

Current Status of Transboundary Fish Diseases in Singapore: Occurrence, Surveillance, Research and Training

Ling Kai Huat¹, Susan Kueh² and Poh Yew Kwang³

Agri-Food and Veterinary Authority of Singapore

¹*Aquaculture Services Centre, Aquaculture Branch, Sembawang Research Station*

Lorong Chencharu, Singapore 769194

²*Aquatic Animal Health Branch, Animal & City Veterinary Laboratory*

60 Sengkang East Way, Singapore 548596

³*Wildlife Regulatory Branch, Sembawang Research Station,*

Lorong Chencharu, Singapore 769194

Introduction

Any significant disease of aquatic animal such as koi herpesvirus (KHV) and spring viremia of carp virus (SVCV) is of concern to Singapore. Import and export of ornamental fishes in Singapore are carried out by licenced traders under the Accredited Ornamental Fish Exporters Scheme (AOFES). Under this Scheme, the exporters have to get their premises approved according to guidelines set by the Agri-Food and Veterinary Authority of Singapore (AVA), which include the provision of designated quarantine area, packing area and disease treatment area. These approved premises are inspected monthly by AVA inspectors. As part of routine fish disease surveillances conducted by AVA, regular fish samples are taken from each exporter premise once every six months for laboratory examinations in the absence of any significant disease. Additional samples are taken for laboratory examination should any significant disease outbreaks occur in these premises. Any significant results from these surveillances are reported in the *Quarterly Aquatic Animal Disease Report (Asia and Pacific Region)*, which is submitted to the OIE and NACA. Since surveillance for KHV started in January 2003, no positive cases have been detected to date.

There are 68 ornamental fish farms and 103 ornamental fish exporters in Singapore. The local farms produced about 44% of the total export with a value of S\$72.8 million (US\$42.3 million) in 2003. Shrimp farming is not popular in Singapore and there are only 2 shrimp farms using traditional earthen ponds for culture of tiger shrimp and Pacific white shrimp. The farms apply intensive culture system with regular water exchanges. Total annual production

from these two farms is about 100 metric tons (MT). So far there is no report of white spot syndrome virus (WSSV) and Taura syndrome virus (TSV) of shrimps in Singapore.

I. Current Status of Koi Herpesvirus Disease (KHVD) in the Production of Common Carp and Koi

I-1. Production of Common Carp and Koi

a. Production of Common Carp

Owing to very small market demand of common carp, there is no commercial farming of common carp in Singapore. There is limited number of wild common carp thriving in reservoirs and lakes in Singapore. These are for leisure and to control pest and not for human consumption. No export record of the species to other countries exists. Singapore imported less than 50 MT of common carp yearly for the last 3 years, mainly from Malaysia, for use in offerings during various special festivals. Data for the past 3 years are summarized in Table 1.

Table 1. Import of live common carp in Singapore for 2001-2003

Country of Origin	2001 (MT)	2002 (MT)	2003 (MT)
Malaysia	32.68	43.26	41.03
Hong Kong			0.02
Taiwan	0.50		
Total	33.18	43.26	41.05

b. Production of Koi

There are 4 koi farms and 40 koi importers and exporters in Singapore. The activities of koi farms are mainly in the import of fingerlings and nursing them into bigger size for local sale or export. The koi farms also provide hotel services for koi hobbyists. The local production is negligible. Importers and exporters with holding and quarantine facilities, import fish from different sources, quarantine them for a period of 3 weeks, or hold them for a longer period before exporting to other countries. The sources of spawners, broodstock or fingerlings are Japan, Malaysia, Thailand, and China.

The import figures of koi for the last 3 years are shown in Figures 1- 4. The main supplier of koi to Singapore is Malaysia, which supplied more than 90% of the total quantity imported. This is followed by Japan (about 2 %) and China (1.5%).

Singapore exports about 2.4 million pieces of koi annually to other countries. The major importers of koi from Singapore are the United Kingdom, Germany, United States and Malaysia. Export figures for the past 3 years are summarized in Figures 5-8.

