

Presented to CPM5, IPPC, FAO, Rome, 25th March, 2010

Aquatic plants and IPPC

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Background

As mentioned during the Report from CBD to the CPM on Tuesday of this week (CPM 2010/INF/9), the last Conference of Parties of the Convention on Biological Diversity (COP9, 2008) invited IPPC “to continue its efforts to expand, within its mandate, its actual coverage of invasive alien species which impact on biodiversity, including in aquatic environments”

I was asked to address the Scientific Session of CPM 5 on the subject of “Aquatic Plants”

CONTENTS

- **What are aquatic plants?**
- **Types of aquatic plants**
- **Values of aquatic plants**
- **Threats to aquatic plants**
- **Threats by aquatic plants**
- **IPPC and aquatic plants**
- **Conclusions**



Definitions

AQUATIC ECOSYSTEM = an area of water (H₂O), be it inland or oceanic; freshwater, brackish water or seawater

INLAND WATERS = areas of water (fresh or with varying amounts of dissolved salts) in lakes, ponds, dams, rivers, streams and wetlands*

MARINE WATERS = areas of water dominated by salty water (containing NaCl) in estuaries, tidal flats, sea coasts, seas and oceans

* Using the Ramsar Convention on Wetlands of International Importance definition of “wetlands” – see next slide

Places where aquatic plants grow

The Ramsar definition of “**wetlands**” (Convention Article 1) is related to “where plants will grow”, especially in the depth of water described:

“areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres”.

This is based upon the depth to which sunlight can (on average) reach to assist the growth of plants

(of course there are exceptions to the depth of light penetration in different waters and the reliance of plants on sunlight – but this is, in general, a useful definition of “places where aquatic plants will grow”)

aquatic plants

Aquatic plants rely on water, as either water-dependent plants or those that can survive in flooded conditions. In most cases, they have adaptations to the aquatic environment :—

- structurally (as in support structures),
 - in relation to nutrient uptake,
 - associated with gas exchange,
 - associated with reproductive structures
- with all, some or one of the listed adaptations

Water Plants and Water Weeds

- The English language terms “water weed” and “seaweed” have caused confusion because they are based on the Old English word “**weed**” which meant “**plant**”
- Thus many have thought that all freshwater plants and all marine plants are “**weeds**” in the sense of “**pests**” or “**problem plants**”
- This is not my belief, so I start by mentioning aquatic plants as valuable in their own right – and suggest that they only become “**weeds**”, in the pest sense, when they are introduced to a new ecosystem – or when the ecosystem around them changes. This coincides with the definition of “**alien species**” which may then become “**invasive**”

Types of aquatic plants

Aquatic plants have been classified in many ways by many authorities – which is a study in itself. Alternative systems rely on whether the plants are entirely in water, partly in water, always in water, occasionally in water and the types of water they inhabit. Probably, most common are systems that classify aquatic plants by habitat and growth form

There are few plant families that are entirely aquatic (perhaps 25) and there are many plant families that have some aquatic members – so plant taxonomy, although essential, hardly helps in any typology of aquatic plants. What follows is a brief description of some of the main types/forms of aquatic plants based on their most usual positions in aquatic systems and their growth forms

The types listed and illustrated are mostly from my own experience in Africa – so please excuse my range of knowledge of types that may be missing from this account

Submerged plants (freshwater)

