Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism	***Eichhornia crassipes* - Water Hyacinth**
	Objectives:	Assess the risks associated with this species in GB
	Version:	FINAL 01/09/2010

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the Risk Assessment?		Request by the GB Programme Board for Non-native Species
2	What is the Risk Assessment area?	GB	
3	Does a relevant earlier Risk Assessment exist?	YES (Go to 4)	A Risk assessment of water hyacinth for the Pacific was prepared by Pacific Island Ecosystems at Risk (PIER) using the Australian risk assessment system (Pheloung *et al.* 1999). The result is a score of 14 and a recommendation of: *species likely to be a pest* . Risk assessment available on the PIER website (http://www.hear.org/pier/index.html).
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTLY VALID OR NOT VALID (Go to 5)	Partly valid. The earlier assessment used a slightly different format and was for a Risk Assessment area with a very different climate to that of the UK.
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Name: Eichhornia crassipes (Mart.) Solms; Synonyms: Eichhornia speciosa Kunth, Heteranthera formosa, Piaropus crassipes (Mart.) Raf., Piaropus mesomelas, Pontederia crassipes Mart. (basionym)* ***Common Names****: water hyacinth (English), aguapé (Portuguese-Brazil), bekabe kairanga (Fiji), bung el ralm (Palauan), bung el ralm (Palau), floating water hyacinth, jacinthe d'eau (French), jacinto de agua (Puerto Rico), jacinto-aquatico (Portuguese), jal khumbe (Fiji), jal kumbhi (Hindi-India), lechuguilla (Spanish), lila de agua (Dominican Republic), lirio acuatico, mbekambekairanga (Fijian), riri vai (Cook Islands), wasserhyazinthe (German), water orchid, wota haisin (Papua New Guinea),* ***Order:*** *Liliales; Kingdom: Plantae*
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	Water hyacinth is invasive throughout the tropics and subtropics. It is naturalised in Southern Europe.
8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?		
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	Water hyacinth is widely grown under glasshouse conditions in UK for horticulture. It is grown outdoors in ornamental ponds in the summer.
10	Is the organism widely distributed in the Risk Assessment area?	NO (Go to 11)	Water hyacinth is widely distributed under cultivation in UK (in glasshouse conditions and in ornamental ponds in summer). According to the National Biodiversity Network website there are distribution records for southern England but there is no indication of whether these refer to persistent or ephemeral populations. Reference to the literature on the global distribution of water hyacinth would indicate that these are ephemeral populations.
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?	YES (Go to 12)	Water hyacinth grows in shallow temporary ponds, wetlands and marshes, sluggish flowing waters, lakes, reservoirs and rivers (Gopal 1987). 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). UK habitats are at higher latitudes than the current known latitudinal limit of water hyacinth distributions in the open (approx 40º). However, projected UK climate change scenarios of 2-3ºC increases in annual average temperatures by the 2080s could transform southerly parts of UK into marginal water hyacinth habitat. Water hyacinth is currently widely grown in protected conditions and the plants are moved to ornamental ponds in summer.
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?	NO (Go to 14)	The main mode of spread of water hyacinth is vegetative reproduction by means of stolons. Water hyacinth has established in a wide range of habitats indicating that it is not constrained by the absence of particular species.
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		

14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?	NO (Go to 15)	
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?	YES (Go to 16)	Water hyacinth is widely grown under glasshouse conditions in UK for horticulture. It is grown outdoors in ornamental ponds in the summer. During this time it can grow vegetatively and set seed. During this survey no records were found of it establishing outside areas in which it has been cultivated in protected conditions in UK. However, this could be possible in principle.
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?	YES (Go to 17)	Native to tropical South America, water hyacinth has been spread by man to all continents apart from Antarctica (Gopal 1987).
17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?	YES OR UNCERTAIN (Go to 19)	At present the UK climate is not suitable for the persistence of water hyacinth in the open. However, this has the potential to change if certain climate change predictions are realised.
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		