I-2. Koi Herpesvirus Disease (KHVD) of Common Carp and Koi

Presently, Singapore is free from KHVD. Since reports were made on KHVD as a significant disease of koi in Israel, Europe and United States in 1998, and the occurrence of koi mass mortality syndrome in Indonesia in 2002, ornamental fish traders dealing with koi in Singapore have been showing concern over this emerging disease. To address the concerns, AVA held a dialogue session with the Singapore koi traders in June 2003 in order to maintain industry awareness of the disease and to promote measures to prevent import and export of KHVD-infected fish. Since the reports of KHVD outbreak in Japan in October 2003, AVA has instituted compulsory inspection, testing and quarantine of all koi consignments imported from Japan and Indonesia. Quarantine is for a minimum period of 3 weeks. Koi samples from a particular consignment, or sentinel koi, are cohabitated with imported koi, and are subjected to testing for KHV by tissue culture. Only koi that tested negative for KHVD will be released from quarantine. KHVD-positive koi consignments are to be destroyed, and the premises disinfected accordingly.

II. Current Status of Viral Diseases in the Production of Shrimps and Prawns

II-1. Production of Shrimps

a. Production of Tiger Shrimp (*Penaeus monodon*)

There are only two shrimp farms in Singapore and they using traditional earthen ponds to culture tiger shrimp. The farms apply intensive culture system with regular water exchange. Below is the annual production for the last 3 years:

Year	Quantity (MT)
2001	106.00
2002	91.82
2003	31.33

There was a drastic decrease in production in year 2003. As a result, one of the shrimp farms adopted crop rotational farming practice and switched to culture seabass in 2003. The spawners, broodstock and postlarvae are imported from Malaysia. Presently, no live export record to any country exists for shrimp and production remains not sufficient for local demand.

b. Production of Pacific White Shrimp (*Litopenaeus vannamei*)

There are only 2 shrimp farms in Singapore using traditional earthen ponds to culture of Pacific white shrimp *L. vannamei*. Annual production for the last 3 years is tabulated below:

Year	Quantity (MT)
2001	8.00
2002	23.00
2003	15.70

The sources of postlarvae is mainly Taiwan and China.

c. Production of Freshwater Prawn (*Macrobrachium rosenbergii*)

There is no freshwater prawn culture activity in Singapore and a small quantity of freshwater prawn is imported from Malaysia and Thailand for local consumption.

II-2. White Spot Syndrome Virus (WSSV)

There is no recent report on WSSV in Singapore.

II-3. Taura Syndrome Virus (TSV)

There has been no report of TSV in shrimp culture in Singapore.

III. Surveillance, Monitoring and Diagnosis of Diseases of Aquatic Animals**III-1. Responsible Facility and Personnel**

The contact persons and responsible facilities that conduct diagnosis and inspection services are the following:

- (i) Aquatic Animal Health Branch, Central Veterinary Laboratory
60 Sengkang East Way, Singapore 548596
Email: susan_kueh@ava.gov.sg
- (ii) Aquaculture Services Centre, Aquaculture Branch
Sembawang Research Station, Lorong Chencharu, Singapore 769194
Email: ling_kai_huat@ava.gov.sg
- (iii) Epidemiology and Surveillance Branch
Email: Chang_Siow_Foong@AVA.gov.sg
- (iv) Wildlife Regulatory Branch, Import & Export Division
Email: Poh_Yew_Kwang@AVA.gov.sg

These facilities conduct surveillance and monitoring for diseases of aquatic animals regularly.

III-2. Diagnostic Capabilities and Major Diseases of Aquatic Animals**a. Definition of Levels of Diagnosis**

- Level I: Diagnostic activity limited to observation of animal and the environment, and clinical examination (On Site or Field Diagnosis).
- Level II: Diagnostic activity includes Parasitology, Bacteriology, Mycology, and Histopathology (Laboratory Diagnosis).
- Level III: Diagnostic activity includes Virology, Electron microscopy, Molecular biology and Immunology (Laboratory Diagnosis).

