

Eichhornia crassipes  [简体中文](#) [正體中文](#)

System: Terrestrial

Kingdom	Phylum	Class	Order	Family
Plantae	Magnoliophyta	Liliopsida	Liliales	Pontederiaceae

Common name water hyacinth (English), wota haisin (English, Papua New Guinea), jacinthe d'eau (French), floating water hyacinth (English), bung el ralm (Palauan), bung el ralm (English, Palau), mbekambekairanga (Fijian), water orchid (English), wasserhyazinthe (German), jal khumbe (English, Fiji), jacinto-aquatico (Portuguese), lechuguilla (Spanish), jal kumbhi (Hindi, India), jacinto de agua (English, Puerto Rico), lila de agua (English, Dominican Republic), riri vai (English, Cook Islands), bekabe kairanga (English, Fiji), lirio acuatico (English), aguapé (Portuguese, Brazil)

Synonym *Pontederia crassipes* , Mart. (basionym)
Eichhornia speciosa , Kunth
Piaropus crassipes , (Mart.) Raf.
Heteranthera formosa
Piaropus mesomelas

Similar species *Limnobium spongia*

Summary Originally from South America, *Eichhornia crassipes* is one of the worst aquatic weeds in the world. Its beautiful, large purple and violet flowers make it a popular ornamental plant for ponds. It is now found in more than 50 countries on five continents. Water hyacinth is a very fast growing plant, with populations known to double in as little as 12 days. Infestations of this weed block waterways, limiting boat traffic, swimming and fishing. Water hyacinth also prevents sunlight and oxygen from reaching the water column and submerged plants. Its shading and crowding of native aquatic plants dramatically reduces biological diversity in aquatic ecosystems.



[view this species on IUCN Red List](#)

Species Description

E. crassipes is a free-floating aquatic macrophyte growing generally to 0.5m in height but to nearly 1 metre in height in some southeast Asian locations (Gopal 1987, in Batcher Undated). *E. Crassipes* may form dense floating mats. Its leaves are thick, waxy, rounded, and glossy and rise well above the water surface on stalks. They are broadly ovate to circular, 10-20cm in diameter, with gently incurved, often undulate sides. Leaf veins are dense, numerous, fine and longitudinal. Leaf stalks are bulbous and spongy. The stalk is erect, to 50cm long, and carries at the top a single spike of 8-15 showy flowers. The flowers have six petals, purplish blue or lavender to pinkish, the uppermost petal with a yellow, blue-bordered central splotch. Its roots are purplish black and feathery (Gopal 1987, in Batcher Undated).

E. Crassipes forms a shoot consisting of a branched, stoloniferous rhizome, 6cm in diameter and up to 30cm in length, with several short internodes. Each node bears a leaf and roots. Axillary buds, which can also form stolons, grow at an angle of 60 degrees from the rhizome and remain at that angle or bend upward in dense stands, or become horizontal in open stands. Plants on the edge of a mat form stolon buds while those in the middle may not. Stolons are purplish violet and extend up to 50cm or more in length and are highly variable in diameter (Gopal 1987, in Batcher Undated).

Leaves form as the axillary bud grows, rupturing a tubular leaf-like structure called a "prophyll." As the internode between the first leaf and the prophyll elongates, roots are produced at the node bearing the primary leaf. Foliage leaves are formed after. Foliage leaves are petiolate with a glossy sheen, and are arranged spirally, appearing to be in a rosette. Each leaf consists of a petiole, isthmus (between petiole and blade) and blade. The petiole bears a large membranous stipule, which forms a sheath around the next younger leaf. Petioles are spongy and measure up to 5cm in diameter and 30-50cm in length (maximum 125cm). They may be elongated, swollen in the middle and tapering towards the blade or they may form a bulbous float (Gopal 1987, in Batcher Undated) containing air-filled lacunate tissue (Sculthorpe 1985, in Batcher Undated).

As much as 50% of a single water hyacinth's biomass can be roots. Roots are adventitious and fibrous, 10-300cm in length. As many as 70 lateral roots per cm give the roots a feathery appearance. They are dark violet to bluish or pinkish violet (though whitish if grown in total darkness) and contain soluble pigments, including anthocyanins that may protect the root from herbivory (Gopal 1987, in Batcher Undated).

Flowers are borne terminally on a lavender spike on an elongated peduncle and are subtended by two bracts. The lower bract has a distinct blade. Each spike has 4-25 flowers (maximum 35) with 8-15 being the most common. The perianth tube is 1.5-1.75cm long with a green base and pale top. Tepals are ovate to oblong, thin, lilac and up to 4cm long. The posterior tepal (labellum) has a central bright yellow diamond-shaped region surrounded by a deep blue border with bright red radiating lines. When young, this labellum has a green spot. There are six stamens (sometimes 5 or 7) having curved filaments with glandular hairs. Three are small and close to the perianth tube. Anthers are violet and measure 1.4-2.2mm long (Gopal 1987, in Batcher Undated).

