Environment Agency

Evidence

Proposed EQS for Water Framework Directive Annex VIII substances: mecoprop

Technical report

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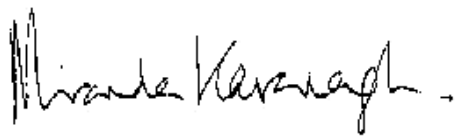


Miranda Kavanagh

Director of Evidence

Use of this report

The development of UK-wide classification methods and environmental standards that aim to meet the requirements of the Water Framework Directive (WFD) is being sponsored by the UK Technical Advisory Group (UKTAG) for WFD on behalf of its members and partners.

This technical document has been developed through a project managed by the Environment Agency and has involved members and partners of UKTAG. It provides background information to support the ongoing development of the standards and classification methods.

While this report is considered to represent the best available scientific information and expert opinion available at the time of its completion, it does not necessarily represent the final or policy positions of UKTAG or any of its partner agencies.

Executive summary

The UK Technical Advisory Group (UKTAG) has commissioned a programme of work to derive Environmental Quality Standards (EQSs) for substances falling under Annex VIII of the Water Framework Directive (WFD). This report proposes predicted no-effect concentrations (PNECs) for mecoprop using the methodology described in Annex V of the Directive. There are existing EQSs mecoprop, but the method used to derive these is not considered to comply with the requirements of Annex V and so is unsuitable for deriving Annex VIII EQSs.

The PNECs described in this report are based on a technical assessment of the available ecotoxicity data for mecoprop, along with any data that relate impacts under field conditions to exposure concentrations. The data have been subjected to rigorous quality assessment such that decisions are based only on scientifically sound data. Following consultation with an independent peer review group, critical data have been identified and assessment factors selected in accordance with the guidance given in Annex V of the WFD.

Where possible, PNECs have been derived for freshwater and saltwater environments, and for long-term/continuous exposure and short-term/transient exposure. If they were to be adopted as EQSs, the long-term PNEC would normally be expressed as an annual average concentration and the short-term PNEC as a 95th percentile concentration.

The feasibility of implementing these PNECs as EQSs has not been considered at this stage. However, this would be an essential step before a regulatory EQS can be recommended.

Properties and fate in water

Mecoprop is a phenoxypropanoic acid, with potent auxin activity in bioassays and in treated sensitive plants. The compound is directly toxic to susceptible plants without metabolic activation and induces a series of morphological and physiological effects.

Mecoprop is not expected to persist in surface waters when released to the aquatic compartment. However, the Environment Agency has identified mecoprop as a potential substance of concern in groundwater, which may require development of a specific PNEC. Mecoprop is not expected to persist in soil when released to the terrestrial compartment since it readily biodegrades (with reported half-lives in soil ranging from 3 to 21 days depending upon soil type and conditions). Mecoprop will also readily leach from soil and may also be lost in run-off following field applications. Mecoprop is not expected to bioaccumulate in aquatic organisms.

Availability of data

Long-term laboratory data are available for four different freshwater taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater short-term toxicity data are available for four taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater macrophytes are more sensitive to both technical grade mecoprop and mecoprop formulations than algae, invertebrates and fish.

For marine organisms, single species short-term toxicity data are available for four different taxonomic groups (algae, crustaceans, fish and molluscs). Long-term toxicity data are available for two different saltwater taxa (algae and molluscs). Laboratory data are not supplemented by freshwater or saltwater mesocosm data.

No information on the endocrine-disrupting properties of mecoprop was located.

Derivation of PNECs

Long-term PNEC for freshwaters

The lowest valid no observed effect concentration (NOEC) value is from an industry generated study that complied with the OECD code of Good Laboratory Practice (GLP) and which assessed the long-term toxicity of mecoprop to macrophytes. This recorded a 7-day NOEC of 180 µg acid equivalents (a.e.) l^{-1} for effects of MCPP-p DMA on the macrophyte *Lemna minor,* which, based on mecoprop's mode of action, is considered to be the most sensitive taxonomic group. Since reliable long-term NOECs are available for algae, crustaceans and fish an assessment factor of 10 has been applied to the lowest valid toxicity value. This results in a $PNEC_{freshwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}. This was derived by applying an assessment factor of 100 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

Short-term PNEC for freshwaters

Reliable short-term data are available for algal, macrophyte, invertebrate and fish species. The lowest reported valid toxicity value is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor..* An assessment factor of 100 can be applied resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg l^{-1}. This was derived by applying a safety factor of 10 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

Long-term PNEC for saltwaters

There are limited long-term toxicity data for marine organisms with data being available only for algae and molluscs. The absence of long-term data for both crustaceans and fish means that it is not appropriate to generate a $PNEC_{saltwater\_lt}$ based on the saltwater data alone. Therefore, it is proposed that the combined freshwater and saltwater dataset is used for the PNEC generation. The lowest long-term value from the combined dataset is a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the macrophyte *Lemna minor.* Since a large body of long-term data is available for freshwater and saltwater organisms, an assessment factor of 10 can legitimately be applied to the lowest valid toxicity value resulting in a $PNEC_{saltwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}, which was 'read across' from the freshwater long-term value.

Short-term PNEC for saltwaters

The limited reliable short-term toxicity data for marine organisms means that it is not appropriate to derive the $PNEC_{saltwater\_st}$ based on the saltwater data alone. Therefore, it is proposed that a combined freshwater and saltwater dataset is used for the PNEC generation.

The lowest valid short-term toxicity value from the combined dataset is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* The available data indicate that macrophytes are the most sensitive taxa to the substance. It is proposed that an assessment factor of 100 is used resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg l^{-1}, which was 'read across' from the freshwater short-term value.

PNECs for sediment

Since the log Kow of mecoprop is >3, the derivation of PNECs for the protection of benthic organisms is required. However field studies indicate that, in a water sediment matrix, mecoprop remains in the water column. No information on the toxicity of mecoprop to sediment dwelling organisms was located, so no $PNEC_{sediment}$ could be derived.

PNECs for secondary poisoning

Bioconcentration data – as bioconcentration factor (BCF) values – for mecoprop for the majority of aquatic organisms are low, with a value of 3 reported in whole fish. Hence the EU Technical Guidance Document BCF trigger of 100 is not exceeded and the derivation of a PNEC in whole fish for secondary poisoning of predators is not required.

Summary of proposed PNECs

Receiving medium/exposure scenario	**Proposed PNEC (µg l^{-1})**	**Existing EQS (µg l^{-1})**
Freshwater/long-term	18	20
Freshwater/short-term	187	200
Saltwater/long-term	18	20
Saltwater/short-term	187	200
Sediment	Insufficient data	–
Secondary poisoning	Not required	–

Analysis

The data quality requirements are that, at a third of the EQS, total error of measurement should not exceed 50 per cent. Using this criterion, it is evident that current analytical methodologies (non-standard) employing gas chromatograph/mass spectrometry (GC-MS) and capable of achieving detection limits as low as 0.0025–1.25 pg l^{-1} should offer adequate performance to analyse for mecoprop.

Implementation issues

These PNECS are suitable for use as EQSs because they are not subject to excessive uncertainty and analytical capability should be adequate for compliance assessment purposes.

Contents

1 Introduction

The UK Technical Advisory Group (UKTAG) supporting the implementation of the Water Framework Directive (2000/60/EC)[1] is a partnership of UK environmental and conservation agencies. It also includes partners from the Republic of Ireland. UKTAG has commissioned a programme of work to derive Environmental Quality Standards (EQSs) for substances falling under Annex VIII of the Water Framework Directive (WFD). This report proposes predicted no-effect concentrations (PNECs) for mecoprop using the methodology described in Annex V of the Directive. There are existing EQSs mecoprop, but the method used to derive these is not considered to comply with the requirements of Annex V of the WFD and so is unsuitable for deriving Annex VIII EQSs

The PNECs described in this report are based on a technical assessment of the available ecotoxicity data for mecoprop, along with any data that relate impacts under field conditions to exposure concentrations. The data have been subjected to rigorous quality assessment such that decisions are based only on scientifically sound data.[2] Following consultation with an independent peer review group, critical data have been identified and assessment factors selected in accordance with the guidance given in Annex V of the WFD. The feasibility of implementing these PNECs as EQSs has not been considered at this stage. However, this would be an essential step before a regulatory EQS can be recommended.

This report provides a data sheet for mecoprop.

1.1 Properties and fate in water

Mecoprop is a phenoxypropanoic acid, with potent auxin activity in bioassays and in treated sensitive plants. The compound is directly toxic to susceptible plants without metabolic activation and induces a series of morphological and physiological effects.

Mecoprop is not expected to persist in surface waters when released to the aquatic compartment. However, the Environment Agency has identified mecoprop as a potential substance of concern in groundwater, which may require development of a specific PNEC. Mecoprop is not expected to persist in soil when released to the terrestrial compartment since it readily biodegrades (with reported half-lives in soil ranging from 3 to 21 days depending upon soil type and conditions). Mecoprop will also readily leach from soil and may also be lost in run-off following field applications. Mecoprop is not expected to bioaccumulate in aquatic organisms.

[1] *Official Journal of the European Communities*, **L327**, 1–72 (22/12/2000). Can be downloaded from http://www.eu.int/comm/environment/water/water-framework/index_en.html

[2] Data quality assessment sheets are provided in Annex 1 of this report.

2 Results and observations

2.1 Identity of substance

Table 2.1 gives the chemical name and Chemical Abstracts Service (CAS) number for the species of interest.

Table 2.1 Species covered by this report

Name	CAS Number
Mecoprop (MCPP)	93-65-2
Mecoprop-p (MCPP-p)	16484-77-8
Mecoprop racemate	7085-19-0
Salts	
Mecoprop, potassium salt	1929-86-8
Mecoprop, diethanolamine salt	1432-14-0
Mecoprop, dimethylamine salt (MCPP DMA)	32351-70-5
Mecoprop-p, dimethylamine salt (MCPP DMA)	66423-09-4
Esters	
Mecoprop, iso-octyl ester	27473-03-2

2.2 PNECs proposed for derivation of quality standards

Table 2.2 lists proposed PNECs obtained using the methodology described in the Technical Guidance Document (TGD) issued by the European Chemicals Bureau (ECB) on risk assessment of chemical substances (ECB 2003).

Section 2.6 summarises the effects data identified from the literature for mecoprop. The use of these data to derive the values given in Table 2.2 is explained in Section 3.

Table 2.2 Proposed overall PNECs as basis for quality standard setting

PNEC	TGD deterministic approach (AFs)	TGD probabilistic approach (SSDs)	Existing EQS
Freshwater short-term	187 µg l^{-1}	–	200 µg l^{-1} (MAC)
Freshwater long-term	18 µg l^{-1}	Insufficient data	20 µg l^{-1} (AA)
Saltwater short-term	187 µg l^{-1}	–	200 µg l^{-1} (MAC)
Saltwater long-term	18 µg l^{-1}	Insufficient data	20 µg l^{-1} (AA)
Sediment	Insufficient data	–	–
Secondary poisoning	Not required	–	–

AA = annual average
AF = assessment factor
MAC = maximum allowable concentration
SSD = species sensitivity distribution

2.3 Hazard classification

Table 2.3 gives the R-phrases (Risk-phrases) and labelling for the species of interest.

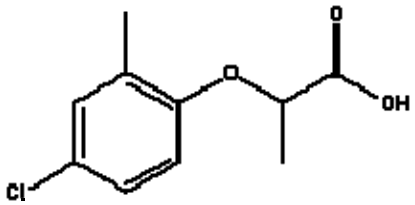
Table 2.3 Hazard classification

R-phrases and labelling	Reference
R 20/21/22	ECB 2003

2.4 Physical and chemical properties

Table 2.4 summarises the physical and chemical properties of the species of interest.

Table 2.4 Physical and chemical properties of mecoprop

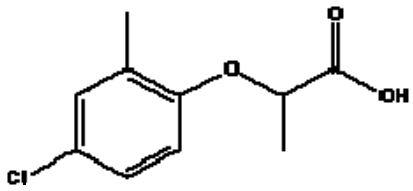
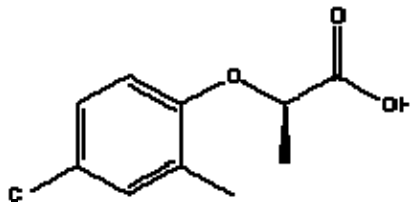
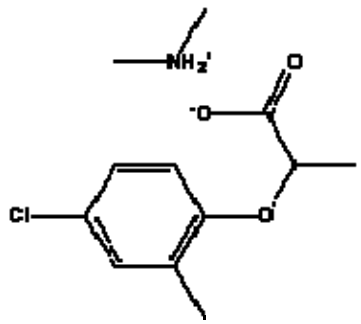
Property	Value (mecoprop unless stated otherwise)	Reference
CAS number	93-65-2 (mecoprop) 16484-77-8 (mecoprop-p) 7085-19-0 (racemate)	ChemID Plus 2006 Tomlin 2003
Substance name	(*RS*)-2-(4-chloro-2-methylphenoxy)propanoic acid	Budavari *et al.* 1989
Molecular formula	$C_{10}H_{11}ClO_3$	ChemID Plus 2006
Molecular structure		NIST 2005
Molecular weight	214.7	ChemID Plus 2006
Colour/form	Colourless or light brown crystals	Tomlin 2003, Extoxnet 1995
Odour	Odourless	HSDB 2003
Melting point (°C)	94.5	ChemID Plus 2006
Boiling point (°C)	289	ChemID Plus 2006
Vapour pressure	7.5×10^{-7} mmHg at 20°C	SRC 2006
Density/specific gravity	1.28 g cm^{-3} at 0°C	IUCLID 2000
Henry's Law constant	1.82 x 10^{-8} atm-m^{-3}/mol	ChemID Plus 2006
Solubility	620 mg l^{-1} in water at 20°C >1,000 g kg^{-1} in acetone, diethyl ether and ethanol, 825 g kg^{-1} in ethyl acetate, 339 g kg^{-1} in chloroform at 20°C. Salts in water: potassium 920 g l^{-1}, sodium 500 g l^{-1}, diethanolamine 580 g l^{-1}, dimethylamine 660 g l^{-1} at 20°C	SRC 2006 Tomlin 2003 EU Draft Assessment Report (EU DAR 1999)*

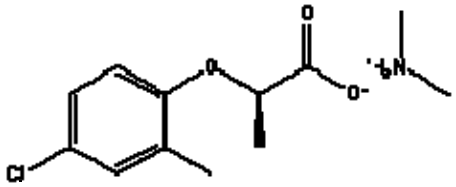
* Prepared under Council Directive 91/414/EEC. Submitted by the rapporteur Member State (Denmark) for assessment on behalf of the European Commission to the Pesticide Risk Assessment Peer Review Unit

(PRAPeR) of the European Food Safety Authority. Referred to subsequently in this report as EU DAR 1999.