Based on the classification, there are laboratories that can conduct Level II and III diagnosis.

	Name of Laboratory	
	Aquatic Animal Health Branch	Aquaculture Services Centre
Address	Central Veterinary Laboratory 60 Sengkang East Way, Singapore 548596	Sembawang Research Station Lorong Chencharu, Singapore 769194
Level of Diagnostic Capability	Level III	Level II
Telephone Number	65-63862181	65-67519851
Fax Number	65-63863572	65-67523242
Email address	Susan_kueh@ava.gov.sg	Ling_kai_huat@ava.gov.sg

b. List of All Economically-Important Diseases of Aquatic Animals

Name of Disease or Agent	Affected Animals (Scientific Name)	Level of Diagnosis
<i>Tetrahymena</i>	Guppy (<i>Poecilia reticulata</i>)	Level II
<i>Hexamita</i>	Discus (<i>Symphysodon</i> spp.) Angelfish (<i>Pterophyllum</i> spp.)	Level II
White spot disease	All species	Level II
Velvet disease, <i>Oodinium</i>	All species	Level II
Ulcer disease and hemorrhagic septicemia	Koi (<i>Cyprinus carpio</i>) and Goldfish (<i>Carrasius auratus</i>)	Level II
Viral encephalopathy and retinopathy	Marine foodfish including seabass (<i>Lates calcarifer</i>) and groupers (mainly <i>Epinephelus</i> spp.)	Level III
White spot syndrome viral disease of shrimps	Shrimp (<i>Penaeus monodon</i>)	Level III
Systemic iridoviral disease	Marine foodfish including groupers (mainly <i>Epinephelus</i> spp.) and mullet (<i>Mugil cephalus</i>)	Level III
<i>Streptococcus iniae</i>	Marine foodfish including seabass (<i>L. calcarifer</i>)	Level III
Gill flatworms	Marine foodfish including groupers (mainly <i>Epinephelus</i> spp.)	Level II

IV. Quarantine Services to Prevent Entry of Diseases of Aquatic Animals

IV-1. Responsible Agency and Personnel

The responsible facilities for quarantine of aquatic animals are the following:

- (1) Wildlife Regulatory Branch, Agri-Food and Veterinary Authority of Singapore
- (2) Epidemiology and Surveillance Branch, Agri-Food and Veterinary Authority of Singapore
- (3) Aquaculture Services Centre, Agri-Food and Veterinary Authority of Singapore

Quarantine and inspection are carried out at the importer's premises when live aquatic animals arrive in the country. The responsible persons conducting quarantine and inspection services are:

- (1) Mr Poh Yew Kwang
- (2) Mr Iyu Ching Ka
- (3) Mr Teo Siang Hong

Levels I and II diagnosis are employed at quarantine stations.

IV-2. Procedures and Requirements for Importation

Licensed importers from Singapore must apply for an inward declaration permit for an incoming consignment. Based on the species declared during permit application, certain species such as koi from specified countries can only be imported on the condition that the fish are quarantined at the importer's premise upon arrival and a sample from the consignment must be submitted to the inspecting officers for lab analyses stipulated by AVA. The importers are to quarantine the fish pending outcome of the lab tests.

On the day of arrival, there will be a follow-up inspection by AVA officers, as well as collection of samples from the newly imported batch for lab testing on specific diseases, e.g. koi herpesvirus. This activity is covered by law under the Singapore Animals and Birds Act, but no certificates are currently required.