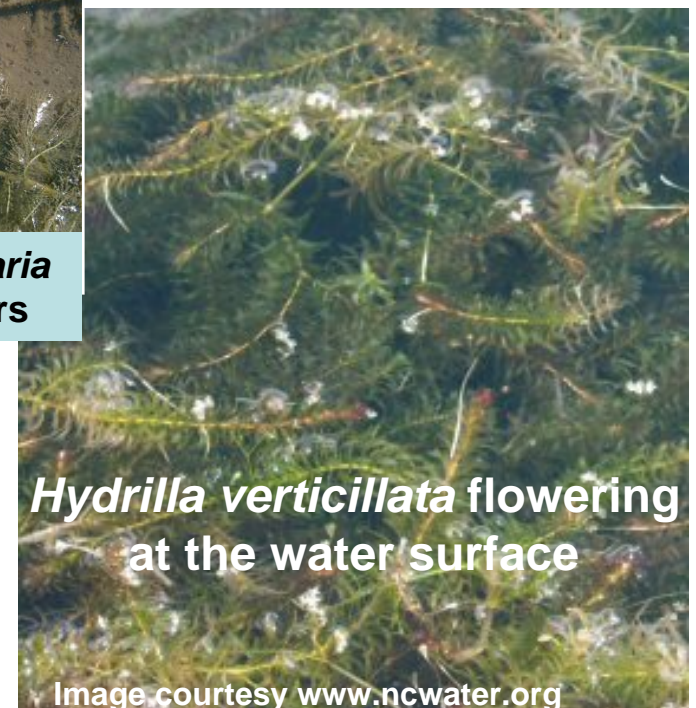
Few plants are entirely submerged but there is a group, sometimes termed “rosulate” (entirely submerged, leaves in a rosette of stems)



This is an entirely submerged plant of the genus *Najas* (family Najadaceae) which remains fully submerged unless stems break free; it flowers below the surface and has under-water pollination and seeds that remain beneath the surface – but which can be dispersed by fish or water birds. (Acknowledged, Sue Scott)

Submerged plants with some connection to the water surface

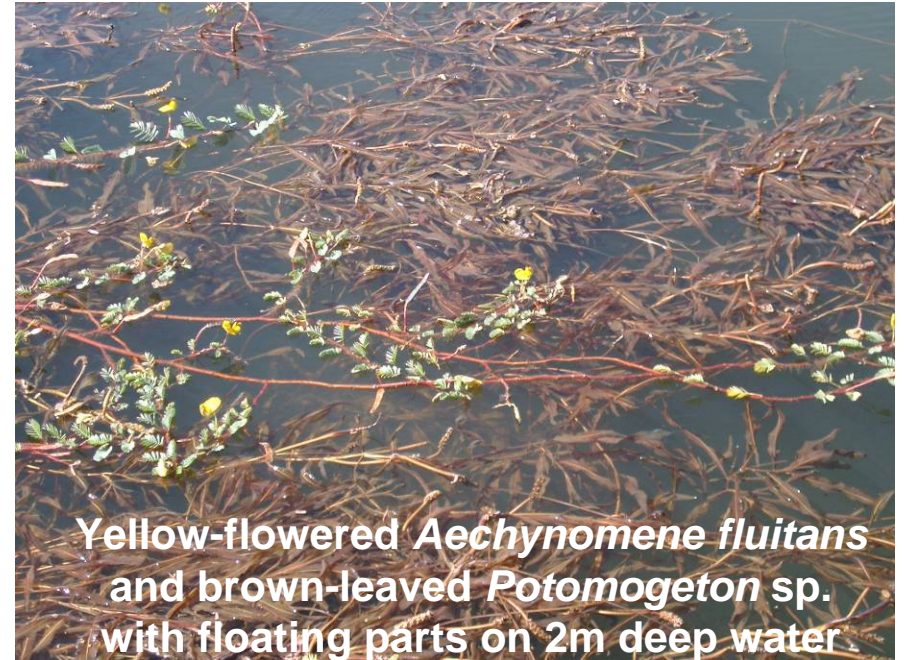
Many (freshwater) submerged aquatic plants are rooted in the substrate and occupy the water column with vegetative structures, but extend flowers above the water surface for pollination and/or dispersal



Floating-leaved plants

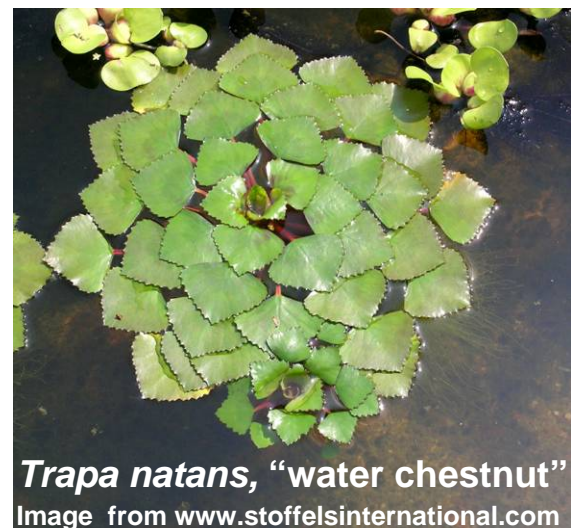


Water lilies have floating leaves and emergent flowers



Yellow-flowered *Aechynomene fluitans* and brown-leaved *Potamogeton* sp. with floating parts on 2m deep water