As well as the acid form, different derivatives of mecoprop exist (i.e. alkali metal and amine salts, and esters). Mecoprop has an asymmetric carbon and therefore has two possible enantiomers, of which the racemate contains equal amounts which form water-soluble salts with many inorganic and organic bases. The dextrorotary [(+) or (*R*)] enantiomer (mecoprop-p) is phytotoxic, but the laevorotatory [(–) or (S)] enantiomer is not (Lewis *et al*. 1996). Table 2.5 shows the different forms of mecoprop that comprise the majority of the available toxicity data (see Section 2.6).

Table 2.5 Different forms of mecoprop

Name	CAS Number	Formula	Structure
Mecoprop (MCPP)	93-65-2	$C_{10}H_{11}ClO_3$	
Mecoprop-p (MCPP-p)	16484-77-8	$C_{10}H_{11}ClO_3$	
Mecoprop dimethylamine salt (MCPP DMA)	32351-70-5	$C_{12}H_{18}ClNO_3$	

Name	CAS Number	Formula	Structure
Mecoprop-p dimethylamine salt (MCPP DMA)	66423-09-4	$C_{12}H_{18}ClNO_3$	

2.5 Environmental fate and partitioning

Table 2.6 summarises the information obtained from the literature on the environmental fate and partitioning of mecoprop.

Table 2.6 Environmental fate and partitioning of mecoprop

Property	Value	Reference
Abiotic fate	A pKa of 3.1 means that mecoprop will be completely dissociated under environmental conditions. Mecoprop has been shown to exist as a vapour in the atmosphere, where it will react with photochemically produced hydroxyl radicals.	HSDB 2003
Hydrolytic stability	Stable to hydrolysis, mecoprop is acidic and forms salts, many of which are water soluble. Stable for 31 days at pH 5–9 at 25°C.	Tomlin 2003 EU DAR 1999
Photostability	Phenoxyalkanoic acids have ultraviolet (UV) absorption maxima between 280 and 290 nm. This suggests that mecoprop could undergo direct photolysis. Photostability in water (half-lives): 6.8 hours at pH 5 10.2 hours at pH 7 4.1 hours at pH 9	HSDB 2003 EU DAR 1999
Volatilisation	Mecoprop has a low Henry's Law constant of 1.82 $x10^{-8}$ atm-m^3/mol	HSDB 2003
Distribution in water/sediment systems (active substances)	Mecoprop has low log Koc values of 1.30–2.22.	HSDB 2003
Distribution in water/sediment systems (metabolites)	The metabolite 4-chloro-2-methylphenol (CAS RN 1570-64-5) has low log Koc values of 2.09 and 2.81. It is expected to volatilise from water surfaces and biodegrade in the aquatic environment.	HSDB 2003
Degradation in soil	Mecoprop has been shown to readily leach out of soils and be	HSDB 2003

Property	Value	Reference
	lost in run-off, particularly in sandy soils. Mecoprop has been shown to remain active in soil for approximately 3–21 days.	HSDB 2003
Biodegradation	Mecoprop readily biodegrades in soil with half-lives ranging from 3 to 9 days.	HSDB 2003
Octanol–water coefficient (log Kow)	3.3	ChemID Plus 2006
Log Koc	1.30–1.63 in four soils ranging from pH 5.6–7.6; 2.13–2.22 in sandy soils ranging from pH 4.3–4.4	EU DAR 1999
Bioaccumulation BCF	Mecoprop is estimated to have a bioconcentration factor (BCF) of 141 and is therefore expected to bioaccumulate moderately in fish. However, measured data from exposure of bluegill sunfish (*Lepomis macrochirus*) to 1,000 µg l^{-1} ^{14}C-labelled mecoprop indicates a lower BCF of 3.	HSDB 2003 Ellgehausen 1986

The primary use of mecoprop is as a herbicide. It may be released to the aquatic and terrestrial environment following application to crops and also as a result of its manufacture, formulation, transport, storage and disposal.

When mecoprop is released to water, it is not expected to adsorb to sediment or particulate matter in the water column, based on its log Koc values (1.30–2.22), or to be lost through volatilisation (given a low Henry's Law constant of 1.82×10^{-8} atm-m^{-3}/mol).

A study of dissolved and adsorbed pesticides in river waters during flood events confirmed that mecoprop was primarily transported dissolved in the water column (Clark *et al*. 1991). Klint *et al*. (1993) reported that mecoprop degraded in 30 days in groundwater at 10°C after a 35–40 day lag in a study investigating the substances biodegradability at an exposure concentration of 100 µg l^{-1} in an aerobic aquifer. In the same study, mecoprop in a groundwater-suspended sediment matrix degraded in 15 days, but there was considerable variation in the degradation rates using sediment collected from different depths of the aquifer. Mecoprop is not expected to persist in surface waters when released to the aquatic compartment. However, the Environment Agency has identified mecoprop as a potential substance of concern in groundwater, which may require development of a specific PNEC (Environment Agency 2004).

Mecoprop readily biodegrades in soil as a result of microbial degradation, with reported half-lives in soil ranging from 3 to 21 days depending upon soil type and conditions. The estimated half-lives of mecoprop (at a concentration of 2 mg kg^{-1}) in a sandy loam soil with a 50 per cent water holding capacity at 20, 10 and 5°C were 3, 12 and 20 days, respectively (Helweg 1993). In dry and flooded soil (25 and 200 per cent water holding capacity) at 20°C, the half-lives increased to 10 and 15 days, respectively, but the half-life fell by 43 per cent when the concentration of mecoprop was decreased by a factor of 10 (Helweg 1993). Mecoprop will also leach readily from soil and may also be lost in run-off following field applications. As a result, mecoprop is not expected to persist in soil when released to the terrestrial compartment.

2.6 Effects data

A summary of the mode of action of this substance can be found in Section 2.6.5.

Data collation followed a tiered approach.

First, critical freshwater and saltwater data were compiled from existing EQS documents. Further data published after derivation of the current UK EQS were then retrieved from:

- the US Environmental Protection Agency (US EPA) ECOTOX database;[3]
- the Draft Assessment Report and Reviews for mecoprop and mecoprop-p prepared under Council Directive 91/414/EEC (EU DAR 1999, EC 2003a, EC 2003b).

In addition, data were sought from a variety of databases including:

- Hazardous Substances Data Bank (HSDB®) database of the US National Library of Medicine (HSDB 2003);
- ScienceDirect®[4]
- US EPA Integrated Risk Information System (IRIS) database;[5]
- World Health Organization (WHO);
- RIVM;[6]
- US Pesticides Database;
- INCHEM;[7]
- ECB European Chemical Substances Information System (ESIS).[8]

Mecoprop can be released to the environment in a number of chemical forms – acid, alkali metal and amine salts – and, also less frequently, as the ester form. However, in the aquatic environment, these different forms will usually dissociate into the acid form.

Therefore, it is necessary to consider the form that has been used to test the toxicity of freshwater or saltwater organisms and to normalise the data to acid equivalents (a.e.) when evaluating the available data.

It is also necessary to consider whether there are differences in the toxicity of mecoprop depending on whether it is used in a study as the technical grade material or as a commercial formulation containing other ingredients.

Not all papers reported in the open literature indicate the form of mecoprop used in the toxicity test. This has limited the extent to which comparisons of toxicity can be made between chemical forms of mecoprop.

2.6.1 Toxicity to freshwater organisms

Freshwater toxicity data on mecoprop are available for various taxonomic groups including the algae, invertebrates and fish required for the application of the approach specified in the EU Technical Guidance Document (ECB 2003). Long-term toxicity data are available for four taxonomic groups (algae, crustaceans, fish and macrophytes), with macrophytes being more sensitive than algae, invertebrates and fish. Short-term toxicity tests are available for four taxonomic groups (algae, crustaceans, fish and macrophytes), with macrophytes again being

[3] http://www.epa.gov/ecotox/
[4] http://www.sciencedirect.com/
[5] http://www.epa.gov/iris/index.html
[6] http://www.rivm.nl/en/
[7] http://www.inchem.org/
[8] http://ecb.jrc.it/esis/

more sensitive than other taxa. The greater toxicity of the various forms of mecoprop to aquatic macrophytes compared with algae, invertebrates and fish – where comparative data are available (see below) – is consistent with the substance showing potent auxin activity in plants (see Section 2.6.5).

Table 2.7 summarises the available data on the effects of different forms of mecoprop to freshwater organisms in long-term and short-term toxicity studies. The majority of the available data are for studies using mecoprop (MCPP), mecoprop-p (MCPP-p) and the dimethylamine salts of mecoprop (MCPP DMA) and mecoprop-p (MCPP-p DMA).

Table 2.7 Summary of data availability for different forms of mecoprop

Type of data	Form of substance	Taxonomic groups for which information is available
Long-term	Mecoprop	Macrophytes
	MCPP-p	Algae, crustaceans and fish
	Racemate	Algae and macrophytes
	MCPP DMA	Crustaceans and fish
	MCPP-p DMA	Algae and macrophytes
	Marks Optica MPn formulation	Algae
	UK46 KV fluid formulation	Algae
Short-term	Mecoprop	Algae, crustaceans and fish
	MCPP-p	Algae, crustaceans and fish
	Racemate	Algae, crustaceans and fish
	MCPP DMA	Crustaceans, fish and macrophytes
	MCPP-p DMA	Algae, fish and macrophytes
	Duplosan KV formulation	Crustaceans and fish
	Marks Optica MPn formulation	Algae, crustaceans and fish
	NHP 1313 formulation	Fish

The data in Tables 2.9 and 2.10 indicate similarity between the toxicity of MCPP, MCPP-p, MCPP DMA and MCPP-p DMA to given taxonomic groups where the experimental conditions are generally comparable and the data are expressed as acid equivalents (as µg a.e. l^{-1}). This is illustrated in Table 2.8, which compares the toxicity of mecoprop-p and the dimethylamine salts of mecoprop and mecoprop-p to specific freshwater algal *Selenastrum capricornutum*, macrophyte (*Lemna minor*), invertebrate (*Daphnia magna*) and fish (*Lepomis macrochirus* or *Oncorhynchus mykiss*) species measured in studies carried out using standardised procedures and which appeared (on the basis of available information) to be compliant with the OECD's code of Good Laboratory Practice (GLP).[9]

Table 2.8 Comparative toxicity of different forms of mecoprop to three species

Data type	Form of substance	Freshwater toxicity data*			
		Algae (*S. capricornutum*)	**Macrophyte (*L.minor*)**	**Invertebrate (*D. magna*)**	**(Long-term: *O. mykiss*, Short-term: *L. macrochirus*)**
Long-term	MCPP-p	ND	ND	21-day NOEC (reproduction) = 50,000 µg a.e. l^{-1}	28-day NOEC (mortality) = 50,000 µg a.e. l^{-1}
	MCPP DMA	ND	7-day NOEC = 180 µg a.e. l^{-1}	28-day NOEC (reproduction) = 22,000 µg a.e. l^{-1}	21-day NOEC (mortality) = 89,621 µg a.e. l^{-1}

[9] See Annex 1.

Short-term	MCPP-p	120-hour EC50 (growth inhibition) = 28040 µg a.e. l^{-1}	ND	48-h EC50 (immobilisation) = >91,000 µg a.e. l^{-1}	96-hour LC50 (mortality) = >50,000 µg a.e. l^{-1}
	MCPP-p DMA	ND	7-day EC50 = 18,700 µg a.e. l^{-1}	ND	96-hour LC50 (mortality) = >93,000 µg a.e. l^{-1}

* From Tables 2.9 and 2.10.
ND = no data
NOEC = no observed effect concentration

However, there is variability associated with the toxicity data for any given form of mecoprop. Therefore, a relatively large difference between the sensitivity of a given taxonomic group to different forms of mecoprop may be needed to conclude that one chemical form of mecoprop is consistently more toxic than others. There is no such clear difference between the toxicity of different chemical forms of mecoprop for which data are available. Consequently data from all different chemical forms (technical grade materials and formulations), adjusted to acid equivalents, have been combined to derive the PNECs.

Diagrammatic representations of the available freshwater data (cumulative distribution functions) for mecoprop are presented in Figures 2.1 and 2.2. These diagrams include all data regardless of quality and provide an overview of the spread of the available data. These diagrams are not species sensitivity distributions and have not been used to set the mecoprop PNECs. The lowest critical freshwater data for mecoprop are presented in Tables 2.9 (for long-term data) and 2.10 (for short-term data).

Figure 2.1 Cumulative distribution function of freshwater long-term data (µg a.e. l^{-1}) for mecoprop

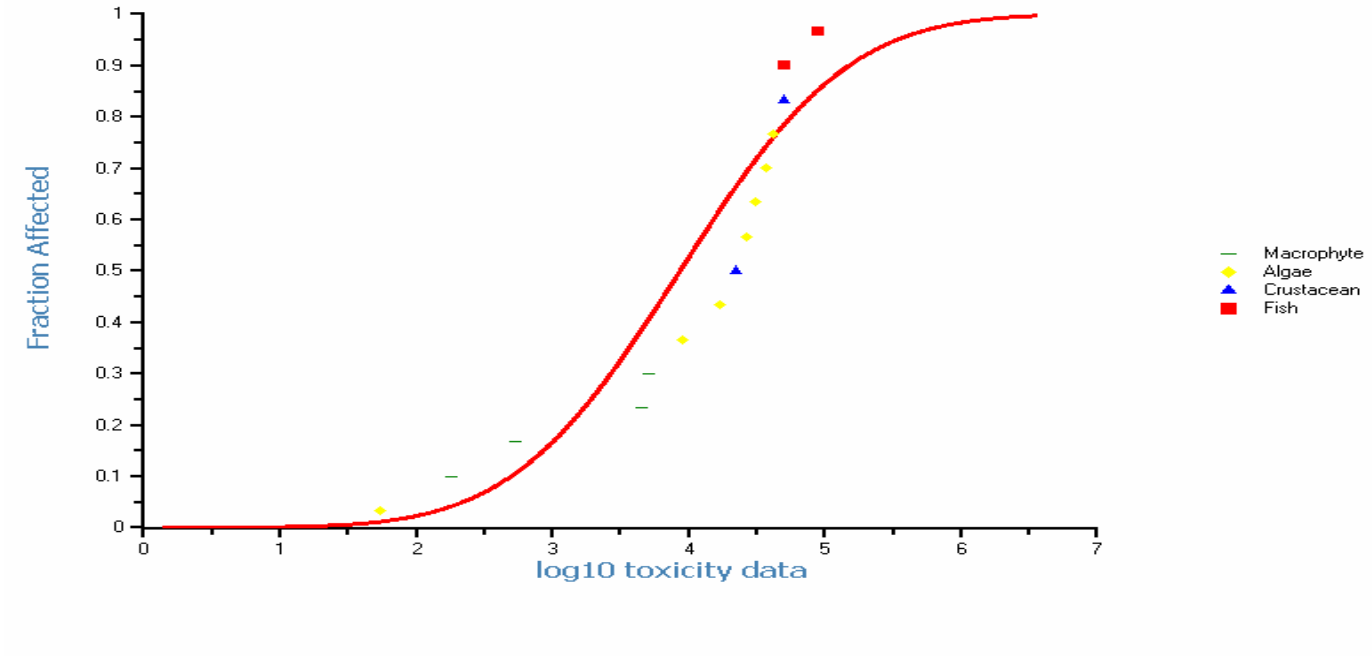


Figure 2.2 Cumulative distribution function of freshwater short-term data (µg a.e. l^{-1}) for mecoprop