IV-3. List of Quarantinable Diseases of Aquatic Animals

- a. Viral diseases: SVCV, KHVD
- b. Bacterial diseases: none
- c. Fungal diseases: epizootic ulcerative syndrome (EUS)
- d. Parasitic diseases: none
- e. Other diseases: none

V. Research and Training of Fish Health Staff for Quarantine, Diagnosis, and Surveillance of Diseases of Aquatic Animals

Current research is geared towards establishment of diagnostic tests for aquatic animal disease agents. Research is conducted at local universities and polytechnic schools. Significant fish disease work is conducted at the National University of Singapore. Following are major publications on viral diseases of fishes and shrimps:

Gibson-Kueh S, Netto P, Ngoh GH, Chang SF, Ho LL, Qin QW, Chua FHC, Ng ML, Ferguson HW. 2003. The pathology of systemic iridoviral disease in fish. *J. Comp. Pathol.* 129:111-119.

Chang SF, Ngoh-Lim GH, Kueh LFS, Qin QW, Seng EK, Sin YM. 2002. Initial investigations into two viruses isolated from marine food fish in Singapore. *Veterinary Record* 150:15-16.

Chang SF, Ngoh GH, Kueh LFS, Qin QW, Chen CL, Lam TJ, Sin YM. 2001. Development of a tropical marine fish cell line from Asian seabass (*Lates calcarifer*) for virus isolation. *Aquaculture* 192:133-145.

Training on Fish Diseases are conducted by the following:

- (1) Aquaculture Services Centre, Sembawang Research Station, Lorong Chencharu, Singapore 769194
- (2) Aquatic Animal Health Branch, Central Veterinary Laboratory, 60 Sengkang East Way, Singapore 548596

Topics covered in these training are on basic animal health course. Responsible personnel have gained experience from local and overseas seminars/workshops, and have earned postgraduate degrees. In order to support the needs for surveillance, monitoring and diagnosis, an inter-laboratory and agency attachments are necessary to disseminate and enhance hands on experience.