A common type of aquatic plant is rooted in the substrate but has leaves floating on the water surface. Some, like *Potamogeton* spp. and *Trapa natans*, have submerged, as well as floating, leaves



Trapa natans, "water chestnut"
Image from www.stoffelsinternational.com

Water's edge plants

Riparian plants, floodplain plants, wetland plants



Floodplain wetland shrub and grasses

Water's edge (**riparian**) plants are adapted to occasional (**long-term** or **short-term**) inundation from lakes, rivers and floods – exhibiting tolerance of inundation and often water-dispersed propagules

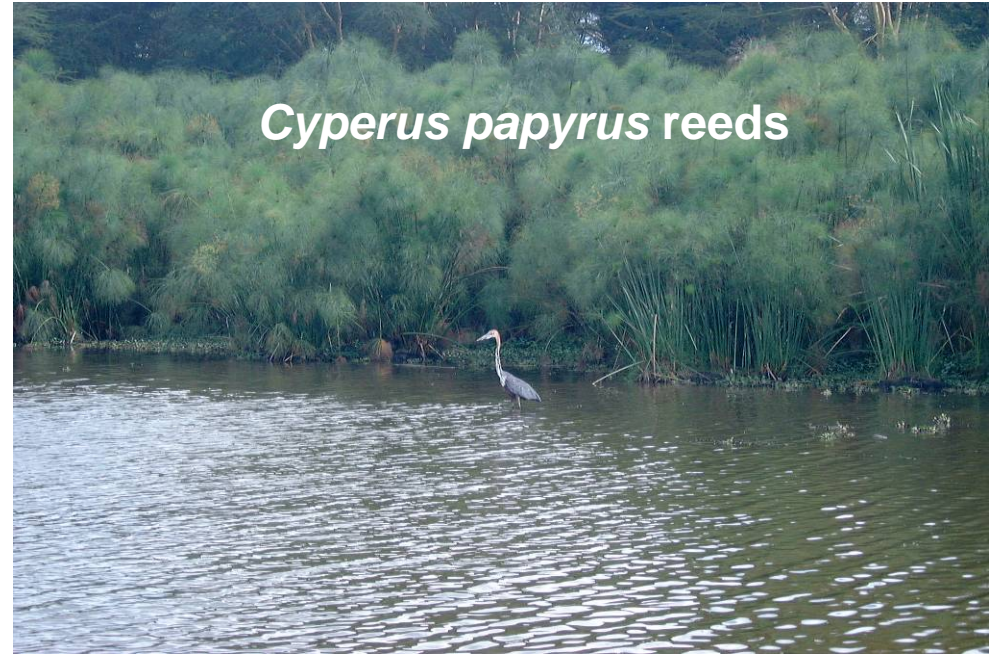


Lake-edge shrubs and grasses



River-edge reeds and shrubs

Emergent aquatic plants



Most widespread are the “reeds” with hollow stems and roots in submerged substrate



Also many aquatic grasses, sedges (Cyperaceae), emergent herbs and freshwater “mangroves” and swamp forest trees