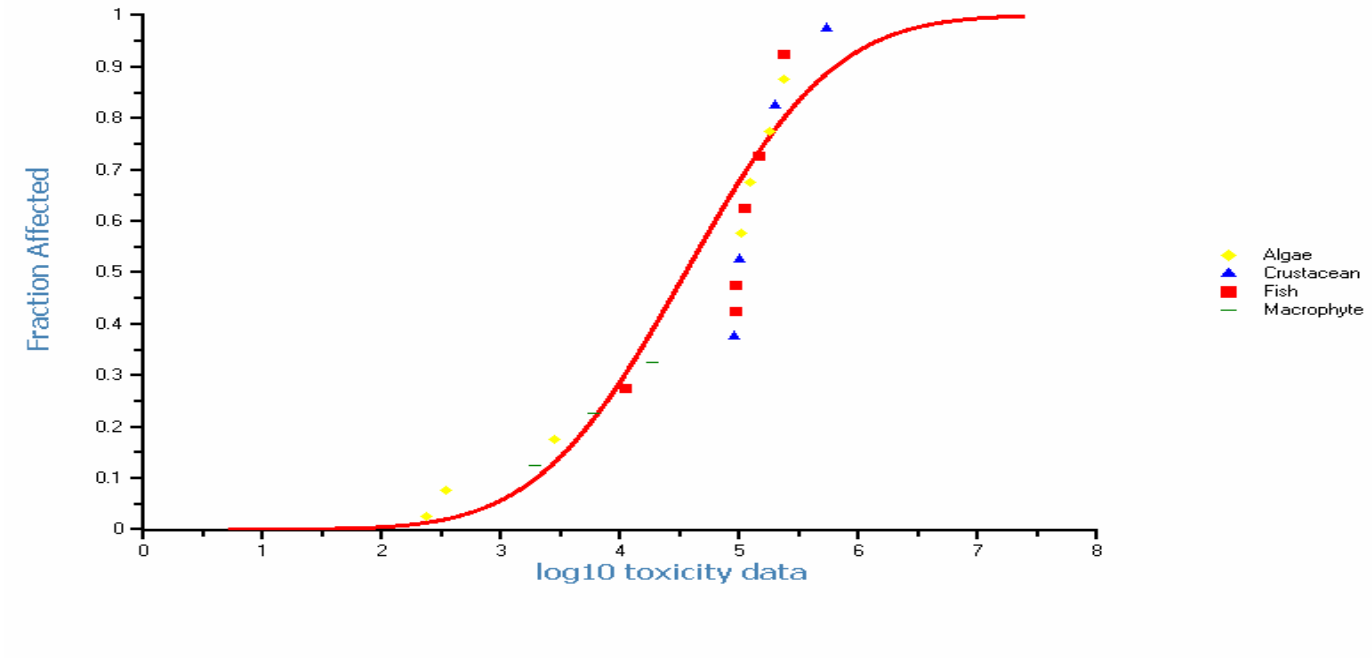


Table 2.9 Most sensitive long-term aquatic toxicity data for freshwater organisms exposed to mecoprop

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration (days)	Conc. (µg a.e. l^{-1})	Exposure[1]	Toxicant analysis[2]	Comments	Reliability (Klimisch Code*)	Reference
Mecoprop technical grade (98% purity)	*Lemna minor*	Macrophyte	MAC	EC50	Frond number	10	5,150	ss	n	25ºC; pH = 7	3	Kirby and Sheahan 1994
Racemate	*Selenastrum capricornutum*	Green algae	ALG	NOEC	Growth inhibition	4	37,600	ND	py	–	4	MCPP Task Force[#]
Racemate	*Lemna minor*	Macrophyte	MAC	EC10	Growth inhibition	7	4,500	s	ND	–	3	Nitschke *et al.* 1999
MCPP-p (92.9% pure)	*Selenastrum capricornutum*	Green algae	ALG	NOEC	Growth inhibition	3	9,000	ND	py	–	4	MCPP Task Force[#]
MCPP-p (92.9% pure)	*Pseudokirchneriella subcapitata*	Green algae	ALG	NOECb	Growth inhibition	3	27,000	s	y	23ºC	1	Dohmen 1993a
MCPP-p (92.2% pure)	*Daphnia magna Straus*	Water flea	CRU	NOEC	Reproduction	21	50,000	ss	y	21ºC; pH = 8.0	1	Dohmen 1993b[†]
MCPP-p (92.7% pure)	*Oncorhynchus mykiss*	Rainbow trout	FIS	NOEC	Mortality	28	50,000	f	y	16ºC; pH = 8.4	1	Munk 1993[†]
MCPP DMA (91.6% pure)	*Daphnia magna*	Water flea	CRU	NOEC	Reproduction	28	22,200	ss	y	20ºC; pH = 8.0	1	Mullerschon 1990[†]
MCPP DMA (91.6% pure)	*Oncorhynchus mykiss*	Rainbow trout	FIS	NOEC	Mortality and other effects	21	89,621	f	y	13–15ºC; pH = 7.8	1	Bogers 1990a[†]
MCPP-p DMA	*Navicula pelliculosa*	Diatom	ALG	NOEC	Growth inhibition	5	55	ND	py	–	3	Hoberg 1992a (also cited as OPP data in the US EPA Ecotox database)[‡]
MCPP-p-DMA	*Navicula pelliculaosa*	Diatom	ALG	NOEC	Growth inhibition	4	41800	s	y	22-23 ºC; pH = 7.24 – 7.89	1	Jenkins (2007)
MCPP-p DMA	*Selenastrum capricornutum*	Green algae	ALG	NOEC	Growth inhibition	5	<55	ND	py	–	3	Hoberg 1992b (also cited as OPP data in the US EPA Ecotox database)[‡]
MCPP-p DMA	*Selenastrum capricornutum*	Green algae	ALG	EC10	Growth inhibition	5	55	ND	py	–	3	Hoberg 1992b (also cited as OPP data in the US EPA Ecotox database)[‡]

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration (days)	Conc. (µg a.e. l^{-1})	Exposure[1]	Toxicant analysis[2]	Comments	Reliability (Klimisch Code*)	Reference
MCPP-p DMA	*Lemna gibba*	Duckweed	MAC	NOEC	Reduction in frond number	5	<530	ND	py	24–26ºC; pH = 4.9–5.8	3	Hoberg 1992c(also cited as OPP data in the US EPA Ecotox database) ‡
MCPP-p DMA	*Lemna gibba*	Duckweed	MAC	EC10	Reduction in frond number	5	530	ND	py	24–26ºC; pH = 4.9–5.8	3	Hoberg 1992c (also cited as OPP data in the US EPA Ecotox database)‡
MCPP-p-DMA	*Lemna minor*	Duckweed	MAC	NOEC	Reduction in frond number	7	180	ss	y	23–26ºC; pH = 6.5 – 9.8	1	Caley and Kelly (1999)
Marks Optica MPn (602 g/l as MCPP)	*Pseudokirchneriella subcapitata*	Green algae	ALG	NOECb	Growth inhibition	3	17,000	s	y	23ºC	1	Memmert and Knoch 1993a†
U46KV Fluid (560 g/l MCPP DMA)	*Selenastrum capricornutum*	Green algae	ALG	NOECb	Growth inhibition	4	31,058	s	n	23ºC	4	Hansveit 1988†

* See Annex 1.
# Confidential data cited in Lewis *et al*. (1996).
† Cited in EU DAR 1999.
‡ Data from MCPP Task Force cited in Lewis *et al.* (1996) and submitted to the US EPA as part of FIFRA submissions.
[1] Exposure: s = static; ss = semi-static; f = flow-through.
[2] Toxicant analysis: y = measured; n = nominal; py = presumably measured.
ALG = algae; CRU = crustaceans; FIS = fish; MAC = macrophytes
ND = no data
NOEC = no observed effect concentration
NOECb = no observed effect concentration (biomass)
ECx = concentration effective against X% of the organisms tested

Table 2.10 Most sensitive short-term aquatic toxicity data for freshwater organisms exposed to mecoprop

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration	Conc. (µg a.e. l^{-1})	Expo-sure[1]	Toxicant analysis[2]	Comments	Reliability (Klimisch Code*)	Reference
Mecoprop technical grade (98% purity)	*Scenedesmus subspicatus*	Green algae	ALG	EC50	Growth inhibition	96 hours	102,660	s	n	20ºC	3	Kirby and Sheahan 1994
MCPP	*Daphnia magna*	Water flea	CRU	EC50	Immobilisation	48 hours	>100,000	s	ND	–	4	OPP 2000
MCPP	*Lepomis macrochirus*	Bluegill sunfish	FIS	LC50	Lethality	96 hours	92,000	s	ND	–	4	OPP 2000
Racemate	*Scenedesmus subspicatus*	Green algae	ALG	EC50	Growth inhibition	72 hours	>180,000	s	ND	–	3	Nitschke *et al.* 1999
Racemate	*Lemna minor*	Macrophyte	MAC	EC50	Growth inhibition	7 days	6,000	s	ND	–	3	Nitschke *et al.* 1999
Racemate	*Daphnia magna*	Water flea	CRU	EC50	Immobilisation	24 hours	>100,000	s	ND	–	3	Nitschke *et al.* 1999
Racemate	*Oncorhynchus mykiss*	Rainbow trout	FIS	LC50	Lethality	96 hours	150,000–220,000	s	py	15–18ºC	4	MCPP Task Force**
MCPP-p	*Selenastrum capricornutum*	Green algae	ALG	EC50	Growth inhibition	120 hours	2,8040	s	ND	–	4	OPP 2000
MCPP-p (87.9% pure)	*Daphnia magna*	Water flea	CRU	EC50	Immobilisation	48 hours	>91,000	s	y	22ºC; pH 7.0–7.8	1	Bell 1994†
MCPP-p (91.4% pure)	*Lepomis machrochirus*	Bluegill sunfish	FIS	LC50	Lethality	96 hours	>50,000	s	y	22ºC; pH 8.0	1	Munk 1989†
MCPP DMA	*Daphnia magna*	Water flea	CRU	EC50	–	48 hours	>200,000	ND	y	–	1	Mullerschon 1990 Cited in EC 2003a
MCPP DMA (91.6% pure)	*Oncorhynchus mykiss*	Rainbow trout	FIS	LC50	Lethality	96 hours	240,000	f	y	15–17ºC; pH 7.85–8.26	1	Bogers 1990b
MCPP DMA (91.6% pure)	*Lepomis machrochirus*	Bluegill sunfish (2.0 g fish)	FIS	LC50	Lethality	96 hours	112,000	s	ND	–	4	OPP 2000
MCPP-p DMA	*Scenedesmus subspicatus*	Green algae	ALG	EC50	Growth inhibition	72 hours	237,000	ND	py	–	4	Armstrong 2000#
MCPP-p DMA	*Selenastrum capricornutum*	Diatom	ALG	EC50	Growth inhibition	120 hours	340	s	ND	–	3	Hoberg 1992b (also cited as OPP data in USEPA Ecotox database)‡
MCPP-p DMA	*Navicula pelliculosa*	Diatom	ALG	EC50	Growth inhibition	120 hours	240	s	ND	–	3	Hoberg 1992a (also cited as OPP data in USEPA Ecotox database)‡

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration	Conc. (µg a.e. l^{-1})	Expo-sure[1]	Toxicant analysis[2]	Comments	Reliability (Klimisch Code*)	Reference
MCPP-p DMA	*Navicula pelliculosa*	Diatom	ALG	EC50	Growth inhibition	96	152000	s	y	22-23 ºC; pH = 7.24 – 7.89	1	Jenkins (2007)
MCPP-p DMA	*Lemna minor*	Macrophyte	MAC	EC50	Growth inhibition	7 days	1900	s	ND	–	3	Hoberg 1992c (also cited as OPP data in USEPA Ecotox database) ‡
MCPP-p-DMA	*Lemna minor*	Duckweed	MAC	EC50	Reduction in frond number	7	18700	ss	y	23–26ºC; pH = 6.5 – 9.8	1	Caley and Kelly (1999)
MCPP-p DMA	*Lepomis macrochirus*	Bluegill sunfish	FIS	LC50	Lethality	96 hours	>93,000	ND	y	22ºC; pH 8.5	1	Kirsch and Munk 1992a†
MCPP-p DMA	*Oncorhynchus mykiss*	Rainbow trout	FIS	LC50	Lethality	96 hours	>93,000	ND	y	12ºC; pH 8.5	1	Kirsch and Munk 1992b†
Marks Optica MPn (602 g/l as MCPP)	*Pseudokirchneriella subcapitata*	Green algae	ALG	ECb50	Growth inhibition	72 hours	122,000	s	y	23ºC	1	Memmert and Knoch 1993a†
Marks Optica MPn (602 g/l as MCPP)	*Daphnia magna*	Water flea	CRU	EC50	Immobilisation	48 hours	147,000	s	y	22ºC; pH 7.8–8.0	1	Memmert and Knoch 1993b†
Marks Optica MPn (602 g/l as MCPP)	*Oncorhynchus mykiss*	Rainbow trout	FIS	LC50	Lethality	96 hours	76,000 (estimate)	s	y	13–15ºC; pH 7.4–8.1	1	Memmert and Knoch 1993c†
Duplosan KV (600 g/l as MCPP)	*Daphnia magna*	Water flea	CRU	EC50	Immobilisation	48 hours	>531,000	s	y	21ºC; pH 7.9–8.0	1	Bias 1988†
NPH 1313 (40% mecoprop)	*Rasbora heteromorpha*	Harlequin fish	FIS	LC50	Lethality	48 hours	11,000	ss	n	20ºC; pH 7.2	3	Alabaster 1969

* See Annex 1.
** Confidential data cited in Lewis *et al*. (1996).
† Cited in EU DAR 1999.
‡ Data from MCPP Task Force cited in Lewis *et al*. (1996) and submitted to the US EPA as part of FIFRA submissions.
# Cited in EC 2003a and b.
[1] Exposure: s = static; ss = semi-static; f = flow-through.
[2] Toxicant analysis: y = measured; n = nominal; py = presumably measured.
ALG = algae; CRU = crustaceans; FIS = fish; MAC = macrophytes
ECb = effective concentration (biomass)
EC50 = concentration effective against 50% of the organisms tested
LC50 = concentration lethal to 50% of the organisms tested
ND = no data

2.6.2 Toxicity to saltwater organisms

Toxicity data referring to the effects of mecoprop on marine organisms are available for algae, invertebrates and fish.

Single species long-term toxicity data on the effects of mecoprop on marine organisms are available for two different taxonomic groups: algae and molluscs. Short-term toxicity data are only available for four species: algae, crustaceans, fish and molluscs.