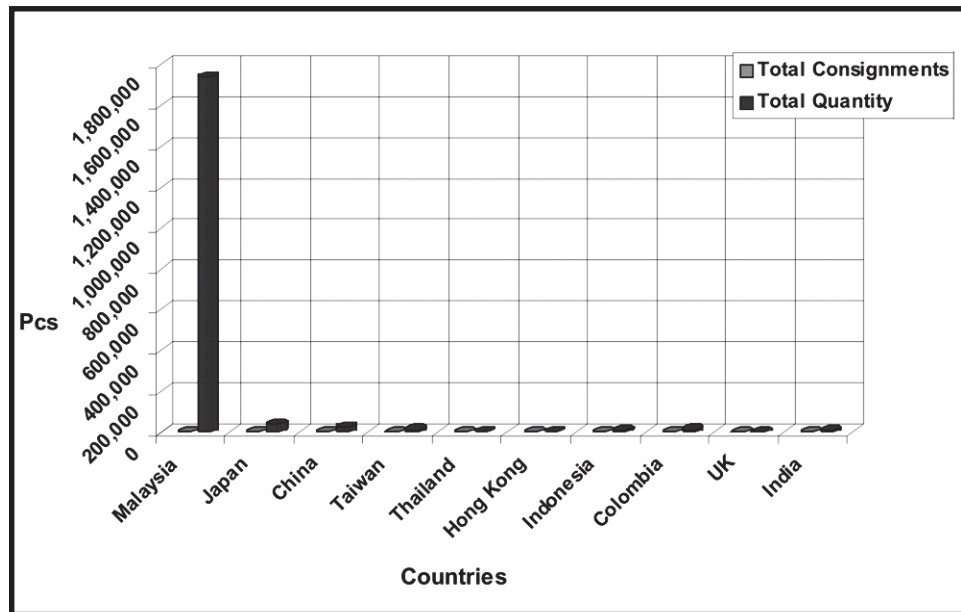


Fig. 1. Koi import from various countries in year 2001

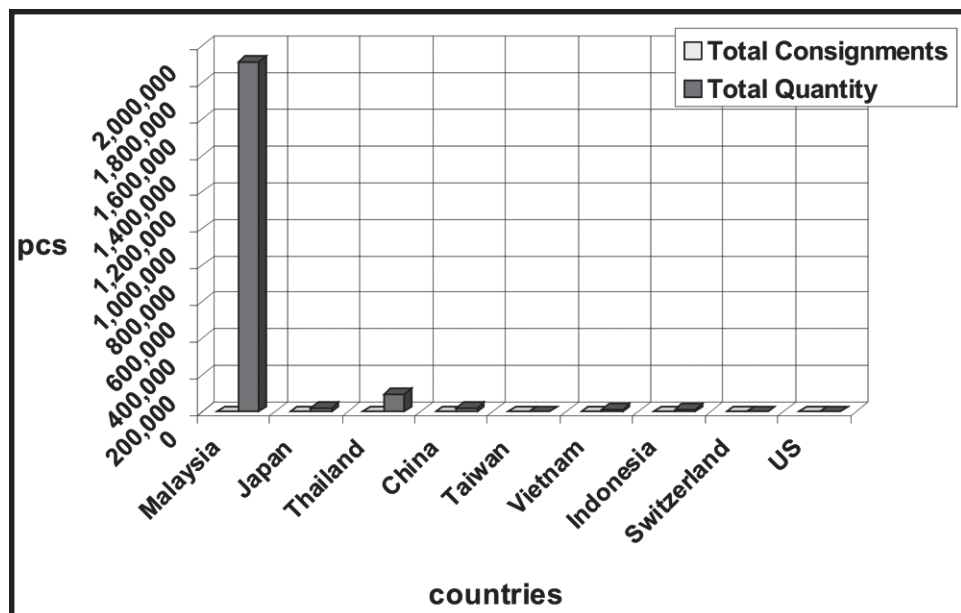


Fig. 2. Koi import from various countries in year 2002

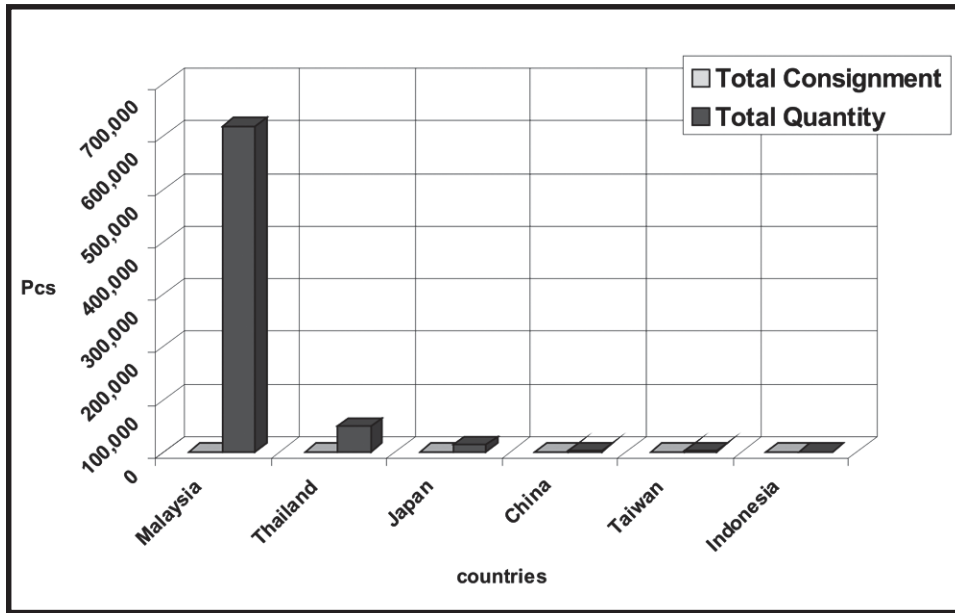