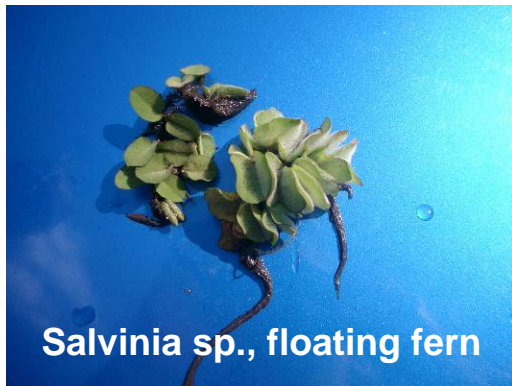


Floating plants

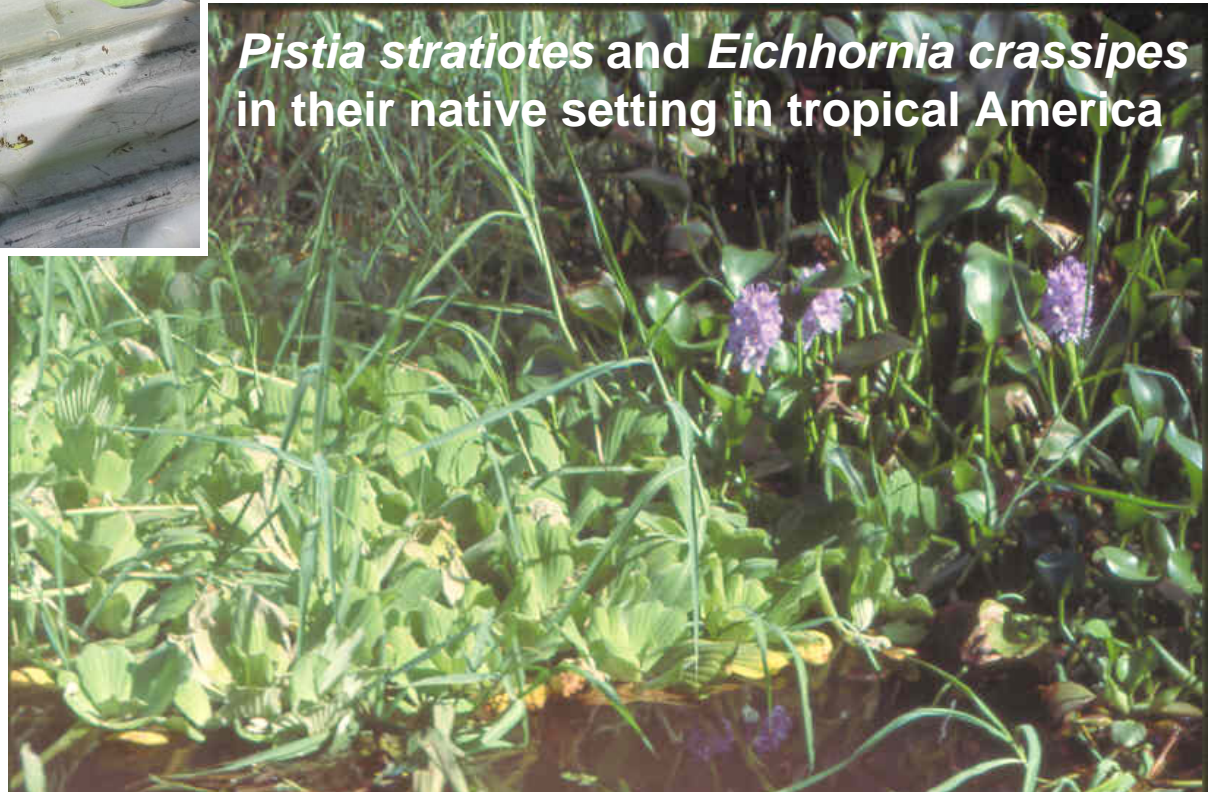


Free-floating plants with both aerial and water-immersed parts; nutrients derived from water, sometimes rooted in drought conditions

Pistia stratiotes and *Eichhornia crassipes*
in their native setting in tropical America