The fruit is a thin-walled capsule enclosed in a relatively thick-walled hypanthium developed from the perianth tube. Mature seeds can number 450 per capsule, are 4 x 1mm, with an oval base and tapering apex. The coat has 12-15 longitudinal ridges (Gopal 1987, in Batcher Undated).

Notes

A useful resource on the spread, impact and control of water hyacinth is: [M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig \(eds.\). Biological and Integrated Control of Water Hyacinth *Eichhornia crassipes* \(Proceedings PR102 2001\).](#)

Uses

There has been some use of *E. crassipes* for the removal of nutrients and heavy metals from sewage and sludge ponds (bioremediation) (Vietmeyer 1975, in Batcher Undated). In Kenya the experimental use of water hyacinth as an organic fertiliser and animal feed has been undertaken in places such as flower farms (The Nation Nairobi 2004). However there is some controversy as to the effect of the fertiliser on the soil due to its highly alkaline PH value (>9).

In China the weed was widely used as animal food from the 1950s to the 1970s. As at that time, the economy in rural areas was very depressed and there was great shortage of food for animals. It was also used for fertiliser in a few areas. Since the end of 1980s the use of water hyacinth has fallen greatly and its sole use now is for feeding ducks and as a test plant for the purification of polluted water (Jianqing et al. 2001).

Habitat Description

Water hyacinth now flourishes in all continents but Europe (Lindsey and Hirt 1999, in Williams Undated) where it does exist but doesn't flourish as a result of climatic conditions. *E. crassipes* grows in shallow temporary ponds, wetlands and marshes, sluggish flowing waters, lakes, reservoirs and rivers (Batcher Undated). Plants can tolerate extremes of water level fluctuation and seasonal variations in flow velocity, and extremes of nutrient availability, pH, temperature and toxic substances (Gopal 1987, in Batcher Undated).

Growth by water hyacinth is largely exuberated by nutrient rich waters, particularly those rich in nitrogen, phosphorus and potassium (FAO Undated). Originating from the tropical regions of South America, this weed exhibits frost sensitivity (Biosecurity New Zealand Undated) and does not tolerate brackish water (Holm et al. 1977). Salinity can limit or modify its distribution (for example, in the coastal lagoons of West Africa, where water hyacinth accumulates during the wet season and is reduced to saline regions during the dry season).

Reproduction

Water hyacinth reproduces both vegetatively and sexually (Penfound and Earle 1948, Gopal and Sharma 1981, in Langeland and Burks Undated.). The plant flowers year-round in mild climates, producing abundant amounts of long-lived seeds (Penfound and Earle 1948; Sculthorpe 1971; FAO Undated). However it has been reported that sexual reproduction is limited and although the plant flowers profusely few observers have seen seeds or seedlings in the field (Gopal 1987, in Batcher Undated). Maximum fruiting occurs in 90% humidity and at 22.5°C to 35°C (Gopal 1987, in Batcher Undated). Several species of bee pollinate the flowers and several researchers report a high level of self-compatibility (Batcher Undated). High light intensity and altering high and low temperatures (5°C to 40°C) favour germination (Batcher Undated).

Vegetative reproduction is more important. Water hyacinth grows and spreads rapidly under favourable temperature and nutrient conditions (Batcher Undated). Stolon buds develop that bear offshoots from axillary buds and stolons are readily distributed by water currents, winds and boat traffic.

General Impacts

E. crassipes is one of the world's worst weeds (Holm *et al.* 1977, in Room and Fernando 1992). People have spread it to most tropical and subtropical regions in the world where it forms thick mats that cover rice paddies, clog irrigation channels, impede navigation, halt fishing, sweep away buildings during floods and foster breeding by disease-transmitting mosquitoes (Carter 1950, Chow *et al.* 1955, Williams 1956, Kotalawala 1976, in Room and Fernando 1992). Doubling in biomass every 6 to 18 days, the exact time being dependent on location and time of year (Lindsey and Hirt 1999, in Williams Undated), this weed rapidly invades water-ways and has caused problems for people around the globe. Populations living along Lake Victoria in Africa have been negatively affected by the weed which clogged water ways, resulted in the closure of a hydroelectric plant at Jinga and increased cases of vector borne diseases (Williams Undated). In Papua New Guinea water hyacinth disrupted water transport by canoes, dinghies and larger vessels, obstructing people's access to schools, health centres, government services, food gardens, fishing grounds and local markets (Julien and Orapa 2001, in Plant Protection Services 2006).

Invasive plant theory predicts that a release from environmental constraints due to altered hydrology can often lead to a successful invasion (Galatowitsch *et al.* 1999, in Toft 2000). In other words: disrupted or modified environments that have been altered by humans pave the way for invasive species' establishment. Disruptions of wetland ecosystems involving irrigation canals, hydroelectric projects and construction of artificial lakes have made areas particularly susceptible to invasion by water hyacinth (Barret 1989, in Toft 2000). Dams are thought to have exuberated the effects of water hyacinth in the Sacramento/San Joaquin Delta in California, where the weed was present in 1947 but did not begin to hinder boat traffic until the 1980s (Toft 2000).