Long-term and short-term toxicity data for marine species are summarised in Tables 2.11 and 2.12 respectively.

Diagrammatic representations of the available saltwater data (cumulative distribution functions) for mecoprop are presented in Figures 2.3 and 2.4. These diagrams include all data regardless of quality and provide an overview of the spread of the available data. These diagrams are not species sensitivity distributions and have not been used to set the mecoprop PNECs. The lowest critical long-term and short-term toxicity data for marine species are summarised in Tables 2.11 and 2.12, respectively.

Figure 2.3 Cumulative distribution function of saltwater long-term data (µg a.e. l^{-1}) for mecoprop

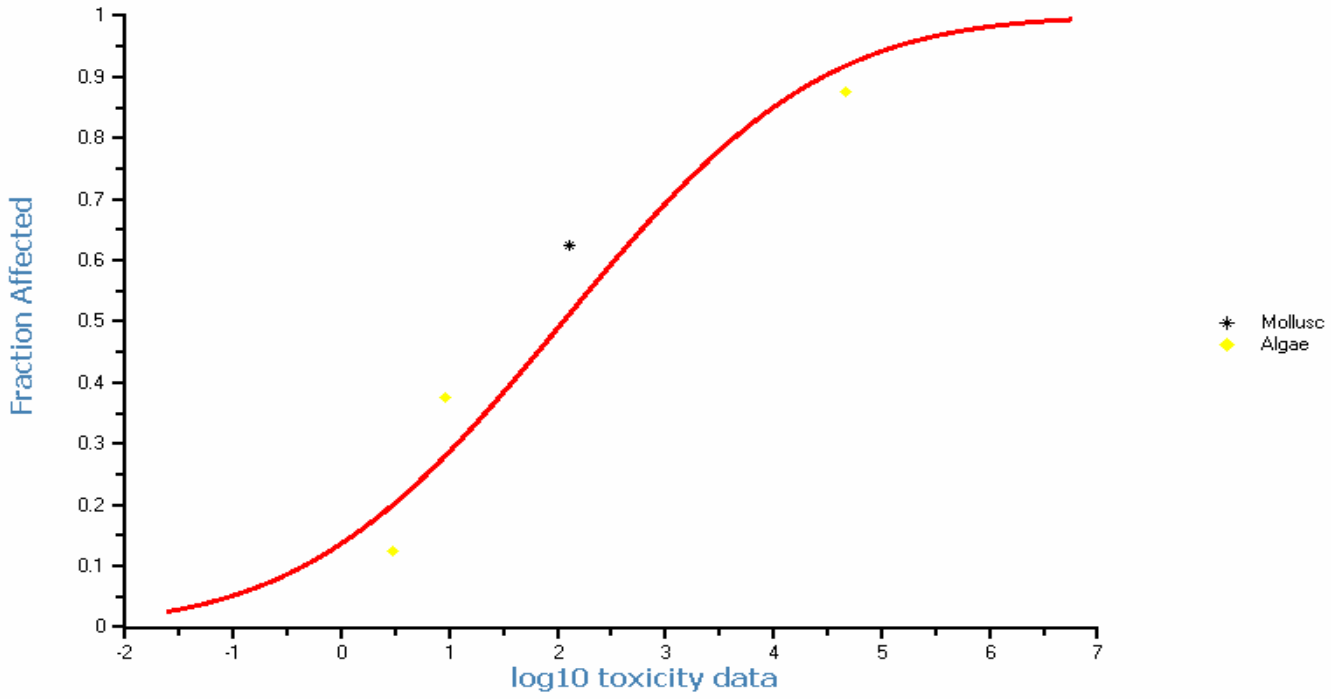


Figure 2.4 Cumulative distribution function of saltwater short-term data (µg a.e. l^{-1}) for mecoprop

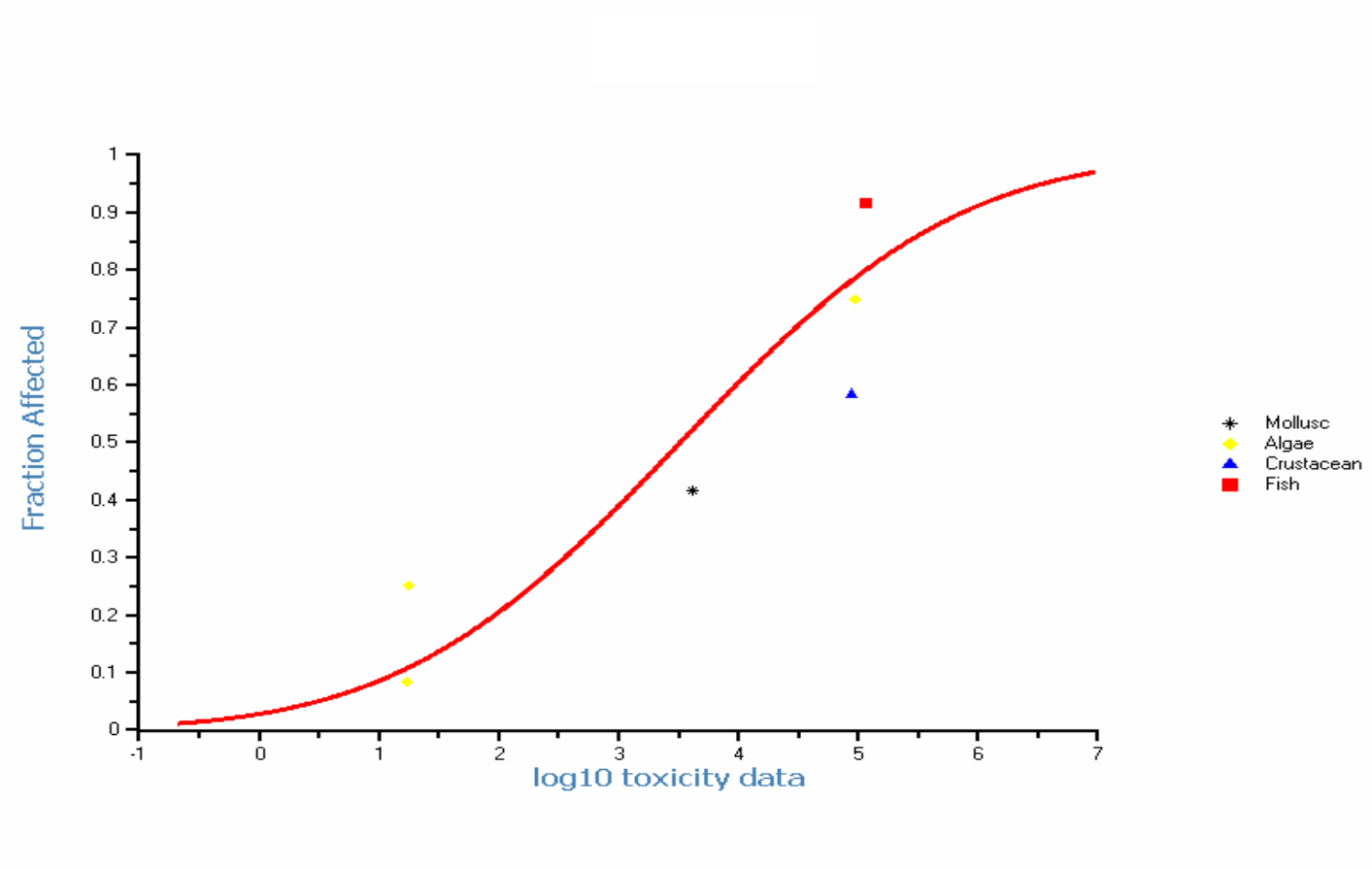


Table 2.11 Most sensitive long-term aquatic toxicity data for saltwater organisms exposed to mecoprop

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration	Conc. (µg a.e. l^{-1})	Exposure	Toxicant analysis[1]	Comments	Reliability (Klimisch Code*)	Reference
MCPP	*Crassostrea gigas*	Pacific oyster (larvae)	MOL	EC10	Growth inhibition	9 days	130	ND	ND	–	4	His and Seaman 1993
MCPP-p	*Skeletonema costatum*	Marine diatom	ALG	LOEC	Growth inhibition	120 hours	9.0	ND	py	18–20ºC	4	MCPP Task Force[#]
MCPP-p	*Skeletonema costatum*	Marine diatom	ALG	NOEC	Growth inhibition	120 hours	3.0 (estimate)	ND	py	18–20ºC	4	MCPP Task Force[#]
MCPP-p_DMA	*Skeletonema costatum*	Marine diatom	ALG	NOEC	Growth inhibition	96 hours	47000	s	y	19-25 ºC; salinity = 36‰	1	Burke 2007

* See Annex 1. [#] Confidential data cited in Lewis *et al*. (1996).
[1] Toxicant analysis: py = presumably measured.
ALG = algae; MOL = molluscs
EC10 = concentration effective against 10% of the organisms tested; LOEC = lowest observed effect concentration; NOEC = no observed effect concentration
ND = no data

Table 2.12 Most sensitive short-term aquatic toxicity data for saltwater organisms exposed to mecoprop

Form of the substance	Scientific name	Common name	Taxonomic group	End-point	Effect	Test duration	Conc. (µg a.e. l^{-1})	Exposure[1]	Toxicant analysis[2]	Comments	Reliability (Klimisch Code*)	Reference
MCPP	*Crassostrea gigas*	Pacific oyster (larvae)	MOL	EC50	Growth	9 days	4,200	ss	ND	–	4	His and Seaman 1993
MCPP-p	*Skeletonema costatum*	Marine diatom	ALG	EC50	Growth inhibition, cell density	120 hours	18	ND	py	18–20ºC	4	MCPP Task Force[#]
MCPP, K-salt content of active ingredient = 640 g/l	*Nitocra spinipes*	Copepod	CRU	LC50	Lethality	96 hours	87,000	s	n	20–22ºC; salinity 7‰	3	Linden *et al.* 1979
MCPP, K-salt content of active ingredient = 640 g/l	*Alburnus alburnus*	Bleak	FIS	LC50	Lethality	96 hours	115,000	s	n	10ºC; salinity 7‰	3	Linden *et al.* 1979
MCPP-p DMA	*Skeletonema costatum*	Marine diatom	ALG	EC50	Growth inhibition	5 days	17	s	ND	–	3	Hoberg 1992d
MCPP-p_DMA	*Skeletonema costatum*	Marine diatom	ALG	EC50	Growth inhibition	96 hours	95000	s	y	19-25 ºC; salinity = 36‰	1	Burke 2007

* See Annex 1. [#] Confidential data cited in Lewis *et al*. (1996). [1] Exposure: s = static; ss = semi-static. [2] Toxicant analysis: n = nominal; py = presumably measured.
ALG = algae; CRU = crustaceans; FIS = fish; MOL = molluscs
EC50 = concentration effective against 50% of the organisms tested; LC50 = concentration lethal to 50% of the organisms tested
ND = no data

2.6.3 Toxicity to sediment-dwelling organisms

Mecoprop's low log Kow of 3.06–3.25 (see Section 2.5) means that it is not expected to strongly sorb to organic matter. This hypothesis has been confirmed in field studies which indicate that, in a water/sediment matrix, mecoprop remains predominantly in the water column (see Section 2.5). No laboratory data on the toxicity of mecoprop (in terms of mg mecoprop per kg sediment) to sediment-dwelling organisms was located.

2.6.4 Endocrine-disrupting effects

No information on the endocrine-disrupting properties of mecoprop was located. Studies are only available in which the endocrine-disrupting properties of mecoprop were evaluated in combination with other substances.

2.6.5 Mode of action of mecoprop

Mecoprop is a phenoxypropanoic acid with potent auxin activity in bioassays and in treated sensitive plants. The compound is directly toxic to susceptible plants without metabolic activation. Mecoprop induces a series of morphological and physiological effects. These include decreases in root and shoot growth, epinasty (downward bending) of stems, severe chloroplast damage leading to leaf chlorosis, altered stomatal function, reduced water consumption, inhibition of photosynthetic carbon dioxide assimilation, changes in vascular tissues, disruption of membrane integrity, tissue collapse and, ultimately, decay. Phenoxy herbicides are not direct inhibitors of photosynthesis.

Mecoprop possesses a high degree of metabolic stability in the plant, unlike endogenous auxin. Physiological and molecular investigations have proposed that the primary reasons for phytotoxic action are effects on plasmalemma ATPases and proton gradient development influencing cell wall plasticity, induction of ethylene biosynthesis, and an aberrant nucleic acid metabolism induced by hormonal imbalance in treated tissues.

Studies on unicellular algae exposed to phenoxy herbicides indicate that these organisms are not particularly susceptible to these substances given that there is no precedent for a diffusion hormone in single cell plants. Instead aquatic macrophytes are expected to be the most sensitive taxonomic group to mecoprop.

It is also evident that in general the effects of mecoprop on algae are reversible at least at moderate concentrations, i.e. they are phytostatic (algistatic), rather than phytolethal (algicidal).

2.6.7 Mesocosm and field studies

Freshwater mesocosm and field studies

No information on the effects of exposure to mecoprop alone on freshwater organisms from mesocosm and field studies was located. Studies are only available in which mecoprop was applied in combination with other substances.

Saltwater mesocosm and field studies

No information on the effects of mecoprop on saltwater organisms from mesocosm or field studies was located.

3 Calculation of PNECs as a basis for the derivation of quality standards

3.1 Derivation of PNECs by the TGD deterministic approach (AF method)

3.1.1 PNECs for freshwaters

PNEC accounting for the annual average concentration

For the freshwater environment, data are available for the 'base set' of toxicity tests (i.e. tests with algae, crustaceans and fish) and therefore the EU Technical Guidance Document (TGD) assessment factor method can be applied. Long-term (lt) toxicity data are available for four taxonomic groups (algae, crustaceans, fish and macrophytes), with macrophytes being more sensitive than algae, invertebrates and fish.

While evaluating the available data some uncertainties were raised over the reliability of the toxicity data reported by Holberg (tests from the Springborn laboratory in the 1990s) some of which were considered in the derivation of the existing EQSs in 1996 (Lewis *et al*. 1996). The 'Hoberg' data generally show the lowest toxicity values for different chemical forms of mecoprop, but there is no or limited information on the test conditions and particularly whether there was analytical confirmation of the exposure concentrations. The data are not included in the EU DAR (1999). However, key data (Hoberg 1992a, Hoberg 1992b, Hoberg 1992c) were submitted to the US EPA by industry as part of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) submission process and these data are listed on the ECOTOX database as OPP data.

During this review of the PNEC, the MCPP Task Force have provided data which indicates that there may have been a systematic bias in the data generated in the 1990s by the Springborn laboratory for algal and macrophyte toxicity tests carried out on a series of phenoxy herbicides. This is based on the fact that 21 tests have been repeated in other laboratories in various European countries and the USA and in 19 studies the repeated result always showed lower toxicity, with the difference in some cases being several orders of magnitude. Despite investigations at the Springborn laboratory and elsewhere, no specific cause for these discrepancies between the values has been discovered.