Fig. 3. Koi import from various countries in year 2003

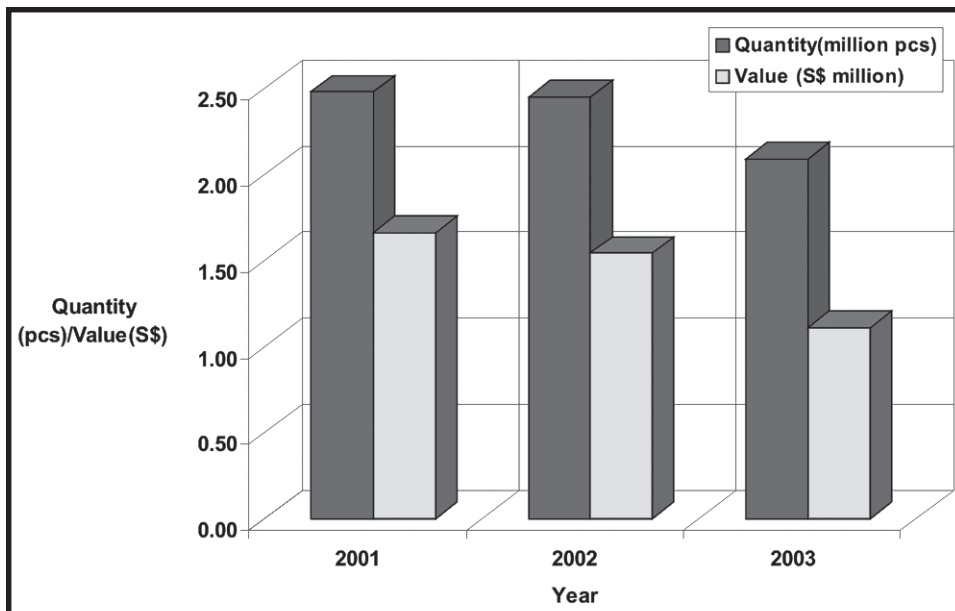


Fig. 4. Koi export statistics from 2001-2003

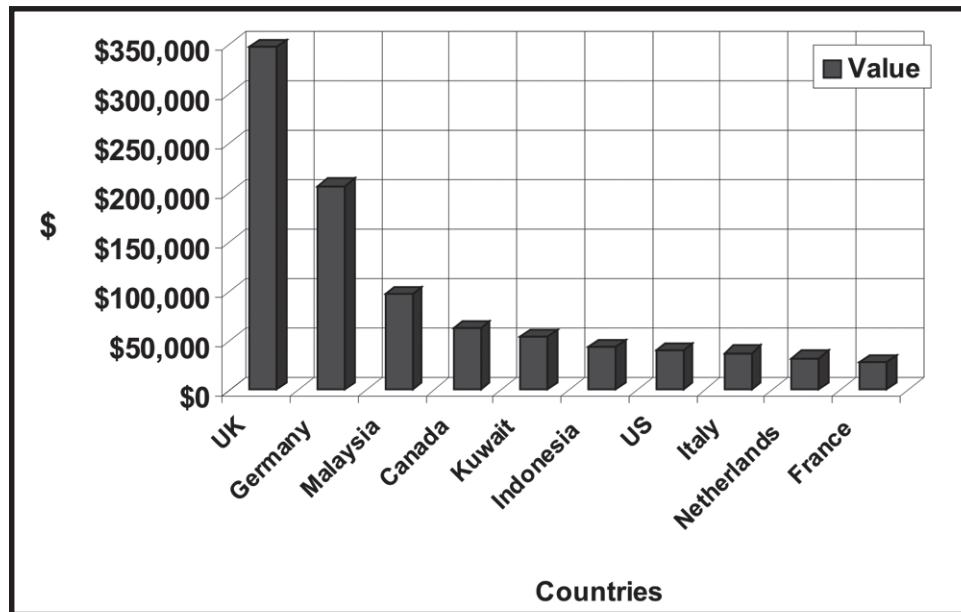