Environmental problems associated with the water hyacinth are exuberated in warm areas where the weed grows throughout the year and develops into dense large, free-floating, monospecific islands or mats which compete with other aquatic species for light, nutrients and oxygen (Gopal 1987, in Batchner Undated; FDEP Undated; Toft 2000). These mats shade out native submersed plant species and uproot native emergent species (FDEP Undated). They reduce dissolved oxygen levels and light, significantly altering ecosystems and plant and animal communities. Low oxygen levels harms native fish populations (FDEP Undated) and fish spawning areas may be reduced, as well as critical waterfowl habitat degraded (Schmitz *et al.* 1993, in Batchner Undated). Mats also deposit large amounts of organic matter which increases the organic content of sediments and greatly accelerates succession patterns, allowing emergent and riparian vegetation to colonise (Penfound and Earle 1948, Trivedy *et al.* 1978, Gopal 1987, Woods 1997, in Toft 2000).

E. crassipes has a detrimental impact on water use by humans. In drainage canals it reduces the flow, which can result in flooding and damage to canal banks and structures. In irrigation canals it impedes flow and clogs intakes of pumps used for irrigation. Water flow patterns have been disrupted in utility cooling reservoirs. Water hyacinth interferes with navigation of both recreational and commercial craft, negatively impacting fisherman, sports-fisherman, water-skiers and swimmers in recreational waters. Limitations on water use can reduce real estate values and tourism (Batchner Undated). Economic losses may be the result of attempts to control the weed. Manual removal of the weed in China alone cost an estimated 100 million RMB yuan (US\$12m) each year but was neither economic nor effective (Jianqing *et al.* 2001).

Management Info

Control strategies must address both watershed management (to reduce nutrient supply) and direct weed control (eg: by introduction of biological control agents) (FAO Undated). Nutrient run-off into infestations should be minimised. Heavy nutrient loadings in water come from erosion of cultivated land, cattle yards, domestic and municipal sewerage outfalls and wastewater discharges from factories. This nutrient inflow can be reduced or prevented by treating water before discharging it into waterways (Burton 2005).

Preventative measures: A [Risk assessment of *Eichhornia crassipes*](#) for Australia and the Pacific was prepared by Pacific Island Ecosystems at Risk (PIER) using the Australian risk assessment system (Pheloung, 1995). The result is a score of 14 and a recommendation of: reject the plant for import (Australia) or species likely to be a pest (Pacific).

Mechanical: Small infestations of *E. crassipes* can be controlled by pulling (Randall and Rice. Unpub., in Batcher Undated). Specially designed harvesting machines may also be utilised. Permanent drainage of the water body will control *E. crassipes* (Smith *et al.* 1984) but may not be appropriate if the area is environmentally valuable.

Click here for [Information about chemical and biological control](#)

Pathway

In the 1950s and 1960s, water hyacinth was distributed widely into almost all provinces in China for animal food. After artificial transplanting and mass rearing and breeding, water hyacinth was distributed to further areas in the 1970s (Jianqing *et al.* 2001). Water hyacinth has an attractive purple flower which has made it a favourite amongst ornamental pond and botanical garden enthusiasts. As a result humans have spread it widely and due to its fast growth rate it now flourishes in all continents but Europe. Most spread can be attributed to deliberate planting of water hyacinth in ponds or dams as an ornamental, or use in aquariums. Unwanted plant material is discarded into creeks, rivers and dams is a major mode of dispersal (Burton 2005). Water hyacinth has an attractive purple flower which has made it a favourite amongst ornamental pond and botanical garden enthusiasts. As a result humans have spread it widely and due to its fast growth rate it now flourishes in all continents but Europe (Lindsey and Hirt 1999, in Williams Undated). Seeds are translocated by machinery (Burton 2005).

Principal source:

Compiler: IUCN/SSC Invasive Species Specialist Group (ISSG)

Review:

Publication date: 2006-08-04

ALIEN RANGE

[1] AMERICAN SAMOA

[1] BAHAMAS

[1] BENIN

[1] BRAZIL

[1] BURKINA FASO

[1] CAMBODIA

[1] CAYMAN ISLANDS

[7] CHINA

[1] COLOMBIA

[1] CONGO, THE DEMOCRATIC REPUBLIC OF THE

[1] COSTA RICA

[1] CUBA

[1] ECUADOR

[7] AUSTRALIA

[1] BANGLADESH

[1] BERMUDA

[1] BRUNEI DARUSSALAM

[1] BURUNDI

[1] CAMEROON

[1] CHILE

[1] CHRISTMAS ISLAND

[1] CONGO

[2] COOK ISLANDS

[1] COTE D'IVOIRE

[1] DOMINICAN REPUBLIC

[1] EGYPT

[1] EQUATORIAL GUINEA	[1] ETHIOPIA
[2] FIJI	[4] FRENCH POLYNESIA
[1] GABON	[1] GHANA
[1] GUADELOUPE	[1] GUAM
[1] GUATEMALA	[1] GUINEA
[1] GUINEA-BISSAU	[1] HAITI
[1] HONDURAS	[1] HONG KONG
[1] INDIA	[2] INDONESIA
[1] ISRAEL	[1] JAMAICA
[1] JAPAN	[1] JORDAN
[2] KENYA	[1] LAKE VICTORIA
[1] LAO PEOPLE'S DEMOCRATIC REPUBLIC	[1] LEBANON
[1] LIBERIA	[1] MADAGASCAR
[1] MALAWI	[1] MALAYSIA
[1] MALDIVES	[2] MARSHALL ISLANDS
[1] MARTINIQUE	[1] MAURITIUS
[1] MEXICO	[4] MICRONESIA, FEDERATED STATES OF
[1] MOZAMBIQUE	[1] MYANMAR
[1] NAURU	[1] NEW CALEDONIA
[1] NEW ZEALAND	[1] NICARAGUA
[1] NIGERIA	[1] NORFOLK ISLAND
[2] NORTHERN MARIANA ISLANDS	[3] PALAU
[1] PANAMA	[1] PAPUA NEW GUINEA
[1] PERU	[1] PHILIPPINES
[1] PORTUGAL	[1] PUERTO RICO
[1] REUNION	[1] RIVER NILE
[1] RUSSIAN FEDERATION	[1] RWANDA
[1] SAINT LUCIA	[1] SAMOA
[1] SENEGAL	[1] SIERRA LEONE
[1] SINGAPORE	[1] SOLOMON ISLANDS
[1] SOUTH AFRICA	[1] SRI LANKA
[1] STATE OF PALESTINE	[1] SUDAN
[1] SWAZILAND	[1] SYRIAN ARAB REPUBLIC
[1] TAIWAN	[2] TANZANIA, UNITED REPUBLIC OF
[1] THAILAND	[1] TOGO
[2] UGANDA	[30] UNITED STATES
[1] UNITED STATES MINOR OUTLYING ISLANDS	[1] VANUATU
[1] VENEZUELA	[1] VIET NAM
[2] VIRGIN ISLANDS, BRITISH	[1] ZAMBIA
[2] ZIMBABWE	

Red List assessed species 21: EX = 1; CR = 4; EN = 3; VU = 5; NT = 4; LC = 4;

Allotoca diazi CR	Aythya innotata CR
Aythya nyroca NT	Biomphalaria tchadiensis EN
Chloropeta gracilirostris VU	Citharidium ansorgii LC
Cyprinus intha EN	Dendrocygna bicolor LC
Haliaeetus leucorhynchus VU	Microrasbora rubescens EN
Mutela franci VU	Ottelia scabra NT
Oxyura maccoa NT	Pollimyrus petricolus LC
Puntius compressiformis CR	Rhodonessa caryophyllacea CR
Rynchops albicollis VU	Steatocranus irvinei NT
Tachybaptus pelzelni VU	Tachybaptus rufolavatus EX
Villorita cyprinoides LC	

BIBLIOGRAPHY

67 references found for *Eichhornia crassipes*

Management information

[Batcher, Michael S. \(no date\) Element Stewardship Abstract for *Eichhornia crassipes* \(Martius\) Solms. The Nature Conservancy, Virginia, USA.](#)

Summary: Contains names, description, diagnostic characteristics, pest weed status, references and a stewardship summary that includes information on habitat, ecology, biology, impacts, management, monitoring, research.

[Champion, P. Clayton, J. and Rowe, D. 2002. Alien Invaders Lake Managers Handbook. Ministry for the Environment.](#)

Summary: Available from: <http://www.mfe.govt.nz/publications/water/lm-alien-invaders-jun02.pdf> [Accessed 3 February 2005]

[Champion, P.D.; Clayton, J.S. 2000. Border control for potential aquatic weeds. Stage 1. Weed risk model. Science for Conservation 141.](#)

Summary: This report is the first stage in a three-stage development of a Border Control Programme for aquatic plants that have the potential to become ecological weeds in New Zealand.

Available from: <http://www.doc.govt.nz/upload/documents/science-and-technical/sfc141.pdf> [Accessed 13 June 2007]

[Champion, P.D.; Clayton, J.S. 2001. Border control for potential aquatic weeds. Stage 2. Weed risk assessment. Science for Conservation 185. 30 p.](#)

Summary: This report is the second stage in the development of a Border Control Programme for aquatic plants that have the potential to become ecological weeds in New Zealand. Importers and traders in aquatic plants were surveyed to identify the plant species known or likely to be present in New Zealand. The Aquatic Plant Weed Risk Assessment Model was used to help assess the level of risk posed by these species. The report presents evidence of the various entry pathways and considers the impact that new invasive aquatic weed species may have on vulnerable native aquatic species and communities.