B	SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences			
	Probability of Entry	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	moderate number - 2	LOW - 0	Intentional introductions: Ornamentals and amenity species of plants; aquarium/ponds/amenity/water.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.			The other questions in this section are not answered as importation for release is the major pathway for water hyacinth in UK.
1.3	How likely is the organism to be associated with the pathway at origin?			
1.4	Is the concentration of the organism on the pathway at origin likely to be high?			
1.5	How likely is the organism to survive existing cultivation or commercial practices?			
1.6	How likely is the organism to survive or remain undetected by existing measures?			
1.7	How likely is the organism to survive during transport /storage?			
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?			
1.9	What is the volume of movement along the pathway?			
1.10	How frequent is movement along the pathway?			
1.11	How widely could the organism be distributed throughout the Risk Assessment area?			
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?			
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?			
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?			

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	not similar - 0	LOW - 0	Worldwide, the limits of distribution are at 40ºN a nd S latitude. (Gopal 1987). The northern boundary of distribution in Japan is the area marked by an average temperature in January of 1ºC and average annual temperatures of 13ºC and average minimum monthly temperatures of -3ºC (Ueki 1978) and water hyacinth cannot survive more than three weeks of near freezing temperatures (Owens and Madsen, 1995). 30 year mean annual temperatures (1971-2000) in UK are 8.5º - 11ºC (UK Met Office figures - www.metoffice.gov.uk). Projected temperature rises would allow water hyacinth to survive in the open in southern parts of UK.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	slightly similar - 1	LOW - 0	Water hyacinth can establish in a broad spectrum of physico-chemical environments (Gopal 1987). A large number of freshwater habitats in UK would be suitable for water hyacinth establishment if temperature criteria were met. Under current climatic conditions these temperature criteria are not met.
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	very few - 0	LOW - 0	Water hyacinth can establish in freshwater lakes, ponds, marshes, ditches, canals, slow-moving streams. Its distribution is limited by brackish water (Gopal 1987). UK habitats are at higher latitudes than the current worldwide distribution of water hyacinth.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	Surveys based on those carried out by the Nature Conservancy Council (NCC) in UK (e.g. Duigan, Kovach & Palmer, 2006) indicate that there are many habitats that would be suitable for the multiplication of water hyacinth if temperature criteria were met.
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A		
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	moderately likely - 2	HIGH -2	It is difficult to predict the effect of competition on the likelihood of establishment of water hyacinth in the UK. Water hyacinth has readily colonised water bodies in parts of the world with favourable climatic conditions. Even with projected temperature increases during this century the climate in southern UK would still be likely to be only on the margins of suitability for water hyacinth in UK. In such conditions existing rooted and floating macrophytes might be more competitive than the equivalent organisms in more favourable water hyacinth habitat.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	likely - 3	MEDIUM -1	There is little evidence that existing natural enemies have been effective in controlling water hyacinth in its introduced range. This has driven the search for natural enemies in the water hyacinth's native range (Julien, 2001)
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	N/A		The conditions under which water hyacinth would establish in UK are very different from current conditions. If the UK climate became suitable for widespread water hyacinth establishment, it is likely that man's management of the environment/habitat in the Risk Assessment area will be very different from current practice.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	unlikely - 1	MEDIUM -1	Under current climatic conditions it is likely that currently available control measures (physical and chemical) could prevent the establishment of water hyacinth in the UK. Existing biological control agents for water hyacinth are unlikely to be able establish under UK conditions.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	very rare - 0	MEDIUM -1	There are a large number of establishments cultivating and selling water hyacinth in the UK. Three of these were contacted during this exercise (contact details withheld at the request of those questioned). They all said that they had never seen water hyacinth establishing under protected conditions outside areas in which the plants were grown.
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	very likely - 4	LOW - 0	Given suitable biotic and abiotic conditions water hyacinth exhibits many characteristics that aid establishment. Very rapid vegetative growth is very important for its spread and colonisation of new water bodies. Seeds are produced in its introduced range and these can remain viable for many years, allowing water hyacinth to establish in ephemeral water bodies (Gopal 1987).
1.26	How likely is it that the organism's capacity to spread will aid establishment?	likely - 3	MEDIUM -1	The main mechanism of spread is vegetative growth and reproduction. "Islands" of water hyacinth can break free of an area of infestation and can float downstream to (permanently or temporarily) connected water bodies (Cilliers *et al.* 2003). Plants can also be spread on machinery (e.g. dredgers) that is moved between water bodies.
1.27	How adaptable is the organism?	moderately adaptable - 2	MEDIUM -1	Water hyacinth is able to establish in a wide variety of tropical, sub-tropical and warm temperate areas. It has so far failed to establish in cool temperate areas. There is anecdotal evidence that horticulturalists in Holland are attempting to develop cold-hardy water hyacinth varieties. It may be necessary to repeat the risk assessment process for hardier varieties should these be developed.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	very likely - 4	LOW - 0	Studies indicate that established water hyacinth invasions are often from a very limited number of founders (Li *et al.* 2006).
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	very many - 4	LOW - 0	Water hyacinth now has a near worldwide distribution throughout the tropics and has spread to more than 50 countries on five continents (Gopal 1987).