Salvinia sp., floating fern



Estuarine plants

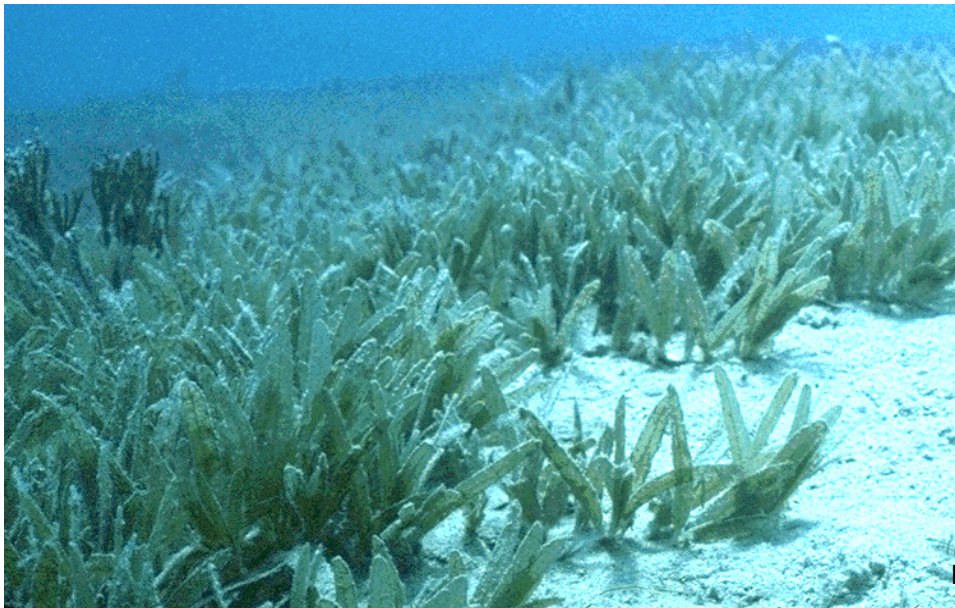
Estuarine plants often consist of the *mangal* or *mangrove* complex of species adapted to marine waters but which require some freshwater for survival and growth



Mangrove forest trees have mechanisms for aeration of tidally flooded roots and for extraction of salt from leaves and other tissues – but are otherwise typical swamp forest trees

Marine water plants

In warmer, shallow marine (mainly coastal) waters there are significant areas of “**sea grass beds or meadows**” of submerged plants in the families Cymodoceaceae, Hydrocharitaceae, Posidoniaceae and Zosteraceae which complete their life cycles below the water surface. Green algae also grow here with brown and red algae in rocky coastal areas and deeper waters



“**Salt marshes**” are a type of estuarine or interface area between the freshwaters of inland areas and the saline waters of the ocean coast. Here there is a range of aquatic and semi-aquatic plants, some specialised to tolerate salt – some restricted to less salty areas

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Values of aquatic plants - 1

Value to biodiversity and ecosystem services

Species diversity for its own sake

Relationship to freshwater ecosystem functions:

- **Food and nesting sites for aquatic animals**
- **Water quality maintenance and pollution retention**
- **Sediment retention and control – increasing light availability and reducing turbidity**
- **Amelioration of flood waves and high flows**
- **Persistence of stream flows throughout a year**
- **Slowing of shallow sheet flows and streams to facilitate groundwater recharge**
- **Oxygenation of water for other organisms**

Values of aquatic plants - 2

In the coastal and marine realm, aquatic plants:

Mangroves provide breeding and growing sites for many off-shore and benthic organisms – including crustaceans, molluscs and fishes (through their high productivity and leaf-fall providing nutrients as well as refuges for growing larvae)

Seagrass “meadows” provide food and shelter for a range of marine organisms

Both mangroves and seagrasses ameliorate destructively rough seas, storm surges and high tides for the protection of marine organisms, land plants and terrestrial ecosystems

Values of aquatic plants - 3

Economic benefits of aquatic plants include:-

- **Food, shelter and nesting sites for both inland and marine fisheries**
- **Purification and de-silting of water – in lakes, rivers and wetlands**
- **Food products from various aquatic plants such as taro, water yams, water chestnuts, water greens (e.g. *Ipomoea aquatica*), water cress, (paddy and wild rice) + medicinals and food additives from algae**
- **Stock feed (grazing and stall-fed)**
- **Green mulch and fertilizer for crops**
- **Plants for aquarium trade and “water gardens”**
- **Building materials and mats from reeds and other types**
- **Fuelwood from swamp forests and fuel from riparian and floodplain plants (e.g. *Mimosa pigra*)**

Threats to aquatic plants - 1

The main threats to aquatic plants are:

- Human destruction and alteration of aquatic habitats – both freshwater and marine
- Over-harvesting of aquatic plants
- Pollution (land-based, agricultural, urban, industrial and water-based pollution from shipping)
- Global change affecting temperatures and water availability parameters as well as floods and storms
- **Plant diseases (seemingly rare)**
- **Aquatic plant herbivores – especially alien and invasive insects, mites, crustaceans, molluscs, fishes and waterbirds**
- **Invasive plants (see next slide)...**