Available from: <http://www.doc.govt.nz/upload/documents/science-and-technical/SFC185.pdf> [Accessed 13 June 2007]

[Collins, J.N., May M., Grosso C. 2003. Water hyacinth *Eichhornia crassipes*. Practical Guidebook to the Control of Invasive Aquatic and Wetland Plants of the San Francisco Bay - Delta Region.](#)

Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.

Available from: <http://legacy.sfei.org/nis/hyacinth.html> [Accessed 22 May 2010].

[The Guidebook](#) is available from: <http://legacy.sfei.org/nis/index.html>

Fact sheet from the Department of Natural Resources, Queensland, Australia. (PDF format)

[Fayad, Y.H., Ibrahim, A.A., El-Zoghby, A.A. and Shalaby, F.F. 2001. Ongoing Activities in the Biological Control of Water Hyacinth in Egypt. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig \(eds.\). Biological and Integrated Control of Water Hyacinth *Eichhornia crassipes* \(Proceedings PR102 2001\).](#)

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

[Florida Department of Environmental Protection \(FDEP\). Undated. Weed Alert: Water Hyacinth: *Eichhornia crassipes*. Bureau of Invasive Plant Management.](#)

Summary: Available from: <http://www.dep.state.fl.us/lands/invaspec/2ndlevpgs/pdfs/hyacinth.pdf> [Accessed 27 April 2006]

Gee II, David E., pers. comm. 2006. Wildlife Biologist, Guam Division of Aquatic & Wildlife Resources and Guam team member of the Pacific Invasives Learning Network (PILN).

[Hill, M.P. and Olckers, T. 2001. Biological Control Initiatives against Water Hyacinth in South Africa: Constraining Factors, Success and New Courses of Action. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig \(eds.\). Biological and Integrated Control of Water Hyacinth *Eichhornia crassipes* \(Proceedings PR102 2001\).](#)

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

[Jianqing, D., Ren, W., Weidong, F. and Guoliang, Z. 2001. Water Hyacinth in China: Its Distribution, Problems and Control Status. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig \(eds.\). Biological and Integrated Control of Water Hyacinth *Eichhornia crassipes* \(Proceedings PR102 2001\).](#)

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

[Jiménez, Maricela Martínez. 2003. Progress on water hyacinth \(*Eichhornia crassipes*\) management. In Weed Management for Developing Countries Addendum 1 \(Ed\) by R. Labrada. Food And Agriculture Organisation Of The United Nations \(FAO\) Rome](#)

Summary: Available from: http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/Y5031E/y5031e0c.htm [Accessed 19 May 2005]

[Julien, M.H. 2001. Biological Control of Water Hyacinth with Arthropods: a Review to 2000. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig \(eds.\). Biological and Integrated Control of Water Hyacinth *Eichhornia crassipes* \(Proceedings PR102 2001\).](#)

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

Julien, M. H. (ed.) 1992. Biological control of weeds: A world catalogue of agents and their target weeds (3rd edition). CAB International, Wallingford, UK. pp. 77-82, 126, 135-136.

Kueffer, C. and Mauremootoo, J., 2004. Case Studies on the Status of Invasive Woody Plant Species in the Western Indian Ocean. 3. Mauritius (Islands of Mauritius and Rodrigues). Forest Health & Biosecurity Working Papers FBS/4-3E. Forestry Department, Food and Agriculture Organization of the United Nations, Rome, Italy.

Le Bourgeois, T. 2006. Dossier technique concernant *Neochetina eichhorniae* et *N. bruchi* (Coleoptera-Curculionidae) et *Neohydronomus affinis* (Coleoptera-Curculionidae) pour une demande d'importation et de lâcher la Réunion en vue de la lutte biologique contre *Eichhornia crassipes* (Pontederiaceae) et *Pistia stratiotes* (Araceae), plantes aquatiques exotiques envahissantes des étendues d'eau douce littorales. CIRAD/UMR PVBMT. 35p

Summary: Rapport technique présentant les enjeux de la lutte biologique contre la Jacinthe d'eau et la Laitue d'eau la Réunion et les différentes étapes du programme.

Mack, R. N and W. M. Lonsdale., 2002. Eradicating invasive plants: Hard-won lessons for islands. In *Turning the tide: the eradication of invasive species*: 311-318. Veitch, C.R. and Clout, M.N.(eds). IUCN SSC Invasive Species Specialist Group. IUCN. Gland. Switzerland and Cambridge. UK.

Summary: Uses *Clidemia hirta* in Hawaii as an eradication case study. *Clidemia* is in the Melastomataceae and somewhat similar ecologically to *miconia*.