Following a thorough review of the new data provided by the MCPP Task Force, which includes recent studies on the toxicity of mecoprop to freshwater and marine algae (Burke 2007, Jenkins 2007), it has been concluded that the data generated in the Springborn laboratory during the 1990s should be considered unreliable and therefore not be used in the derivation of PNECs.

With respect to the freshwater long-term PNEC the data that have been assessed to be unreliable are the Hoberg (1992a) and Hoberg (1992b) studies that assessed the long-term toxicity of mecoprop to algae and the Hoberg (1992c) study that reported effects of MCPP-p DMA on the macrophyte *Lemna gibba*.

Specifically, Hoberg (1992b) reported a 5-day NOEC of <55 µg a.e. l^{-1} for effects of MCPP-p DMA on inhibition of the growth of the green alga *Selenastrum capricornutum* was reported along with a 5-day EC10 of 55 µg a.e. l^{-1}. Holberg (1992a) reported a 5-day NOEC of 55 µg a.e. l^{-1} for effects of MCPP-p on inhibition of the growth of the diatom *Navicula pelliculosa* was reported, while Hoberg (1992c) reported a 5-day NOEC of <530 µg a.e. l^{-1} (and a 5-day EC10 of 530 µg a.e. l^{-1}) for effects of MCPP-p DMA on the macrophyte *Lemna gibba*.

A recent GLP compliant study by Jenkins (2007) reported a 4-day NOEC of 41800 µg a.e. l^{-1} for effects of MCPP-p-DMA on the inhibition of the growth rate of the diatom *Navicula pelliculosa* is now considered to the most reliable and lowest effects data for algae. The study was carried out in accordance with relevant EC/OECD/EPA Guidelines and incorporated analytical confirmation of the exposure concentrations.

Overall, the lowest valid GLP compliant data available for mecoprop is a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor* (Caley and Kelly 1999). This study was carried out in accordance with relevant OECD/EPA Guidelines and incorporated analytical confirmation of the exposure concentrations.

For the crustacean *Daphnia magna*, 21-day and 28-day NOEC values of 50,000 µg a.e. l^{-1} (Dohmen 1993b) and 22,200 µg a.e. l^{-1} (Mullerschon 1990) have been reported for reproduction effects in organisms exposed to MCPP-p and MCPP DMA respectively. Both studies were carried out to standardised procedures (OECD Guideline 202, Part B[10]) and there was analytical confirmation of the exposure concentrations.

Fish showed slightly lower sensitivity to mecoprop than invertebrates. A 28-day NOEC of 50,000 µg a.e. l^{-1} for effects of MCPP-p on the survival of *Oncorhynchus mykiss* was reported by Munk (1993). Bogers (1990a) reported a 21-day NOEC of 89,621 µg a.e. l^{-1} for effects of MCPP DMA on the survival and physiology of *Oncorhynchus mykiss*. Both these studies were carried out to standardised procedures (OECD Guideline 204[10]) and there was analytical confirmation of the exposure concentrations.

Since long-term NOECs are available for algae, crustaceans and fish, an assessment factor (AF) of 10 has been applied to the lowest valid toxicity value. Deriving the $PNEC_{freshwater\_lt}$ using the 4-day NOEC of 180 µg a.e. l^{-1} for effects on the growth of the macrophyte *Lemna minor*, the resulting value is:

$PNEC_{freshwater\_lt}$ = 180 µg l^{-1}/AF (10) = 18 µg l^{-1} mecoprop

PNEC accounting for transient concentration peaks

Short-term (st) toxicity tests are available for four taxonomic groups (algae, crustaceans, fish and macrophytes), with macrophytes being more sensitive than the other taxa.

As discussed above in the derivation of the freshwater long-term PNEC, the lowest toxicity values from studies carried out at the Springborn laboratory are now considered unreliable. For short term exposure this specifically relates to a 120-hour EC50 of 240 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the diatom *Navicula pelliculosa* (Hoberg 1992a); a 120-hour EC50 of 340 µg l^{-1} was reported for the green algae *Selenastrum capricornutum* when exposed to MCPP-p DMA (Hoberg 1992b) and a 5-day EC50 of 1900 µg a.e. l^{-1} for effects of MCPP-p DMA on *Lemna gibba* (Hoberg 1992c).

[10] See http://www.oecd.org/document/62/0,2340,en_2649_34377_2348862_1_1_1_1,00.html

Once the Springborn data are disregarded, the following can be considered the most relevant and reliable data.

For algae, a recent GLP compliant study by Jenkins (2007) reported a 96-hour EC50 of 152000 µg l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor* (Caley and Kelly 1999). This study was carried out in accordance with relevant OECD/EPA Guidelines, carried out to GLP and incorporated analytical confirmation of the exposure concentrations.

For macrophytes a 7-day EC50 of 6000 µg a.e. l^{-1} for effects of racemate mecoprop on the growth of *Lemna minor* has been reported (Nitschke *et al* 1999). This study was carried out using the OECD procedure but the paper did not indicate whether there was analytical confirmation of the exposure concentrations. Therefore, it is proposed that this value is not used to derive the PNEC.

The lowest valid toxicity value is considered to be a 7-day EC50 of 18700 µg a.e. l_{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor* (Caley and Kelly 1999). This study was carried out in accordance with relevant OECD/EPA Guidelines, carried out to GLP and incorporated analytical confirmation of the exposure concentrations.

The reported data for the crustacean *Daphnia magna* includes 24- and 48-hour EC50s of >100,000 µg a.e. l^{-1} based on the immobilisation endpoint after exposure to mecoprop and racemic mecoprop respectively (Nitschke *et al.* 1999, OPP 2000). The study by Nitschke *et al.* involved analytical confirmation of the stock exposure concentrations whereas it is not evident from the Office of Pesticide Program data whether there was analytical confirmation of the exposure concentrations.

Short-term toxicity data for fish range between 11,000 and 630,000 µg a.e. l^{-1} depending on the species tested. The most sensitive fish lethality data is a 96-hour LC50 of 11,000 µg a.e. l^{-1} for effects of the NPH 1313 formulation on the harlequin fish *Rasbora hetermorpha* (Alabaster 1969) However, full details of the experimental procedures are not available for this study.

Based on the available data, it is proposed that the $PNEC_{freshwater\_st}$ is derived using a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* Using the guidance given in the TGD on effects assessment for intermittent releases [Section 3.3.2 of Part II of the TGD document (ECB 2003)], an assessment factor of 100 can be applied resulting in the following value:

$PNEC_{freshwater\_st}$ = 18700 µg l^{-1}/AF (100) = 187 µg l^{-1} mecoprop

3.1.2 PNECs for saltwaters

The effects database for marine species is considerably smaller than that for freshwater organisms. Long-term data are available for two different taxonomic groups, i.e. algae and molluscs. Short-term toxicity data are available for four different taxonomic groups (algae, crustaceans, fish and molluscs). However, the limited marine toxicity database is too small to draw firm conclusions on possible differences between freshwater and saltwater organisms.

Based on the available data, it is proposed that the TGD approach of using freshwater data within the marine effect assessment is adopted and proposed freshwater PNECs should be considered in deriving PNECs for marine water bodies.

PNEC accounting for the annual average concentration

There are limited long-term single species toxicity data for marine organisms (Table 2.11) with data being available only for algae and molluscs. The lowest long-term saltwater toxicity value is an estimated 5-day NOEC of 3 µg a.e. l^{-1} (based on a LOEC of 9 µg a.e. l^{-1} being divided by a factor of 3) for effects of MCPP-p DMA on the growth of the *Skeletonema costatum* (Hoberg 1992d). However, for the reasons already discussed in Section 3.1.1, this study is not considered reliable.

Rather the most reliable algal data can be considered that reported in a recent study by Burke (2007) where a 4-day NOEC of 47000 µg a.e. l^{-1} for effects on growth of the marine diatom *Skeletonema costatum* was calculated. The study was carried out in accordance with relevant EC/OECD/EPA Guidelines and incorporated analytical confirmation of the exposure concentrations.

The absence of long-term data for both crustacean and fish means that it is not appropriate to generate a $PNEC_{saltwater\_lt}$ based on the saltwater data alone. Therefore, it is proposed that the combined freshwater and saltwater dataset is used for the PNEC generation, an approach which is consistent with that described in the TGD (ECB 2003. The use of *Lemna* data in deriving the saltwater PNEC is considered appropriate in the absence of marine macrophyte data, and given that the valid *Skeletonema* data are no more sensitive than equivalent freshwater species.

Although long-term NOECs are available for algae, invertebrates and fish, there are no toxicity data for marine taxa such as echinoderms. This would normally result in the application of an additional assessment factor of 10, resulting in a total AF of 100. However, the available freshwater toxicity data and information on the substances mode of action indicate that the macrophytes (and potentially macroalgae) are the most sensitive taxa to the substance.. Since a large body of long-term data is available for freshwater and saltwater algae, an assessment factor of 10 can legitimately be applied to the lowest valid toxicity value.

Deriving the $PNEC_{saltwater\_lt}$ using the estimated 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the macrophyte *Lemna minor* and an assessment factor of 10 the resulting value would be:

$PNEC_{saltwater\_lt}$ = 180 µg l^{-1}/AF (10) = 18 µg l^{-1} mecoprop

PNEC accounting for transient concentration peaks

Single species short-term toxicity data relating to marine organisms are available for four different taxonomic groups, i.e. algae, crustaceans, fish and molluscs.

A 120-hour EC50 of 17 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the diatom *Skeletonema costatum* was reported by Hoberg (1992d). However, for the reasons already discussed in Section 3.1.1, this study is not considered reliable.

Rather, the most reliable algal data can be considered that reported in a recent study by Burke (2007) where a 96-hour EC50 of 95000 µg a.e. l^{-1} for effects on growth of the marine diatom *Skeletonema costatum* was calculated. The study was carried out in accordance with relevant EC/OECD/EPA Guidelines and incorporated analytical confirmation of the exposure concentrations.

Other reported short-term data include two 96-hour LC50 studies reported by Linden *et al.* (1979) for lethal effects of MCPP on the brackish water copepod (*Nitocra spinipes*) and fish bleak (*Alburnus alburnus*) of 87,000 and 115,000 µg a.e. l^{-1}, respectively. However, there was no analytical confirmation of the exposure concentrations. As a result, there are issues with the reliability of these data.

The limited data available means that it is not appropriate to derive the $PNEC_{saltwater\_st}$ based on the saltwater data alone. Therefore, it is proposed that a combined freshwater and saltwater dataset is used for the PNEC generation in accordance with

the TGD (ECB 2003). The use of *Lemna* data in deriving the saltwater PNEC is considered appropriate in the absence of marine macrophyte data, and given that the valid *Skeletonema* data are no more sensitive than equivalent freshwater species

The TGD does not provide specific guidance on assessment of short-term effects of intermittent releases to marine water bodies. Therefore, calculation of the PNEC accounting for effects following short-term exposure to mecoprop is suggested, based on the general guidance given in the TGD on the effects assessment for intermittent releases [Section 3.3.2 of Part II of the TGD (ECB 2003)]. This would normally result in application of an assessment factor of 100 being applied. Although short-term EC50s are available for freshwater algae, invertebrates and fish, there are no toxicity data for marine taxa such as echinoderms. This would normally result in the application of an additional assessment factor of 10, resulting in a total AF of 1,000. However, the available data indicate that the macrophytes are the most sensitive taxa to the substance. Therefore, it is proposed that a factor of 100 is used.

Deriving the $PNEC_{saltwater\_st}$ using a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor* and an assessment factor of 100, the resulting value would be:

$PNEC_{saltwater\_st}$ = 18700 µg l^{-1}/AF (100) = 187 µg l^{-1} mecoprop

3.2 Derivation of PNECs by the TGD probabilistic approach (SSD method)

There are insufficient data to construct a species sensitivity distribution (SSD) based on long-term exposure data.

3.3 Derivation of existing EQSs

The derivation of the proposed EQSs for mecoprop was described in the Environment Agency R&D Note 502 (Lewis *et al*. 1996).

In freshwaters, the available data for mecoprop and its derivatives/formulations were limited and mainly concerned the dimethylamine salt. Aquatic macrophytes were reported as the most sensitive organisms to mecoprop. The data were considered sufficient to derive proposed EQSs for mecoprop as an annual average (AA) and maximum allowable concentration (MAC). They were derived by applying safety factors of 100 and 10 to the EC50 for frond production for *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance. The EQSs of 20 µg mecoprop l^{-1} (AA) and 200 µg mecoprop l^{-1} (MAC) were proposed for the protection of freshwater life.

Data on the toxicity of mecoprop to saltwater organisms were limited to one marine algae and one brackish invertebrate. The data were considered insufficient to derive a saltwater EQS for mecoprop. Therefore it was proposed that the EQS of 20 µg mecoprop l^{-1} (AA) and 200 µg mecoprop l^{-1} (MAC) – as proposed for the protection of freshwater life – be used as guideline standards.

3.4 Derivation of PNECs for sediment

Since the log Kow of mecoprop is >3 (see Section 2.5), the derivation of PNECs for the protection of benthic organisms is required. However field studies indicate that, in a

water sediment matrix, mecoprop remains in the water column (see Section 2.5). No information on the toxicity of mecoprop to sediment dwelling organisms was located, so no $PNEC_{sediment}$ could be derived.

3.5 Derivation of PNECs for secondary poisoning of predators

3.5.1 Mammalian and avian toxicity data

Several reviews have been published regarding mecoprop (ACP 1994, IUCLID 2000, EC 2003a, EC 2003b).

The more recent reports by the European Commission[11] and IUCLID were assumed to contain the most sound and scientifically accurate mammalian data. These were therefore the primary sources used. However, the ACP review was also consulted. Additional literature searches were performed from 2003 to the present day to locate any lower effect data since 2003, but none were located.

Due to the lack of relevant data in the IUCLID and EC reviews, the ACP review was assumed to contain the most sound and scientifically accurate data for avian toxicity. As for mammalian data, a comprehensive literature search was performed from 1994 to the present day to locate any lower effect data since 1994; however, none were located.

Oral exposure of mammals to mecoprop results in LD50 values of 930–1,210 mg/kg for rats and 650 mg/kg for mice (Thomson 1982, Budavari *et al.* 1989, Mesiter 1992). There have been a number of short- and long-term studies on the effects of mecoprop following oral exposure. These are summarised in Table 3.1.

[11] Carried out when mecoprop added to the list of substances covered by the Plant Protection Products (PPP) Directive.