Fig. 5. Top 10 importing countries of koi from Singapore in year 2003

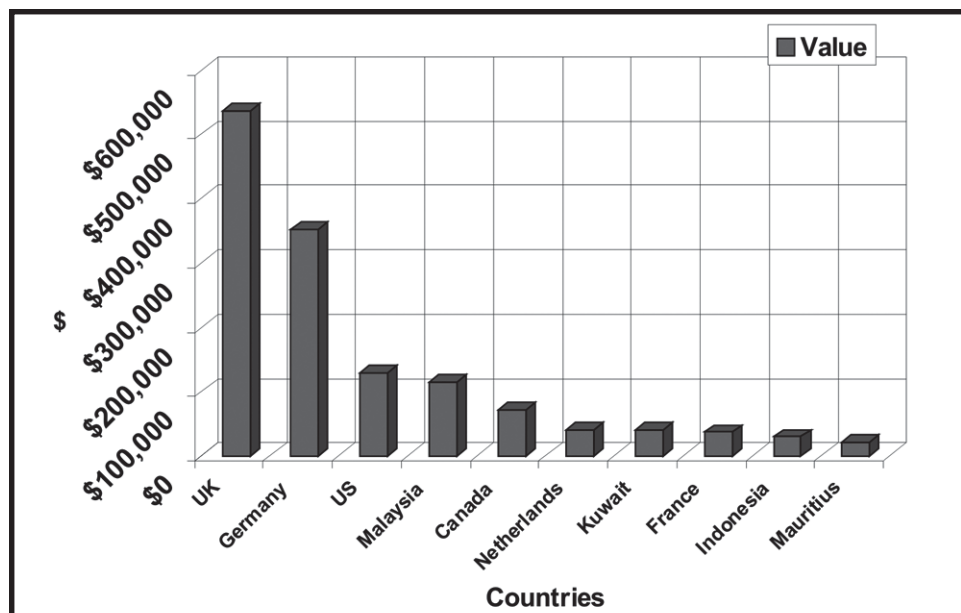


Fig. 6. Top 10 importing countries of koi from Singapore in the year 2002

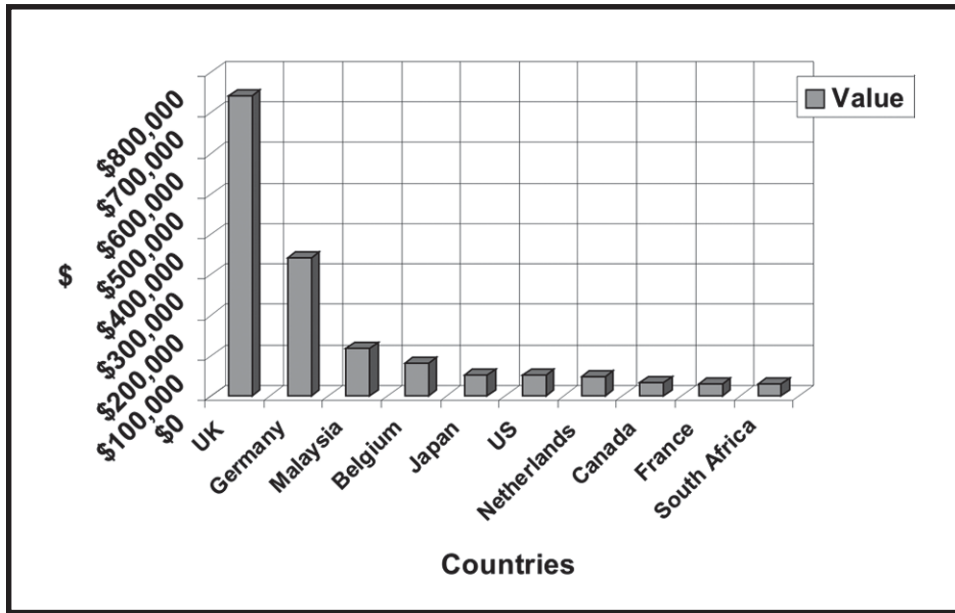