Eradication case study in *Turning the tide: the eradication of invasive species*.

Moorhouse, T.M., Agaba, P. and McNabb, T.J. 2001. Recent Efforts in Biological Control of Water Hyacinth in the Kagera River Headwaters of Rwanda. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig (eds.). *Biological and Integrated Control of Water Hyacinth Eichhornia crassipes (Proceedings PR102 2001)*.

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

National Pest Plant Accord, 2001. Biosecurity New Zealand.

Summary: The National Pest Plant Accord is a cooperative agreement between regional councils and government departments with biosecurity responsibilities. Under the accord, regional councils will undertake surveillance to prevent the commercial sale and/or distribution of an agreed list of pest plants.

Available from: <http://www.biosecurity.govt.nz/pests-diseases/plants/accord.htm> [Accessed 11 August 2005]

Navarro, L.A. 2001. Water Hyacinth Information Partnership for Africa and the Middle East. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig (eds.). *Biological and Integrated Control of Water Hyacinth Eichhornia crassipes (Proceedings PR102 2001)*.

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

Pacific Pest Info Newsletter. Published by the Secretariat of the Pacific Community: Plant Protection Service, Private Mail Bag, Suva, Fiji Islands. Tel: (679) 3370-733; Fax: (679) 3370-021.

Pacific Pest Info No. 51, August 2004. ISSN: 1728-5291. Secretariat of the Pacific Community. Plant Protection Service.

Summary: Available from: http://www.spc.int/pps/PestInfos/PestInfo51_Aug04.pdf [Accessed May 20 2005]

Phiri, P.M., Day, R.K., Chimatiro, S., Hill, M.P., Cock, M.J.W., Hill, M.G. and Nyando, E. Progress with Biological Control of Water Hyacinth in Malawi. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig (eds.). *Biological and Integrated Control of Water Hyacinth Eichhornia crassipes (Proceedings PR102 2001)*.

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

Photos and additional information at University of Florida, Center for Aquatic and Invasive Plants.

Raulerson, Dr. Lynn., pers. comm. 2006. University of Guam (Biology). From information collected by David E. Gee II, Wildlife Biologist. Guam Division of Aquatic & Wildlife Resources and Guam team member of the Pacific Invasives Learning Network (PILN).

Room, P.M. and Fernando, I.V.S. 1992. Weed Invasions Countered by Biological Control: *Salvinia molesta* and *Eichhornia crassipes* in Sri Lanka, *Aquatic Botany* 42: 99 - 107.

Summary: This paper gives an excellent outline of the biological control of *S. molesta* in Sri Lanka between 1982 and 1990, including a history of the weed in the country, an overview of the release and distribution of the weevil (*Cyrtobagous salviniae*) and an summary of the results and most interesting findings. Also mentions the performance of *Neochetina eichhorniae* as a biological control agent for water hyacinth (*Eichhornia crassipes*).

Royal New Zealand Institute of Horticulture (RNZIH), 2005. Water hyacinth *Eichhornia crassipes*

Summary: Available from: http://www.rnzih.org.nz/pages/nppa_089.pdf [Accessed 1 October 2005]

Shabana, Y.M., Elwakil, M.A. and Charudattan, R. Biological Control of Water Hyacinth by a Mycoherbicide in Egypt. In: M.H. Julien, M.P. Hill, T.D. Center and Ding Jianquig (eds.). *Biological and Integrated Control of Water Hyacinth Eichhornia crassipes (Proceedings PR102 2001)*

Summary: Available from: <http://www.aciar.gov.au/web.nsf/doc/JFRN-5J4725> [Accessed 27 April 2006]

Swaziland s Alien Plants Database., Undated. *Eichhornia crassipes*

Summary: A database of Swaziland s alien plant species.

The Nation (Nairobi) March 25 2004. Local Scientist Patents Hyacinth Processing Machine. Dan Teng o Nairobi.

Summary: Available from: <http://allafrica.com/stories/200403250465.html> Accessed on 10:18 AM 3/29/2004].

The Nature Conservancy photos and Stewardship Abstract.

Varnham, K. 2006. Non-native species in UK Overseas Territories: a review. JNCC Report 372. Peterborough: United Kingdom.

Summary: This database compiles information on alien species from British Overseas Territories.

Available from: <http://www.jncc.gov.uk/page-3660> [Accessed 10 November 2009]

Waterhouse, D. F. 1994. Biological control of weeds: Southeast Asian prospects. Australian Centre for International Agricultural Research, Canberra. p. 68-83.

Waterhouse, D. F. and K. R. Norris. 1987. Biological control: Pacific prospects. Inkata Press, Melbourne. p. 332-341.

Williams, A.E. Undated. Water Hyacinth (*Eichhornia crassipes*). University of Waterloo (Canada) and FIRRI (Uganda) Collaborative Project.