Table 3.1 Most sensitive mammalian and bird oral toxicity data relevant for the assessment of secondary poisoning

Study and result	Details
Sub-chronic toxicity to mammals	
BASF 1985 Cited in EU DAR 1999, IUCLID 2000 and ACP 1994 **Sub-chronic NOAEL = 4–4.5 mg/kg bw/day**	Male and female Wistar rats (15 per sex per group) received mecoprop orally via their diet for 90 days at doses of 0, 50, 150 or 450 mg mecoprop (technical; purity 92.7%) per kg diet. The NOAEL was based on increased kidney weight, clinical chemistry changes in the kidney, increased liver weight and enzyme induction in the liver at the top two doses. This study was not conducted to GLP, but conformed to the OECD Guideline 408 'Subchronic Oral Toxicity – Rodent: 90 day Study'.
TNO 1979 Cited in EU DAR 1999, IUCLID 2000 and ACP 1994 **Sub-chronic NOAEL = 4 mg/kg bw/day**	Male and female Beagle dogs (4 per sex per group) received mecoprop orally via their diet for 90 days at doses equivalent to 0, 4, 16 or 64 mg (technical; purity 92.4%) per kg bodyweight (bw) per day. The NOAEL was based on increased kidney weight, clinical chemistry changes in the kidney, increased liver weight and enzyme induction in the liver at the top two doses. This study was not conducted to GLP.
Chronic toxicity to mammals	
BASF 1988 Cited in EU DAR 1999, IUCLID 2000 and ACP 1994 **Chronic NOAEL = 1.1–1.3 mg/kg bw/day males or 1.4–1.6 mg/kg bw/day females**	Male and female SPF-Wistar rats (50 per sex per group) received mecoprop orally via the diet for two years at doses of 0, 20, 100 or 400 mg mecoprop (technical; purity 92.7%) per kg diet. The NOAEL was based on increased kidney weight, chronic nephropathy, increased liver weight and enzyme induction in the liver that occurred at the top two doses. No signs of carcinogenicity were observed.
Effects on reproduction of mammals	
Anon Cited in EU DAR 1999 **Reproductive NOAEL = 10 mg/kg bw/day**	Rats (sex and strain unspecified) received mecoprop orally via the diet for an unspecified duration at doses that included 100 mg/kg diet (approximately 10 mg/kg bw/day). The NOAEL was based on reduced pup weight gain at unspecified doses that were maternally toxic. No further details were provided and it is unclear in the review as to the identity of the original paper, although it is possible that these data may originate from BASF (1992), which was cited in IUCLID (2000) (see the study below).
BASF 1992 Cited in IUCLID 2000 **Reproductive NOAEL = 50 mg/kg bw/day**	Male and female rats (species unspecified) received mecoprop orally via the diet during two generations (i.e. F0 parental and F1 parental generations for a total of 25 weeks, including a pre-mating exposure of 70 days) at doses of 0, 20, 100 or 500 mg/kg diet (approximately 0, 2, 10 or 50 mg/kg bw/day). The reproductive NOAEL was based on unspecified effects. NOAELs for maternal toxicity (basis unspecified) were also derived – 10 mg/kg bw/day for F0 females and F1a and F2 pups and 2 mg/kg bw/day for F0 males, F1 males and females and F1b pups. This study was conducted to GLP.

Study and result	Details
Embryotoxicity and teratogenicity	
Anon Cited in EU DAR 1999 **Developmental NOAEL = 50 mg/kg bw/day**	Rats (sex and strain unspecified) received mecoprop orally (vehicle unspecified) for an unspecified duration at unspecified doses. The NOAEL was based on reduced pup weight and skeletal variations at unspecified doses that were maternally toxic. No further details were provided and the identity of the original paper is unclear, although it is possible that this data may originate from BASF (1992), which was cited in IUCLID (2000) (see the study above).
Hazleton Laboratories 1980 Cited in EU DAR 1999 **Teratogenic NOAEL = 75 mg/kg bw/day**	Female Dutch Belted rabbits received mecoprop orally via gavage during gestation days 6–19 (inclusive) at doses of 0, 12, 30 or 75 mg/kg bw/day. The teratogenic NOAEL was based on no evidence of teratogenicity observed at all dose levels. A maternal NOAEL of 75 mg/kg bw/day was also set, based on the lack of toxicity observed. This study was not conducted to GLP.
Sub-chronic toxicity to birds	
Anon Cited in ACP 1994 **Sub-chronic NOEC = 2,500 mg/kg diet**	Male and female 14-day-old bobwhite quails (*Colinus virginianus*; 10 per group) received mecoprop via their diet at doses of 0, 313, 625, 1,250, 2,500 or 5,000 mg mecoprop (>92.7% purity) per kg diet for five days. The NOEC was based on apathy, decreased food consumption and mortality occurring at the highest dose. No mention of GLP was made, but the method was stated to be that of the US EPA 'Avian dietary LC50 test'. It is unclear in the review as to the identity of the original paper.
Anon Cited in ACP 1994 **Sub-chronic NOEC = 1,780 mg/kg diet**	Male and female 9-day-old mallards (*Anas platyrhynchos*; 10 per group) received mecoprop via their diet at doses of 0, 562, 1,000, 1,780, 3,160 or 5,620 mg mecoprop (racemic acid; >92.7% purity) per kg diet for five days. The NOEC was based on decreased body weight gain and decreased food consumption occurring at the highest dose. The study was stated to be carried out so as to conform with GLP. It is unclear in the review as to the identity of the original paper.
No studies were available regarding the potential effects of mecoprop on avian reproduction, development or potential carcinogenicity.	

LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
NOEC = no observed effect concentration

3.5.2 PNECs for secondary poisoning of predators

Bioconcentration data (as BCF values) for mecoprop for the majority of aquatic organisms are low. Bioconcentration factors of 1.2, 5.5 and 3.0 were calculated in edibles (carcass, mainly fillets), non-edibles (head, viscera and fins) and whole fish, respectively. The study was a 28-day dynamic flow-through system according to US EPA guidelines based on radioactivity (^{14}C-mecoprop equivalents) (Ellgehausen 1986). Hence the trigger of BCF values >100 is not met and the derivation of PNECs for secondary poisoning of predators is not required.

4 Analysis and monitoring

Analytical methods for the determination of mecoprop were discussed in Environment Agency R&D Note 502 (Lewis *et al.* 1996).

The most popular method for the analysis of mecoprop in liquid and solid samples involves the use of gas–liquid chromatography. Coquart and Hennion (1993) reported measuring concentrations of mecoprop in drinking water using liquid chromatography (LC) separation. The method required on-line precolumn sampling using an anion exchanger to preconcentrate samples prior to their separation by LC. This preconcentration occurred as a two-step process. First, samples were percolated at pH 1 through a precolumn packed with a sorbent material. This was coupled to a second precolumn, which was packed with the anion exchanger. Coquart and Hennion (1993) reported detection limits in a 500-ml sample ranging from 15 to 35 ng l^{-1}.

Garcíca-Campaña *et al.* (2001) measured mecoprop concentrations through the combination of flow injection analysis (FIA) and micellar photochemically induced fluorescence (MEPIF) detection. Utilising a cationic surfactant and direct irradiation with UV light, they reported that mecoprop was photolysed into strongly fluorescent photoproducts. A liner calibration was achieved based on photointensity and a detection limit of 33.5 ng ml^{-1} (33.5 µg l^{-1}) was determined for mecoprop.

Fung and Mak (2001) reported using micellar electrokinetic capillary chromatography to quantify levels of 14 pesticides in drinking water. They utilised a two-step sample preconcentration procedure prior to analysis – solid-phase extraction of the pesticides followed field-amplified sample stacking, which provided up to 30-fold preconcentration. They reported that this method allowed analysis of pesticides at concentrations at least tenfold lower than WHO guideline values.

Scheyer *et al.* (2005) reported atmospheric concentrations of several pesticides, including mecoprop, with detection limits ranging from 2.5 to 1,250 pg m^{-3} (0.0025–1.25 pg l^{-1}). This approach utilised gas chromatography coupled to ion-trap tandem mass spectrometry (MS/MS). Mecoprop analysis also required an additional derivatisation step, prior to analysis on the MS/MS, to resolve their peaks. This was achieved by the use of pentafluorobenzylbromide. Scheyer *et al.* (2005) successfully used this technique to determine pesticide levels in atmospheric samples.

For water, proposed PNECs derived for mecoprop range from 18-187 µg l^{-1}. The data quality requirements are that, at a third of the EQS, total error of measurement should not exceed 50 per cent. Using this criterion, it is evident that current analytical methodologies (non-standard) employing gas chromatography coupled to ion-trap tandem mass spectrometry (MS/MS) capable of achieving detection limits as low as 0.0025–1.25 pg l^{-1} should offer adequate performance to analyse for mecoprop.

5 Conclusions

5.1 Availability of data

Long-term laboratory data are available for four different freshwater taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater short-term toxicity data are also available for four taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater macrophytes are more sensitive to both technical grade mecoprop and mecoprop formulations than algae, invertebrates and fish.

For marine organisms, single species short-term toxicity data are available for four different taxonomic groups (algae, crustaceans, fish and molluscs). Long-term toxicity data are available for two different saltwater taxa (algae and molluscs). Laboratory data are not supplemented by freshwater or saltwater mesocosm data.

No information on the endocrine-disrupting properties of mecoprop was located.

5.2 Derivation of PNECs

The proposed PNECS are described below and summarised in Table 5.1.

5.2.1 Long-term PNEC for freshwaters

The lowest valid NOEC value is from an industry generated study that complied with GLP and which assessed the long-term toxicity of mecoprop to macrophytes. This recorded a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the macrophyte *Lemna minor,* which is considered to be the most sensitive taxonomic group based on the substances mode of action. Since long-term NOECs are available for algae, crustaceans and fish an assessment factor of 10 has been applied to the lowest valid toxicity value. This results in a $PNEC_{freshwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}. This was derived by applying a safety factor of 100 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

5.2.2 Short-term PNEC for freshwaters

Reliable short-term data are available for algal, macrophyte, invertebrate and fish species. The lowest valid toxicity value is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* An assessment factor of 100 can be applied resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg $l^{-1.}$ This was derived by applying a safety factor of 10 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

5.2.3 Long-term PNEC for saltwaters

There are limited long-term toxicity data for marine organisms with data being available only for algae and molluscs. The absence of long-term data for both crustaceans and fish means that it is not appropriate to generate a $PNEC_{saltwater\_lt}$ based on the saltwater data alone. Therefore, it is proposed that the combined freshwater and saltwater dataset is used for the PNEC generation. The lowest long-term toxicity value from the combined dataset is a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the macrophyte *Lemna minor.* Since a large body of long-term data is available for freshwater and saltwater organisms, an assessment factor of 10 can legitimately be applied to the lowest valid toxicity value resulting in a $PNEC_{saltwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}, which was 'read across' from the freshwater long-term value.

5.2.4 Short-term PNEC for saltwaters

The limited reliable short-term toxicity data for marine organisms means that it is not appropriate to derive the $PNEC_{saltwater\_st}$ based on the saltwater data alone. Therefore, it is proposed that a combined freshwater and saltwater dataset is used for the PNEC generation.

The lowest valid short-term toxicity value from the combined dataset is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* The available data indicate that macrophytes are the most sensitive taxa to the substance. Given the large quantity of short-term data, it is proposed that an assessment factor of 100 is used resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg l^{-1}, which was 'read across' from the freshwater short-term value.

5.2.5 PNEC for sediments

Since the log Kow of mecoprop is >3, the derivation of PNECs for the protection of benthic organisms is required. However field studies indicate that, in a water sediment matrix, mecoprop remains in the water column. No information on the toxicity of mecoprop to sediment dwelling organisms was located, so no $PNEC_{sediment}$ could be derived.

5.2.6 PNEC for secondary poisoning

Bioconcentration data – as bioconcentration factor (BCF) values – for mecoprop for the majority of aquatic organisms are low, with a value of 3 reported in whole fish. Hence the EU Technical Guidance Document BCF trigger of 100 is not exceeded and the derivation of a PNEC in whole fish for secondary poisoning of predators is not required.

Table 5.1 Summary of proposed PNECs

Receiving medium/exposure scenario	Proposed PNEC (µg l^{-1})	Existing EQS (µg l^{-1})
Freshwater/long-term	18	20
Freshwater/short-term	187	200
Saltwater/long-term	18	20
Saltwater/short-term	187	200
Sediment	Insufficient data	–
Secondary poisoning	Not required	–

5.3 Analysis

The data quality requirements are that, at a third of the EQS, total error of measurement should not exceed 50 per cent. Using this criterion, it is evident that current analytical methodologies (non-standard) employing gas chromatograph/mass spectrometry (GC-MS) and capable of achieving detection limits as low as 0.0025–1.25 pg l^{-1} should offer adequate performance to analyse for mecoprop.

5.4 Implementation issues

These PNECS are suitable for use as EQSs because they are not subject to excessive uncertainty and analytical capability should be adequate for compliance assessment purposes.

6 Conclusions

6.1 Availability of data

Long-term laboratory data are available for four different freshwater taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater short-term toxicity data are also available for four taxonomic groups (algae, crustaceans, fish and macrophytes). Freshwater macrophytes are more sensitive to both technical grade mecoprop and mecoprop formulations than algae, invertebrates and fish.

For marine organisms, single species short-term toxicity data are available for four different taxonomic groups (algae, crustaceans, fish and molluscs). Long-term toxicity data are available for two different saltwater taxa (algae and molluscs). Laboratory data are not supplemented by freshwater or saltwater mesocosm data.

No information on the endocrine-disrupting properties of mecoprop was located.

6.2 Derivation of PNECs

The proposed PNECS are described below and summarised in Table 5.1.

6.2.1 Long-term PNEC for freshwaters

The lowest valid NOEC value is from an industry generated study that complied with GLP and which assessed the long-term toxicity of mecoprop to macrophytes. This recorded a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the macrophyte *Lemna minor,* which is considered to be the most sensitive taxonomic group based on the substances mode of action. Since long-term NOECs are available for algae, crustaceans and fish an assessment factor of 10 has been applied to the lowest valid toxicity value. This results in a $PNEC_{freshwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}. This was derived by applying a safety factor of 100 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

6.2.2 Short-term PNEC for freshwaters

Reliable short-term data are available for algal, macrophyte, invertebrate and fish species. The lowest valid toxicity value is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* An assessment factor of 100 can be applied resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg $l^{-1.}$ This was derived by applying a safety factor of 10 to an EC50 for frond production for the macrophyte *Lemna gibba* (EC50 = 1,900 µg l^{-1}) obtained using the mecoprop-p amine salt as a test substance.

6.2.3 Long-term PNEC for saltwaters

There are limited long-term toxicity data for marine organisms with data being available only for algae and molluscs. The absence of long-term data for both crustaceans and fish means that it is not appropriate to generate a $PNEC_{saltwater\_lt}$ based on the saltwater data alone. Therefore, it is proposed that the combined freshwater and saltwater dataset is used for the PNEC generation. The lowest long-term toxicity value from the combined dataset is a 7-day NOEC of 180 µg a.e. l^{-1} for effects of MCPP-p DMA on the growth of the macrophyte *Lemna minor.* Since a large body of long-term data is available for freshwater and saltwater organisms, an assessment factor of 10 can legitimately be applied to the lowest valid toxicity value resulting in a $PNEC_{saltwater\_lt}$ of 18 µg l^{-1}.

This value is lower than the existing EQS of 20 µg l^{-1}, which was 'read across' from the freshwater long-term value.