1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	very likely - 4	MEDIUM -1	Water hyacinth is very difficult to eradicate. Unless an eradication effort was initiated extremely quickly, it would have to be undertaken over many years because of seed dormancy. An eradication campaign would also have to address the large number of sources of reinfestation from plants found in cultivation.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	very likely - 4	MEDIUM -1	The large number of plants found in cultivation and the possibility of release into the outside environment presents a risk of maintaining transient populations of water hyacinth in UK.

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	very slow - 0	LOW - 0	Under current climatic conditions spread is likely to be very slow because of lack of permanent establishment.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	very slow - 0	LOW - 0	Under current climatic conditions spread is likely to be very slow because of lack of permanent establishment.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	easily - 1	MEDIUM -1	Assuming that a water hyacinth population established in UK outside cultivation, once detected it should be possible to contain the population because of the current climatic unsuitability. This situation could alter with increasing temperatures in years to come.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.	Slow flowing freshwater habitats in southern UK	LOW - 0	Low uncertainty under current climatic conditions.

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	massive - 4	LOW - 0	Water hyacinth is invariably listed as one of the world's worst invasive species (e.g. it is featured in a list of 100 of the world's worst invasive alien species - Lowe *et al.* , 2001). Some estimates of economic losses exist in its introduced range. These include a study that demonstrated the economic impacts of water hyacinth on local economies before and after water hyacinth was controlled using biological control agents (De Groote *et al.* 2003). During the height of the water hyacinth infestation, men reported their annual income dropped from $1,984 to $607 USD. After the control of water hyacinth their income rose to $1,160 USD per person.
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minimal - 0	LOW - 0	Water hyacinth has the potential for establishment in the UK only if the plant becomes more cold-hardy (through natural or human selection) or if the UK becomes warmer. It may be necessary to repeat the risk assessment process for hardier varieties should these be developed.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minimal - 0	LOW - 0	See 2.6
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	See 2.6
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	unlikely - 1	LOW - 0	Most of the economic sectors affected are likely to be domestic. However, increased production costs could affect the competitiveness of UK exports. The presence of water hyacinth in UK water bodies is unlikely to constitute a direct barrier to exports.
2.10	How important would other economic costs resulting from introduction be? (specify)	moderate - 2	LOW - 0	If the problem became serious there would be many other costs associated with the management of water hyacinth in UK.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	massive - 4	LOW - 0	The clearest environmental impact of water hyacinth in its introduced range is that on ecosystem services (water availability, flooding regimes, nutrient cycling, etc.). It is very difficult to determine the impact of water hyacinth invasions on biodiversity.
2.12	How important is environmental harm likely to be in the Risk Assessment area?	minor - 1	LOW - 0	Under the assumptions stated in 2.6 the environmental harm from water hyacinth in the UK is likely to be low.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	massive - 4	LOW - 0	Social impacts in water hyacinth's introduced range include reduced fishing catches and lack of access to fisheries, negative impacts on power generation infrastructure, and impeded water transport impacting on trade and travel (De Groote *et al.* 2003).
2.14	How important is the social harm likely to be in the Risk Assessment area?	minor - 1	LOW - 0	Under the assumptions stated in 2.6, the social harm from water hyacinth in the UK is likely to be low.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	The author of this risk assessment is not aware of any evidence to date of water hyacinth carrying its genetic traits to native species in areas in which it has become naturalised or invasive.