Summary: Available from: <http://freespace.virgin.net/ae.williams/WH.htm> [Accessed 27 April 2006]

Wilson, Colin, Wildlife Management Officer, Department of Infrastructure, Planning and Environment, Parks & Wildlife Service, Northern Territory, Australia.

Summary: Compiler of original GISD profile of *Chromolaena odorata*.

General information

Biosecurity New Zealand. Undated. Water hyacinth: *Eichhornia crassipes*

Summary: Available from: <http://www.biosecurity.govt.nz/pest-and-disease-response/pests-and-diseases-watchlist/water-hyacinth> [Accessed 27 April 2006]

Brendonck, L., Maes, J., Rommens, W., Dekeza, N., Nhwatiwa, T., Maxwell, B., Callebaut, V., Phiri, C., Moreau, K., Gratwicke, B., Stevens, M., Alyn, N., Holsters, E., Ollevier, F. and Marshall, B. 2003. The impact of water hyacinth (*Eichhornia crassipes*) in a eutrophic subtropical impoundment (Lake Chivero, Zimbabwe). *Arch. Hydrobiol.* 158(3): 389 - 405.

Summary: Available from: <http://users.ox.ac.uk/~speight/Impact%20of%20Hyacinth%20on%20fish%20in%20Zimbabwe.pdf> [Accessed 27 April 2006]

Burton, J. 2005. *Water hyacinth Eichhornia crassipes (Agfact P7.6.43)*. New Department of Primary Industries.

Summary: Available from:

<http://www.ojdinfo.nsw.gov.au/reader?MlvalObj=21754&doctype=document&MltypeObj=application/pdf&ext=.pdf> [Accessed 27 April 2006]

CONABIO. 2008. Sistema de información sobre especies invasoras en México. Especies invasoras - Plantas. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. Fecha de acceso.

Summary: English:

The species list sheet for the Mexican information system on invasive species currently provides information related to Scientific names, family, group and common names, as well as habitat, status of invasion in Mexico, pathways of introduction and links to other specialised websites. Some of the higher risk species already have a direct link to the alert page. It is important to notice that these lists are constantly being updated, please refer to the main page (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), under the section Novedades for information on updates.

Invasive species - Plants is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Plantas [Accessed 30 July 2008]

Spanish:

La lista de especies del Sistema de información sobre especies invasoras de México cuenta actualmente con información acerca de nombre científico, familia, grupo y nombre común, así como hábitat, estado de la invasión en México, rutas de introducción y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la página de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualización, por favor consulte la portada (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), en la sección novedades, para conocer los cambios.

Especies invasoras - Plantas is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Plantas [Accessed 30 July 2008]

Conservatoire Botanique National De Mascarin (BOULET V. coord.) 2007. - *Eichhornia crassipes* Index de la flore vasculaire de la Réunion (Trachophytes) : statuts, menaces et protections. - Version 2007.1

Summary: Base de données sur la flore de la Réunion. De nombreuses informations très utiles.

Available from: <http://flore.cbnm.org/index2.php?page=taxon&num=f35a2bc72dfdc2aae569a0c7370bd7f5> [Accessed 26 March 2008]

Department of Environmental Affairs and Tourism. 1999. *National State of the Environment Report - South Africa: Fresh Water Systems and Resources: Impacts*.

Summary: Available from: <http://www.ngo.grida.no/soesa/nsoer/issues/water/impact.htm> [Accessed 27 April 2006]

Don, L.D. 2005. *Asian-Pacific Alien Species Database*.

Summary: Available from: <http://pasd-niaes.dc.affrc.go.jp/> [Accessed 27 April 2006]

Flora of the Marquesas. Undated.

Summary: Available from:

<http://ravenel.si.edu/botany/pacificislandbiodiversity/marquesasflora/speciesdescr.cfm?genus=Eichhornia&specific epithet=crassipes&rank=&epithet1=> [Accessed 27 April 2006]

Fournet, J. 2002. Flore illustrée des phanogames de guadeloupe et de Martinique. CIRAD-Gondwana editions.

Holm, Leroy G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The world's worst weeds: Distribution and Biology. East-West Center/University Press of Hawaii. pp. 72-77.

Information from the Purdue University NewCROP web site.

Information on the Weeds in New Zealand web site.

ITIS (Integrated Taxonomic Information System). 2004. *Online Database Eichhornia crassipes*

Summary: An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.

Available from:

http://www.cbif.gc.ca/pls/itasca/taxastep?king=every&p_action=containing&taxa=Eichhornia+crassipes&p_format=&p_ifx=plgt&p_lang= [Accessed December 31 2004]

Langeland, K.A. and Burks, K. C (Eds) 1998. *Identification and Biology of Non-Native Plants in Florida's Natural Areas*. University of Florida. *Eichhornia crassipes*

Summary: Information on plants that pose threats to natural resource areas in Florida.