6.2.4 Short-term PNEC for saltwaters

The limited reliable short-term toxicity data for marine organisms means that it is not appropriate to derive the $PNEC_{saltwater\_st}$ based on the saltwater data alone. Therefore, it is proposed that a combined freshwater and saltwater dataset is used for the PNEC generation.

The lowest valid short-term toxicity value from the combined dataset is a 7-day EC50 of 18700 µg a.e. l^{-1} for effects of MCPP-p-DMA on the growth of the macrophyte *Lemna minor.* The available data indicate that macrophytes are the most sensitive taxa to the substance. Given the large quantity of short-term data, it is proposed that an assessment factor of 100 is used resulting in a $PNEC_{freshwater\_st}$ of 187 µg l^{-1}.

This value is lower than the existing EQS of 200 µg l^{-1}, which was 'read across' from the freshwater short-term value.

6.2.5 PNEC for sediments

Since the log Kow of mecoprop is >3, the derivation of PNECs for the protection of benthic organisms is required. However field studies indicate that, in a water sediment matrix, mecoprop remains in the water column. No information on the toxicity of mecoprop to sediment dwelling organisms was located, so no $PNEC_{sediment}$ could be derived.

6.2.6 PNEC for secondary poisoning

Bioconcentration data – as bioconcentration factor (BCF) values – for mecoprop for the majority of aquatic organisms are low, with a value of 3 reported in whole fish. Hence the EU Technical Guidance Document BCF trigger of 100 is not exceeded and the derivation of a PNEC in whole fish for secondary poisoning of predators is not required.

Table 5.1 Summary of proposed PNECs

Receiving medium/exposure scenario	Proposed PNEC (µg l^{-1})	Existing EQS (µg l^{-1})
Freshwater/long-term	18	20
Freshwater/short-term	187	200
Saltwater/long-term	18	20
Saltwater/short-term	187	200
Sediment	Insufficient data	–
Secondary poisoning	Not required	–

6.3 Analysis

The data quality requirements are that, at a third of the EQS, total error of measurement should not exceed 50 per cent. Using this criterion, it is evident that current analytical methodologies (non-standard) employing gas chromatograph/mass spectrometry (GC-MS) and capable of achieving detection limits as low as 0.0025–1.25 pg l^{-1} should offer adequate performance to analyse for mecoprop.

6.4 Implementation issues

These PNECS are suitable for use as EQSs because they are not subject to excessive uncertainty and analytical capability should be adequate for compliance assessment purposes.

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List of abbreviations

AA	annual average
a.e.	acid equivalents
AF	assessment factor
BCF	bioconcentration factor
bw	body weight
CAS	Chemical Abstracts Service
DAR	Draft Assessment Report
EC50	Concentration effective against 50% of the organisms tested
EQS	Environmental Quality Standard
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act [US]
GLP	Good Laboratory Practice (OECD)
LC50	Concentration lethal to 50% of the organisms tested
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
lt	long term
MAC	maximum allowable concentration
MCPP	mecoprop
MCPP-p	mecoprop-p
MCPP DMA	dimethylamine salt of mecoprop
MCPP-p DMA	dimethylamine salt of mecoprop-p
ND	no data
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOECb	no observed effect concentration (biomass)
OECD	Organization for Economic Co-operation and Development
PNEC	predicted no-effect concentration
SSD	species sensitivity distribution
st	short term
TGD	Technical Guidance Document
UKTAG	UK Technical Advisory Group
US EPA	US Environmental Protection Agency
UV	ultraviolet
WFD	Water Framework Directive
WHO	World Health Organization

ANNEX 1 Data quality assessment sheets

Identified and ordered by alphabetical order of references.

Data relevant for PNEC derivation were quality assessed in accordance with the so-called Klimisch Criteria (Table A1).

Table A1 Klimisch Criteria*

Code	Category	Description
1	Reliable without restrictions	Refers to studies/data carried out or generated according to internationally accepted testing-guidelines (preferably GLP**) or in which the test parameters documented are based on a specific (national) testing guideline (preferably GLP), or in which all parameters described are closely related/comparable to a guideline method.
2	Reliable with restrictions	Studies or data (mostly not performed according to GLP) in which the test parameters documented do not comply totally with the specific testing guideline, but are sufficient to accept the data or in which investigations are described that cannot be subsumed under a testing guideline, but which are nevertheless well-documented and scientifically acceptable.
3	Not reliable	Studies/data in which there are interferences between the measuring system and the test substance, or in which organisms/test systems were used that are not relevant in relation to exposure, or which were carried out or generated according to a method which is not acceptable, the documentation of which is not sufficient for an assessment and which is not convincing for an expert assessment.
4	Not assignable	Studies or data which do not give sufficient experimental details and which are only listed in short abstracts or secondary literature.

* Klimisch H.-J, Andreae M and Tillmann U (1997) A systematic approach for evaluating the quality of experimental toxicological and ecotoxicological data. *Regulatory Toxicology and Pharmacology*, **25**, 1–5.
** OECD Principles of Good Laboratory Practice (GLP). See:
http://www.oecd.org/department/0,2688,en_2649_34381_1_1_1_1_1,00.html

Reference	Alabaster 1969

Information on the test species	
Test species used	*Rasbora heteromorpha*
Source of the test organisms	Not stated
Holding conditions prior to test	One week acclimatisation
Life stage of the test species used	1.3–3 cm long

Information on the test design	
Methodology used	Carried out using a standardised procedure described in Working Document No. 6 of the Pesticides Safety Precaution Scheme.
Form of the test substance	NPH 1313 (40% mecoprop)
Source of the test substance	Not stated
Type and source of the exposure medium	Standard dilution water and natural water with a hardness of 250 ppm $CaCO_3$
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	10
Nature of test system (Static, semi-static or flow-through, duration, feeding)	Renewal system. Temperature = 20ºC, pH 7.2, Hardness 250 ppm $CaCO_3$
Measurement of exposure concentrations	No
Measurement of water quality parameters	No
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Constant delivery of sample solution

Reliability of study	**Not reliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Armstrong 2000) Unpublished, cited in EC 2003b

Information on the test species	
Test species used	No information
Source of the test organisms	No information
Holding conditions prior to test	No information
Life stage of the test species used	No information

Information on the test design	
Methodology used	No information
Form of the test substance	Mecoprop-p dimethylamine salt
Source of the test substance	No information
Type and source of the exposure medium	No information
Test concentrations used	No information
Number of replicates per concentration	No information
Number of organisms per replicate	No information
Nature of test system (static, semi-static or flow-through, duration, feeding)	No information
Measurement of exposure concentrations	No information
Measurement of water quality parameters	No information
Test validity criteria satisfied	No information
Water quality criteria satisfied	No information
Study conducted to GLP	Yes
Overall comment on quality	No details, therefore unable to give an overall comment

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	Bell 1994 Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Daphnia magna*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Neonates (<24-hours old)

Information on the test design	
Methodology used	48-hour test carried out according to EEC Directive 92/69, Part C and OECD 202, Part 1
Form of the test substance	Mecoprop-p (89.7% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 1.0, 2.2, 4.6, 10, 22,46 and 100 mg l^{-1} (as nominals)
Number of replicates per concentration	2
Number of organisms per replicate	10
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 48-hours, no feeding
Measurement of exposure concentrations	Yes (81–92% of nominal concentration)
Measurement of water quality parameters	Yes (pH 7.0–7.8, temperature = 22^{o}C, dissolved oxygen = 8.2–8.4 mg O_2 l^{-1})
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an EEC and OECD method with measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Bias 1988 Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Daphnia magna*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Neonates (<24-hours-old)

Information on the test design	
Methodology used	48-hour test carried out according to EEC Directive 79/831 Annex V, C2
Form of the test substance	Duplosan KV (BAS 037 29 H) containing mecoprop-p DMA with a purity of 726 g/l as salt and 600 g/l as acid
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 62.5, 125, 250, 500 and 1,000 mg l^{-1} (as Duplosan KV/l)
Number of replicates per concentration	4
Number of organisms per replicate	5
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 48-hours, no feeding
Measurement of exposure concentrations	Yes (97.6–103.5% of nominal concentration)
Measurement of water quality parameters	Yes (pH 7.29–8.0, temperature = 19.5–20.5^{o}C, dissolved oxygen = 7.86– 9.44 mg O_2 l^{-1})
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was acceptable. OECD method, flow through with measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Bogers 1990a Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Oncorhynchus mykiss*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	6.0 cm in length and 3.1 g in weight

Information on the test design	
Methodology used	21-day study carried out according to OECD 204
Form of the test substance	MCPP (as dimethylamine) (91.6% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 4.8, 10, 23, 48 and 100 mg l^{-1} (as nominals)
Number of replicates per concentration	Only one vessel per concentration
Number of organisms per replicate	10 fish per concentration
Nature of test system (static, semi-static or flow-through, duration, feeding)	Flow through (6 litres per hour)
Measurement of exposure concentrations	Yes
Measurement of water quality parameters	Yes (pH 7.8–8.1, temperature = 13–15ºC)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an OECD method with a flow through regime and measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Bogers 1990b Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Salmo gairdneri*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	6.89 cm in length and 3.73 g in weight

Information on the test design	
Methodology used	96-hour static study carried out according to OECD 203 and EEC Directive 84/449, CI.
Form of the test substance	MCPP (as DMA salt) – 91.6% pure
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 100, 180, 320, 560 and 1,000 mg l^{-1} (as nominals)
Number of replicates per concentration	Only one vessel per concentration
Number of organisms per replicate	10 fish per concentration
Nature of test system (static, semi-static or flow-through, duration, feeding)	Flow through (6 litres per hour)
Measurement of exposure concentrations	Yes. Measured concentrations were generally above 80%, so results were based on nominals.
Measurement of water quality parameters	Yes (pH 7.85–8.26, temperature = 15–17ºC)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study is of good quality being carried out to OECD and EEC methods with a flow-though regime and measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Burke 2007

Information on the test species	
Test species used	*Skeletonema costatum*
Source of the test organisms	Unicellular, liquid slope cultures of algae were obtained from Plymouth Algal Culture Collection, Marine Biological Association, Plymouth, UK
Holding conditions prior to test	Within 24 hours of receipt, appropriate volumes of these primary cultures were aseptically transferred to test conditions.
Life stage of the test species used	Cells in the lo growth phase

Information on the test design	
Methodology used	The study was conducted in accordance with the principles outlined in the following test guidelines: EC Methods for Determination of Ecotoxicity, Annex to Directive 92/69/EEC (O.J. No. L383A,1992) Part C, Method 3 "Algal Inhibition Test", the OECD Guideline for Testing of Chemicals No. 201 "Alga, Growth Inhibition Test" (1984), Water Quality – Marine Growth inhibition Test with *Skeletonema costatum* and *Phaeodactylum tricornutum*, International Standards Method ISO 10253 (ISO 1998) and US Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, Method 850.5400 "Algal Toxicity, Tiers I and II" (Public draft, 1996).
Form of the test substance	Mecoprop-p-DMA
Source of the test substance	Mecoprop-p 600D (batch 06/23), Nufarm
Type and source of the exposure medium	Sterile f/2 diatom medium and basal medium (natural filtered sterile seawater) supplied by the Marine Biological Association of the United Kingdom.
Test concentrations used	Control, 3.15, 6.25, 12.5, 25, 50, 100 and 200 mg l^{-1} (as mecoprop acid)
Number of replicates per concentration	6 in controls and 3 in treatments
Number of organisms per replicate	Initial cell density = 5.5 x 10^4 cells ml^{-1}
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 96 hours, no feeding
Measurement of exposure concentrations	Yes (At the start of the test, the measured concentrations of Mecoprop-P in samples of thetest cultures ranged between 94 and 100% of their nominal values. After 96 hours, the measured concentrations ranged between 92 and 102% of their nominal values; representing 95 to 100% of their starting values indicating the stability of the compound in test media over the 96-hour test period).
Measurement of water quality parameters	Yes (temperature = 22-25 ^{o}C, pH = 7.7 – 9.4, salinity = 36 ‰)
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Yes
Study conducted to GLP	Yes

Overall comment on quality	The study was of good quality having been carried out to a standardised procedure and to GLP

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Caley and Kelly 1999

Information on the test species	
Test species used	*Lemna minor*
Source of the test organisms	A starter culture was obtained from the Institute of Arable Crop Research (IARC), Long Ashton Research Station, Bristol.
Holding conditions prior to test	Plants cultured in Swedish standard *Lemna* medium
Life stage of the test species used	Plants from stock cultures

Information on the test design	
Methodology used	The study was conducted in accordance with the draft OECD Guideline "*Lemna* Growth Inhibition Test (1998) and the draft US EPA OPPTS Guidelien 850.44000 "Aquatic bPlant Toxicity Test using *Lemna spp*" (1996)
Form of the test substance	Mecoprop-p-DMA
Source of the test substance	Covance Laboratories, Harrogate
Type and source of the exposure medium	Swedish standard *Lemna* medium
Test concentrations used	Control, 56, 180, 560, 1800, 5600, 18000 and 56000 µg l^{-1} (as mecoprop acid)
Number of replicates per concentration	3
Number of organisms per replicate	*Lemna* plants with a total of 15 fronds (either 5 plants with 3 fronds each or 3 pkants with four fronds each plus one plant with 3 fronds)
Nature of test system (static, semi-static or flow-through, duration, feeding)	Semi-static (replacement of test solutions on days 3 and 5), 7 days, no feeding
Measurement of exposure concentrations	Yes
Measurement of water quality parameters	Yes ((temperature = 23-26 ^{o}C, pH = 6.5 – 9.8)
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Yes
Study conducted to GLP	Yes
Overall comment on quality	The study was of good quality having been carried out to a standardised procedure and to GLP

Reliability of study	**Reliable**
Relevance of study	**Relevant**

Klimisch Code	**1**

Reference	Dohmen 1993a Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Pseudokirchneriella subcapitata*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	72-hour study carried out to OECD 201
Form of the test substance	Mecoprop-p (92.9% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 3, 9, 27, 81, 243 and 729 mg l^{-1} (as nominals)
Number of replicates per concentration	Not stated
Number of organisms per replicate	Initial cell density = 3×10^4 cells ml^{-1}
Nature of test system (static, semi-static or flow-through, duration, feeding)	Not stated, 72 hours, no feeding
Measurement of exposure concentrations	Yes (97.4–105.2% of nominal concentration)
Measurement of water quality parameters	Yes (temperature = 23^{o}C)
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an OECD method, with measured exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Dohmen 1993b Unpublished, cited in EU DAR 1999

Information on the test species

Test species used	*Daphnia magna Straus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	21-day semi static study according to EEC guideline XI/681/86 (draft 4) and in part OECD 202 – reproduction
Form of the test substance	MCPP-p (92.2% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 2.5, 10, 25, 50 and 100 mg l^{-1} (as nominals)
Number of replicates per concentration	10
Number of organisms per replicate	1
Nature of test system (static, semi-static or flow-through, duration, feeding)	Semi static, test medium renewed nine times during the 21-day study.
Measurement of exposure concentrations	Yes (98.9–107.6% of nominal concentration)
Measurement of water quality parameters	Yes (pH 8, temperature = 21ºC, photo period 16 hours light/day)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using and EEC and OECD method, with measurement of the exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Ellgehausen 1986 Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Lepomis macrochirus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	2.4 g at day 0 and 3.0 g at day 28

Information on the test design	
Methodology used	BCF 28-day US EPA guideline Subdivision E71-6 (1982)
Form of the test substance	Mecoprop C^{14}
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	1 mg l^{-1} mecoprop C^{14} (nominal)
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Flow-through
Measurement of exposure concentrations	Yes
Measurement of water quality parameters	20ºC
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	US EPA guideline
Overall comment on quality	Acceptable study

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Hansveit 1988 Unpublished, cited in EU DAR 1999

Information on the test species	
Test species used	*Selenastrum capricornutum*
Source of the test organisms	No information
Holding conditions prior to test	No information
Life stage of the test species used	No information

Information on the test design	
Methodology used	No information
Form of the test substance	U46 KV-Fluid
Source of the test substance	No information
Type and source of the exposure medium	No information
Test concentrations used	No information

Number of replicates per concentration	No information
Number of organisms per replicate	No information
Nature of test system (static, semi-static or flow-through, duration, feeding)	No information
Measurement of exposure concentrations	No information
Measurement of water quality parameters	No information
Test validity criteria satisfied	No information
Water quality criteria satisfied	No information
Study conducted to GLP	Yes
Overall comment on quality	No details, therefore unable to give an overall comment

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	His and Seaman 1993

Information on the test species	
Test species used	*Crassostrea gigas*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Larvae

Information on the test design	
Methodology used	Not known
Form of the test substance	MCPP
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Renewal
Measurement of exposure concentrations	Not stated
Measurement of water quality parameters	Not stated

Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Paper not obtained therefore only limited data available.

