* can be found in Australia and are the cousin of the Asian Arowana. These prehistoric fish trace their ancestry back to Gondwanaland and have relatives across Africa, South America and South-east Asia, including the Arapaima from the Amazon, the world's largest freshwater fish. Australia has two species of Saratoga, one of which is confined to central and southern Queensland, while the other is found in the Top End, Kimberley and western flowing river systems of Cape York.

The Gulf Saratoga (*Scleropages jardini*) is an ancient fish, from the Osteoglossidae (Bony Tongue) family, one of the oldest on the planet. Having been around since the dinosaurs ruled the earth; they have not survived this long without being a cunning, top line predator in their Australian tropical freshwater habitat. Preferring clearer waters than *S. leichardti* Gulf Saratoga is usually found in the upper reaches of the rivers within its distribution, inhabiting both still billabongs and fast flowing streams. Like *S. leichardti* Gulf Saratoga are solitary territorial fish. Gulf Saratoga have patchy distribution throughout North Queensland and most of the Gulf of Carpentaria drainage system to as far west as the Adelaide River (East of Darwin in the Northern Territory). Gulf Saratoga are known to be mouth brooders, like *S. leichardti*, producing between 60 to 100 large eggs, however the details of its breeding behavior have not been recorded. An opportunistic carnivore and mainly a surface and mid water feeder like *S. leichardti*, gulf Saratoga take a wider variety of other fish and crustaceans as well as terrestrial insects etc. An attractive and majestic aquarium species, less easily startled than *S. leichardti* gulf Saratoga are relatively easy to keep in an aquarium. The tank should have a heavy cover to prevent the fish jumping out, but this is much less likely than with *S. leichardti*. The Gulf Saratoga is solitary fish and is very territorial and aggressive to other members of their species. Captured specimens often exhibit the scars of past battles. The *Scleropages leichardti* prefers long deep muddy holes with overhanging vegetation. *Scleropages leichardti* are solitary fish and are very territorial and aggressive to other members of their species. Captured specimens often exhibit the scars of past battles. *Scleropages leichardti* occur throughout the Fitzroy River system of North Eastern Queensland, although stocks have been transferred to other areas.

Should *Scleropages formosus* (Asian Arowana) ever be released from effective human controls in the Australian environment it would be the same as the *Scleropages jardini* and *Scleropages leichardti*. Apart from the area mentioned above it is very unlikely that the *Scleropages formosus* (Asian Arowana) can survive in any other part of Australia as their habitat is in slow moving waters flowing through forested swamps and wetlands. Water temperature is between 24-30 ° C (75-86F), that is why it only exists in Southeast Asia where their

colours are different to the Australian *Scleropages*. Breeding farm around South East Asia establish an environment similar to the forest swamps and wetland in order for them to breed. Should it establish a breeding population in the Australian environment, it would only number between 70-200 fishes at any time, as like the *Scleropages leichardti*; it does not and would not flourish into a large population.

Australia would be predominantly unsuitable for establishment of Asian Arowana due to the temperature intolerances, it would be extremely unlikely that Arowana could survive, let alone breed successfully in the surrounding environment. In saying so, however, there are certain climatic areas in Northern Queensland, Northern Territory and Northern Western Australia where the *Scleropages formosus* could inhabit, thus there is potential for establishment. Further investigation suggests that environmental triggers that induce breeding are not relevant to Australia's northern regions, such as rising spring tides, suggesting the chances of long term survival of this species is rare. Another point is that the more ideal climate in areas of Northern Australia has sparse population of people, making the risk of release into the environment minimal.

11. ASSESSMENT OF THE POTENTIAL IMPACTS SHOULD POPULATIONS ESTABLISH.

Should the population of *Scleropages formosus* (Asian Arowana) establish in Australia the impacts would not cause any significant harm to the environment, agricultural and humans. Should it establish a population in the wild its reaction and effect on the Australian environment would be much like the *Scleropages jardini* and the *Scleropages leichardti*. As there is no known record of any adverse environmental effects of the species in their places of origin, it is also likely that it may also be the case in Australia. The *Scleropages formosus* (Asian Arowana) are in demand because of the Chinese beliefs and good feng shui, it therefore exist in the home and in home they remain for the rest of their lives and would not be release in the wild. The fact that they are high price so they are very well taken care of. Also the *Scleropages formosus* (Asian Arowana) exist in South East Asia due to it habitat and environment, should it be release it would merely exist, as the Australian environment is very difficult for them to survive, apart from Northern Queensland, and it is highly likely it would exist in similar conditions and cause similar minimal effects as the related Australian Arowanas.

In the unlikely circumstance that the species does flourish, the potential environmental damage of the Arowana species may include:

- Competition with local fish species for food or shelter
- The spread of disease
- Predating on local species
- Putting pressure on natural food chain.

From the experiences of the single fish introduction in the US, it can be seen that the impacts to aquatic flora and fauna of the regions were unknown, but were consequently considered to be negligible as the inability of the animal to reproduce, and thus flourish, would not make it such a significant threat.

The Asian Arowana, as with all other ornamental fish around the world, can harbor and spread a number of ubiquitous fish bourn diseases. However, in a preliminary literature search, Biosecurity Australia was not able to identify any specific disease agent concerns associated with the importation of the Arowana that could not be covered by the existing conditions for live freshwater ornamental fish importation. Moreso, Asian Arowana, is not especially susceptible to disease, and is actually quite hardy when acclimatized.

12. CONDITIONS OR RESTRICTIONS ON THE IMPORT

There is no risk if *Scleropages formosus* (Asian Arowana) were to be establishing in Australia, Asian Arowana are aquarium fish for the enjoyment of hobbyist. They are a thing of beauty and it had stolen the heart of many hobbyists.

Condition of import under the EPBC Act 1999 and *Quarantine Act 1908* should be applied to *Scleropages formosus* (Asian Arowana), that is specimens of CITES listed species may be imported for commercial purposes provide they have been derived from an approved CITES registered captive breeding program (Appendix I animals), animal bred in captivity or imported for commercial purpose provided a relevant CITES authority in the country of exports has given permission for the export. By applying this it will prevent *Scleropages formosus* (Asian Arowana) being capture in the wild leading to extinction and illegal trading of them.

I recommend an import permit should be applied for this species and the normal import requirement for freshwater species should apply for *Scleropages formosus* (Asian Arowana) as well.

Based on information obtained, there is no evidence of *Scleropages formosus* (Asian Arowana) being any risk to the environment and the people, in fact they are at more threaten from the human than human from them. This is the reason why they are endangered. Without the control of CITES people would not have the opportunity to enjoy this species. Under CITES more breeding farms have been established, therefore the population of *Scleropages formosus* is established and traded for the enjoyment of hobbyist. This result in the reduction of wild capturing of the Asian Arowana and illegal trading, with more breeding farm been establish throughout South East Asia trade of Asian Arowana can be legally imported.

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