Available from: http://www.fleppc.org/ID_book/Eichhornia%20crassipes.pdf [Accessed 30 December 2004]

Lompo-Ouedraogo, Z., pers.comm., 2005. From: *Especies Exotiques Envahissantes: Etat Des Lieux Au Burkina Faso*, a report to the Group of Experts on Invasive Alien Species meeting in Palma de Majorca (Spain), 9-11 June 2005.

MacKee, H.S. 1994. Catalogue des plantes introduites et cultivées en Nouvelle-Calédonie, 2nd edn. MNHN, Paris.

Summary: Cet ouvrage liste 1412 taxons (espèces, sous espèces et variétés) introduits en Nouvelle-Calédonie. L'auteur précise dans la majorité des cas si l'espèce est cultivée ou naturalisée.

Marchante, H. 2005. *Invasive plant species in Portugal*. In: Brunel, S. (Ed.). 2005. *Invasive Plants in Mediterranean Type Regions of the World (Plantes envahissantes dans les régions méditerranéennes du monde)*. *Proceedings of the International Workshop (Actes de l'atelier de travail international)*. Council of Europe Publishing.

Summary: Available from: http://www.iucn.org/places/medoffice/invasive_species/docs/proceedings_ws.pdf [Accessed 27 April 2006]

Meyer, Jean-Yves & Loope, Lloyd & Sheppard, A. & Munzinger, Jérôme & Jaffré, Tanguy. (2006). Les plantes envahissantes et potentiellement envahissantes dans l'archipel néo-calédonien : première évaluation et recommandations de gestion.

Meyer, J.-Y. 2000. *Invasive plants in the Pacific Islands*. In: *The Invasive Species in the Pacific: A Technical Review and Draft Regional Strategy*. Sherley, G. (tech. ed). Published in June 2000 by the South Pacific Regional Environment Programme (SPREP).

Summary: Resource that includes the distribution of invasive species throughout the Pacific Islands.

Natural Research Conservation Service (NRCS). Undated. *Plants Profile: Eichhornia crassipes*. United States Department of Agriculture (USDA): Natural Research Conservation Service (NRCS).

Summary: Available from: <http://plants.usda.gov/java/profile?symbol=EICR> [Accessed 27 April 2006]

Global Invasive Species Database (GISD) 2025. Species profile *Eichhornia crassipes*. Available from:

<https://www.iucngisd.org/gisd/species.php?sc=70> [Accessed 16 September 2025]

[Oudhia, P., 2001. Traditional medicinal knowledge about a noxious weed, jal kumbhi \(*Eichhornia crassipes*\), in Chhattisgarh \(India\).](#)

Summary: Uses and notes on *Eichhornia crassipes* in India.

Available from: <http://aquat1.ifas.ufl.edu/aq-w01-22.html> [Accessed on March 9, 2004].

Parsons, W. T. and E. G. Cuthbertson. 1992. Noxious weeds of Australia. Indata Press, Melbourne/Sydney. p. 139-144.

Photo and additional information at the University of Guam Plants of Guam web site.

[Plant Protection Services. 2006. *Water Hyacinth \(Eichhornia crassipes\)*](#)

Summary: Available from: <http://www.spc.org.nc/pps/> [Accessed 27 April 2006]

[Plants for a Future. 2004. *Eichhornia crassipes* - \(C.Mart.\) Solms. *Water Hyacinth*.](#)

Summary: Available from: <http://www.pfaf.org/database/plants.php?Eichhornia+crassipes> [Accessed 27 April 2006]

Rao, V.S. (1988) Principles of weed science. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi (India), 544 pp.

[Schanzer, L.A., Shvetsov, A.N. and Ivanov, M.V. 2003. *Eichhornia crassipes* and *Pistia stratiotes* are Spreading in Ponds and Rivers of Moscow and Moscow Region, *Biological series* 108\(5\).](#)

Summary: Available from: http://herba.msu.ru/russian/journals/bmsn/108/2003_5.html [Accessed 27 April 2006]

Stone, Benjamin. 1970. The flora of Guam. Micronesica 6:116.

[Toft, J.D. 2000. *Community Effects of the Non-Indigenous Aquatic Plant Water Hyacinth \(Eichhornia crassipes\) in the Sacramento/San Joaquin Delta, California*. Thesis \(MSc\). University of Washington.](#)

Summary: Available from: http://depts.washington.edu/calfed/toft_ms.pdf [Accessed 27 April 2006]

[University of Florida. 1997. *Water hyacinth: Eichhornia crassipes*. Institute of Food and Agricultural Sciences \(IFAS\): Center for Aquatic Plants.](#)

Summary: Available from: <http://aquat1.ifas.ufl.edu/hyacin2.html> [Accessed 27 April 2006]

[University of Florida. 2001. *Biological Control Of Invasive Plants*. Institute of Food and Agricultural Sciences \(IFAS\): Center for Aquatic Plants.](#)

Summary: Available from: <http://aquat1.ifas.ufl.edu/hyacin.html> [Accessed 27 April 2006]