Fig. 7. Top 10 importing countries of koi from Singapore in year 2001

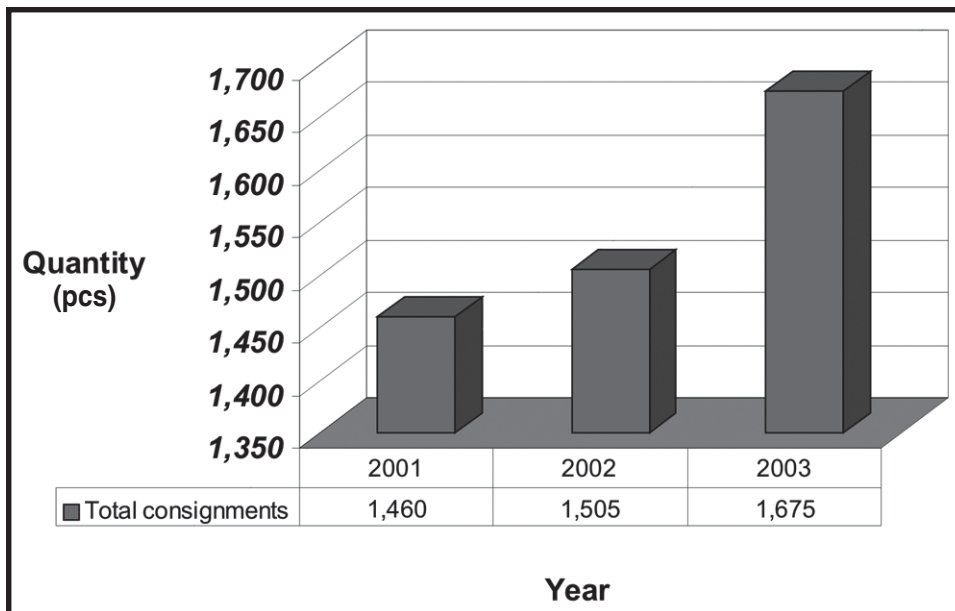


Fig. 8. Koi consignments imported from 2001-2003

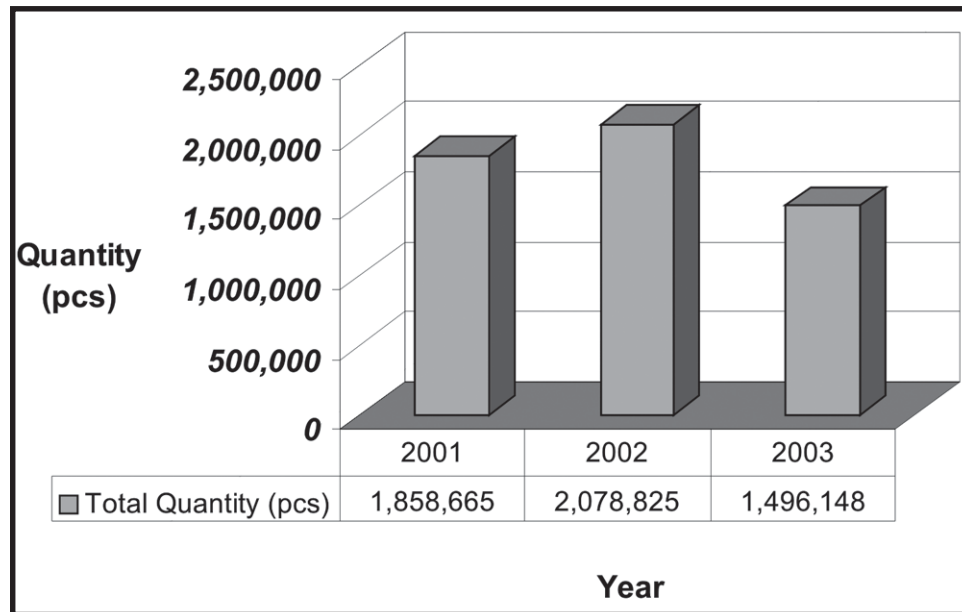


Fig. 9. The quantity of koi imported from 2001-2003