Oreochromis niloticus, an aquatic²⁰
plant “pest” in 4 continents

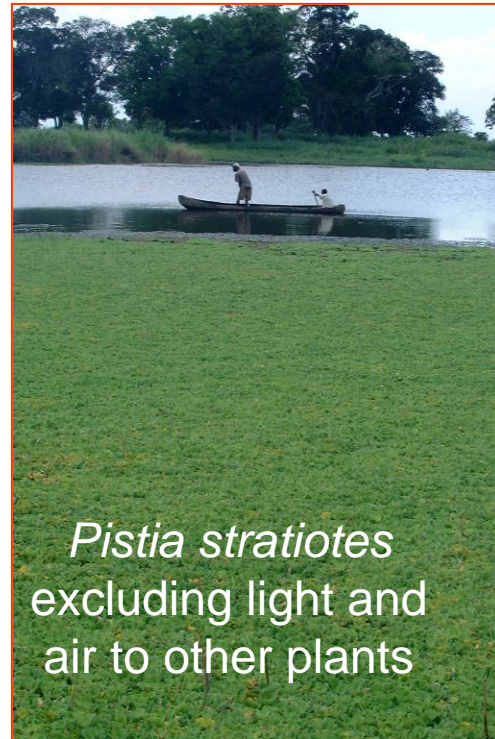
Threats to aquatic plants - 2

Alien and invasive plants are one of the threats to both domesticated and wild aquatic plant species – through competition for space and nutrients, light and air exclusion and physical destruction

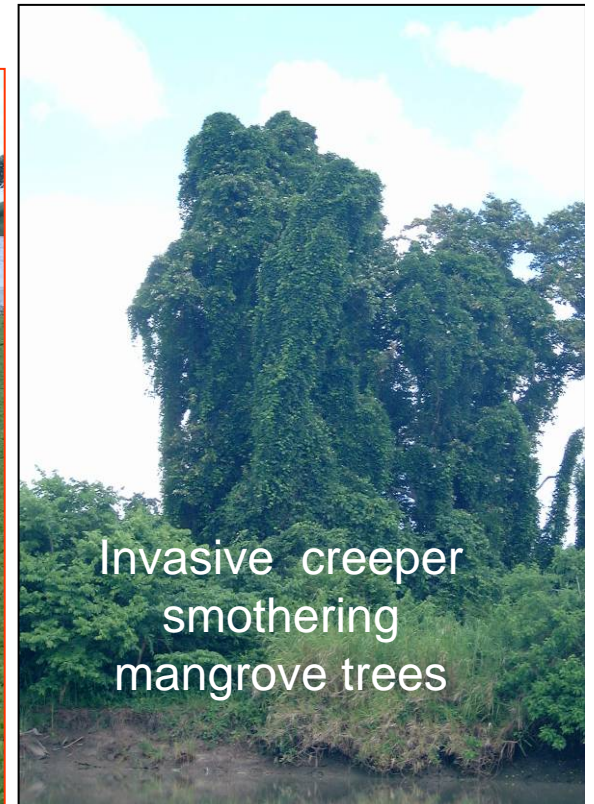
Caulerpa taxifolia from Mediterranean invading US marine waters to the detriment of local marine plants



Invasive water hyacinth covering many km² of Lake Victoria to the demise of all other aquatic plants



Pistia stratiotes
excluding light and
air to other plants



Invasive creeper
smothering
mangrove trees

Threats by/from aquatic plants

When aquatic plants are introduced to an ecosystem in which they were not indigenous, some species may become invasive

They can then have negative impacts on human livelihoods and health, human development, and biodiversity – i.e. they can become “pests” in the IPPC sense