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	very likely - 4	LOW - 0	There is little evidence that existing natural enemies have been effective in controlling water hyacinth in its introduced range. This has driven the search for natural enemies in the water hyacinth's native range (Julien, 2001).
2.17	How easily can the organism be controlled?	with some difficulty - 2	LOW - 0	Water hyacinth control efforts throughout the world have met with variable levels of success. Spectacular decreases in water hyacinth levels have followed the release of biological control agents in Papua New Guinea (Julien and Orapa 1999) and on Lake Victoria in Uganda (Cock *et al.* 2000) while the results of control efforts in South Africa have not been so spectacular (Hill and Olckers 2001). This has been attributed to variable climatic conditions, eutrophication and undesirable impacts of some control methods.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	moderately likely - 2	LOW - 0	The degree to which control measures disrupt existing biological or integrated systems for control of other organisms depends upon the suite of control measures chosen and location-specific factors. There is evidence from South Africa that chemical and mechanical control of water hyacinth have reduced the efficacy of the agents released to control water hyacinth (Hill and Olckers, 2001). It is possible that efforts to control water hyacinth in UK could have negative impacts on other biological or integrated control measures.
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	moderately likely - 2	LOW - 0	Water hyacinth is believed to provide refugia for pest vertebrates (e.g. rats and snakes) and invertebrates (e.g. mosquitoes) (CSIR 2004, NARO 2004, EARO 2004, ECZ 2004).
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur	freshwater lakes, ponds, marshes, ditches, canals, slow-moving streams in Southern UK	LOW - 0	

Summarise Entry	very likely - 4	LOW - 0	Water hyacinth is already present in UK. The most important pathway is intentional introductions through the ornamental plant trade. Water hyacinth has been widely promoted for its value in bioremediation (e.g. Vajpayee *et al.* 1995) and this could represent an important pathway if the climate in some areas of UK becomes suitable for water hyacinth establishment.
Summarise Establishment	very unlikely - 0	LOW - 0	It is unlikely that water hyacinth will establish in UK under current conditions unless cold-hardy varieties are developed. It may be necessary to repeat the risk assessment process for hardier varieties should these be developed. It is possible that water hyacinth will establish in southern UK in the future if some climate change scenarios are realised. However, it is still likely be on the margins of its distribution where conditions for growth and spread are sub-optimal.
Summarise Spread	very slow - 0	LOW - 0	Under current climatic conditions spread is likely to be very slow because of lack of permanent establishment. It is possible that water hyacinth could spread in Southern UK in the future if some climate change scenarios are realised. However, it will still be on the northern margins of it distribution where conditions for growth and spread are sub-optimal. Rates of spread under such conditions, therefore, are likely to be very slow.
Summarise Impacts	minor - 1	LOW - 0	The severe negative impacts of water hyacinth invasions in the tropics are well known (e.g. on fisheries, transport, power generation). Other negative impacts such as those on biodiversity are likely but difficult to establish conclusively. Negative impacts of such magnitude at the margins of its range have not been established. Open areas in UK are currently beyond the northern margins of suitability for water hyacinth. Water hyacinth populations could establish in some areas of UK if certain climate change predictions for UK materialise. However, the it would be likely that the species would still be at the margins of its range, where its impacts are likely to be relatively minor.
Conclusion of the risk assessment	LOW - 0		
Conclusions on Uncertainty		LOW - 0	Levels of uncertainty are low under current climatic conditions. Levels of uncertainty may increase in future with the possible realisation of climate change scenarios.

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