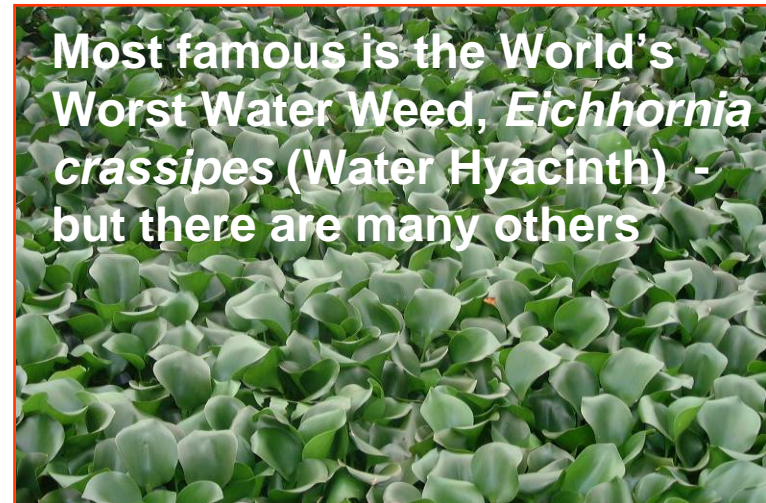
This can apply to any type of aquatic plant – in freshwater, brackish water or marine water .. in the same way it does to terrestrial species (called “weeds”)

All of the types of aquatic plants described have examples of species that have become invasive when introduced to new situations – or when their present ecosystems have been changed by human activity or natural processes and natural disasters (such as salination, water level changes, flow regime changes, impacts of storms and floods, conversions of water systems for other purposes, and climate change)

Threats by/from aquatic plants

The main threats include:

- Competition for light, air, space and nutrients,
- Production of toxic substances and allelopathy
- Possible hybridisation with native species
- Fouling of water and altering water flows – both natural and artificial (such as drainage and irrigation canals, water supplies to plant production systems)



Pathways of introduction of aquatic plants as invaders

- 1. The decorative plant industry, including aquarium trade**
- 2. Biofouling of both freshwater and marine ships and other vessels (and pleasure boats from one inland water to another)**
- 3. Movement of fishing equipment, drilling rigs, dredging equipment, etc.**
- 4. Incomplete and improper management of ballast water (IMO convention prepared)**
- 5. Natural spread after initial introduction through river systems and floods (exacerbated by local movements of fresh fish and equipment from one watershed to another)**

Potential role of IPPC with respect to aquatic plants

IPPC could explicitly list aquatic plants (both freshwater and marine) as plants to be protected from pests under the Convention

This could result from the CPM process and be mentioned as an ISPM

Such steps would be welcomed (I assume) by the Ramsar Convention and the CBD which both view aquatic plants as very important

In due course, it may be possible to consider standards for phytosanitary protection of aquatic plants

Particular areas of operation

Links to CBD – both Marine and Inland Waters Programmes of Work + Invasive Species – as mentioned in the report of the CBD Sec. to this meeting

Revisit the management of invasive species using the IPPC framework ** and the recent ideas from CBD

Consideration of the main pathways of introduction of aquatic plants that may become invasive (pests) – and so the measures needed for their protection

Links to aquatic Natural Sites under the World Heritage Convention and Wetlands of International Importance (of the Ramsar Convention)- for protection of aquatic plants against invasions by aquatic pest plants and other invasive species

**** especially findings of the 2003 Braunschweig (Germany) meeting on “Identification of risks and management of invasive alien species using the IPPC framework”**

Management of aquatic plants under IPPC

Current management of IPPC issues are mostly within national (and regional) government agencies/organisations related to Agriculture

It is suggested that other agencies (and their more closely-related international policies and agreements) could be involved with IPPC – such as fisheries, biodiversity, environment, and, even, water management

This would make non-agricultural aspects of plants and IPPC's interests wider, yet still within the Convention

This should be feasible at both national and regional levels

Conclusions

Aquatic plants include those living in inland (fresh-) waters as well as marine waters – and there are many valuable types of aquatic plants with human uses, and with roles in providing ecosystem services and importance to biodiversity

Aquatic plants (both freshwater and marine) could be considered under IPPC in the same way as those plants already provided with protection

Pests of aquatic plants could be targets for regulation under IPPC, especially invasive alien species affecting aquatics

Aquatic plants which themselves become invaders and so pests of other plants could be regulated under the IPPC systems – at both national and regional levels

There could be integration with other international conventions with like-minded interests in aquatic plants – both as potential invaders and as elements of biodiversity

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THANK YOU

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