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	Hoberg 1992a (cited as OPP data in US Ecotox database)

Information on the test species	
Test species used	*Navicula pelliculosa*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information available
Form of the test substance	MCPP-p DMA
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Not stated
Measurement of exposure concentrations	Assumed measured as GLP-compliant method
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Yes
Overall comment on quality	Manufacturer data produced by a laboratory that appears to demonstrate a systematic bias

Reliability of study	**Unreliable**
Relevance of study	**Relevant**

Klimisch Code	**3**

Reference	Hoberg 1992b (cited as OPP data in US Ecotox database)

Information on the test species	
Test species used	*Selenastrum capricornutum*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information available
Form of the test substance	MCPP-p DMA
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Not stated
Measurement of exposure concentrations	Assumed measured as GLP-compliant method
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Yes
Overall comment on quality	Manufacturer data produced by a laboratory that appears to demonstrate a systematic bias

Reliability of study	**Unreliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Hoberg 1992c (cited as OPP data in US Ecotox database)

Information on the test species	
Test species used	*Lemna gibba*

Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information available
Form of the test substance	MCPP-p DMA
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Not stated
Measurement of exposure concentrations	Assumed measured as GLP-compliant method
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Yes
Overall comment on quality	Manufacturer data produced by a laboratory that appears to demonstrate a systematic bias

Reliability of study	**Unreliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Hoberg 1992d

Information on the test species	
Test species used	*Skeletonema costatum*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information available
Form of the test substance	MCPP-p DMA
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Not stated
Measurement of exposure concentrations	Assumed measured as GLP-compliant method
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Yes
Overall comment on quality	Manufacturer data produced by a laboratory that appears to demonstrate a systematic bias

Reliability of study	**Unreliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Jenkins 2007

Information on the test species	
Test species used	*Navicula peliculosa*
Source of the test organisms	Axenic unicellular liquid slopes cultures of algae were obtained from Sammlung Von Algenkulturen (SAG), the University of Gottingen, Germany
Holding conditions prior to test	Appropriate volumes of these primary cultures were aseptically transferred to test conditions
Life stage of the test species used	Cells in the log growth phase

Information on the test design	
Methodology used	The study was conducted in accordance with the principles outlined in the following test guidelines: EC Methods for Determination of Ecotoxicity, Annex to Directive 92/69/EEC (O.J. No. L383A,1992) Part C, Method 3 "Algal Inhibition Test", the OECD Guideline for Testing of Chemicals No. 201 "Alga, Growth Inhibition Test" (1984), Water Quality – Marine Growth inhibition Test with *Skeletonema costatum* and *Phaeodactylum tricornutum*, International Standards Method ISO 10253 (ISO 1998) and US Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances, Method 850.5400 "Algal Toxicity, Tiers I and II" (Public draft, 1996).
Form of the test substance	Mecoprop-p-DMA
Source of the test substance	Mecoprop-p 600D (batch 06/23), Nufarm
Type and source of the exposure medium	Sterile algal nutrient medium as recommended in oECD Procedure 201 and supplemented with a solution of sodium metasilicate
Test concentrations used	Control, 6.25, 12.5, 25, 50, 100 and 200 mg l^{-1} (as mecoprop acid)
Number of replicates per concentration	6 in controls and 3 in treatments
Number of organisms per replicate	Initial cell density = 1 x 10^4 cells ml^{-1}
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 96 hours, no feeding
Measurement of exposure concentrations	Yes (At the start of the test, the measured concentrations of Mecoprop-P in samples of thetest cultures ranged between 81 and 92% of their nominal values. After 96 hours, the measured concentrations ranged between 83 and 97% of their nominal values; representing 99 to 108% of their starting values indicating the stability of the compound in test media over the 96-hour test period.)
Measurement of water quality parameters	Yes (temperature = 23-24 ^oC, pH = 7.24 – 7.89,)
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Yes

Study conducted to GLP	Yes
Overall comment on quality	The study was of good quality having been carried out to a standardised procedure and to GLP

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Kirby and Sheahan 1994

Information on the test species	
Test species used	*Scenedesmus subspicatus*
Source of the test organisms	Culture Centre of Algae and Protozoa, Institute of Freshwater Ecology, Cumbria, UK
Holding conditions prior to test	Culture maintained in the medium outlined in the ISO protocol
Life stage of the test species used	Not applicable

Information on the test design	
Methodology used	The methodology is reasonably well described, ISO (1989)
Form of the test substance	Technical grade mecoprop (98% purity)
Source of the test substance	Aldrich Chemicals Ltd, Gillingham, Dorset, UK
Type and source of the exposure medium	Not stated
Test concentrations used	0, 80, 93, 107, 121 and 135 mg l^{-1} (as nominals)
Number of replicates per concentration	Not stated
Number of organisms per replicate	Initial cell density of 10^4 cells ml^{-1}.
Nature of test system (static, semi-static or flow-through, duration, feeding)	Closed test vessels placed on an orbital shaker set at 100 revs/min. Temperature set at 20ºC and constant illumination of 1,200–1,400 lux.
Measurement of exposure concentrations	No
Measurement of water quality parameters	No
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Well documented study and conducted to ISO standard, but without analytical confirmation of exposure concentrations.

Reliability of study	**Not reliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Kirby and Sheahan 1994

Information on the test species	
Test species used	*Lemna minor*
Source of the test organisms	Established laboratory culture started in 1988 from a single plant taken from an Essex pond.
Holding conditions prior to test	Not stated
Life stage of the test species used	Double fronded macrophyte

Information on the test design	
Methodology used	The methodology is reasonably well described.
Form of the test substance	Technical grade mecoprop (98% purity)
Source of the test substance	Aldrich Chemicals Ltd, Gillingham, Dorset, UK
Type and source of the exposure medium	Test solutions made up in Steinberg's nutrient medium
Test concentrations used	0, 0.5, 0.9, 1.8, 3.6 and 7.2 mg l^{-1} (as nominals)
Number of replicates per concentration	Four replicate vessels used for each test concentration.
Number of organisms per replicate	Five double fronded colonies per vessel.
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static system, solutions renewed every two days, continuous illumination, temperature maintained at 25ºC (24–26ºC), pH 7.
Measurement of exposure concentrations	No
Measurement of water quality parameters	No
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Well documented study but without analytical confirmation of exposure concentrations

Reliability of study	**Not reliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Kirsch and Munk 1992a Cited in EU DAR 1999

Information on the test species	
Test species used	*Lepomis macrochirus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Length 5.0 cm and weight 1.96 g

Information on the test design	
Methodology used	96-hour study carried out to OECD 203 and EEC Directive 84/449 C1
Form of the test substance	Formulation resembling Duplosan KV - mecoprop-P DMA salt (746.8 g l^{-1} purity)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 100 and 150 mg l^{-1} (as nominals)
Number of replicates per concentration	Not stated except that 150 mg/l carried out in triplicate.
Number of organisms per replicate	10 fish per concentration
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Yes (99.7–100.1% of nominal)
Measurement of water quality parameters	Yes (pH 8.5, temperature = 22ºC and oxygen content 8.3 mg O_2 l^{-1})
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an EEC and OECD method, with measurement of the exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Kirsch and Munk 1992b Cited in EU DAR 1999

Information on the test species	
Test species used	*Oncorhynchus mykiss*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Length 6.09 cm and weight 2.43 g

Information on the test design	
Methodology used	96-hour study carried out to OECD Guideline 203 and EEC Directive 84/449 C1
Form of the test substance	Mecoprop-p DMA (with a purity of 746.8 g/l as DMA salt and 617 g/l as acid)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 100 and 150 mg l^{-1} (as nominals)
Number of replicates per concentration	1–3
Number of organisms per replicate	10
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 96-hour, no feeding
Measurement of exposure concentrations	Yes (97.5–100.7% of nominal concentrations)
Measurement of water quality parameters	Yes (pH 8.5, temperature = 12^{o}C)
Test validity criteria satisfied	Yes
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an EEC and OECD method, with measurement of the exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Linden *et al*. 1979

Information on the test species	
Test species used	*Alburnus alburnus*
Source of the test organisms	Baltic Sea
Holding conditions prior to test	Held for at least two weeks prior to experiment in storage tanks containing brackish water thermostated to 10ºC. Fish were fed once a day until 48 hours prior to the test.
Life stage of the test species used	8-cm long fish

Information on the test design	
Methodology used	Comparable to an international ISO-ring test for screening chemicals
Form of the test substance	MCPP, potassium salt, Hormo-Cornox^{R} 640. Content of active ingredient = 640 g/l
Source of the test substance	Hormo-Cornox^{R}
Type and source of the exposure medium	Natural brackish water from Tvaren Bay in the Baltic Sea.
Test concentrations used	Six concentrations and one control
Number of replicates per concentration	Not stated
Number of organisms per replicate	10 fish
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static with no aeration, no feeding
Measurement of exposure concentrations	No measurement.
Measurement of water quality parameters	Not measured – incoming brackish water was deemed constant (salinity = 7‰, pH 7.8, temperature 10°C, light regulated 12 hours on and 12 hours off, minimum dissolved oxygen = 5 mg O_2 l^{-1}).
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Lack of analysis, static system and no details of replicates.

Reliability of study	**Not reliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Linden *et al.* 1979

Information on the test species	
Test species used	*Nitocra spinipes*
Source of the test organisms	Baltic sea
Holding conditions prior to test	Held in test tubes prior to experiment, in brackish water thermostated to 20–22°C.
Life stage of the test species used	Only adult animals harvested from 3–6 week old cultures were used.

Information on the test design	
Methodology used	96-hour LC50. Comparable to an international ISO-ring test for screening chemicals
Form of the test substance	MCPP, potassium salt, Hormo-Cornox^{R} 640 Content of active ingredient = 640 g l^{-1}
Source of the test substance	Hormo-Cornox^{R}
Type and source of the exposure medium	Natural brackish water from Tvaren Bay in the Baltic Sea.
Test concentrations used	Six concentrations and one control
Number of replicates per concentration	One
Number of organisms per replicate	10 harpacticoids
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static with no aeration, no feeding
Measurement of exposure concentrations	No measurement
Measurement of water quality parameters	Not measured – incoming brackish water was deemed constant (salinity = 7‰, pH 7.8, temperature 10°C, light regulated 12 hours on and 12 hours off, minimum dissolved oxygen = 5 mg O_2 l^{-1}). During the study the temperature was maintained at 20–22ºC.
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Lack of analysis, static system and no details of replicates.

Reliability of study	**Not reliable**
Relevance of study	**Relevant**
Klimisch Code	**3**

Reference	Confidential MCPP Task Force data cited in Lewis *et al.* (1996)

Information on the test species	
Test species used	*Oncorhynchus mykiss*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information
Form of the test substance	MCPP (racemate)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Assumed measured as GLP-compliant study
Measurement of water quality parameters	Temperature = 15–18ºC
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Manufacturer data – therefore assumed to be of good quality as GLP compliant.

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	Memmert and Knoch 1993a Cited in EU DAR 1999

Information on the test species	
Test species used	*Pseudokirchneriella subcapita*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	72-hour study according to Directive 92/69/EEC C3 and OECD Guideline 201
Form of the test substance	Marks Optica MPn containing MCPP-p DMA salt with a purity of 728 g l^{-1} as DMA salt and 602 g l^{-1} as acid
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 28, 60, 130, 280 and 600 mg preparation l^{-1}
Number of replicates per concentration	3
Number of organisms per replicate	3×10^4 cells ml^{-1}
Nature of test system (static, semi-static or flow-through, duration, feeding)	Constant shaking
Measurement of exposure concentrations	Yes (80.3–99.7% of nominal concentrations)
Measurement of water quality parameters	Yes (temperature 23°C)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an EEC and OECD method, and there was measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Memmert and Knoch 1993b Cited in EU DAR 1999

Information on the test species	
Test species used	*Daphnia magna*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Neonates <24 hours old

Information on the test design	
Methodology used	48-hour study according to Directive 92/69/EEC C2 and OECD Guideline 201
Form of the test substance	Marks Optica MPn containing MCPP-p DMA salt with a purity of 728 g l^{-1} as DMA salt and 602 g l^{-1} as acid
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 25, 50, 100, 200, 400 and 1,000 mg preparation l^{-1}
Number of replicates per concentration	4
Number of organisms per replicate	5
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 48-hours, no feeding
Measurement of exposure concentrations	Yes (101.1–104.3% of nominal concentrations)
Measurement of water quality parameters	Yes (pH 7.8–8.0, temperature = 21.6°C, dissolved oxygen = 8.2–8.4 mg O^2 l^{-1})
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an OECD method and there was measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Memmert and Knoch 1993c Cited in EU DAR 1999

Information on the test species	
Test species used	*Oncorhynchus mykiss*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Length 5.1 cm, weight 1.8 g

Information on the test design	
Methodology used	96-hour LC50, OECD Guideline 203, Directive 92/69/EEC, C1
Form of the test substance	Marks Optica MPn containing MCPP-p DMA
Source of the test substance	Not stated
Type and source of the exposure medium	MCPP-p DMA with a purity of 728 g l^{-1} as DMA salt or 602 g/l as acid
Test concentrations used	Nominal concentrations 0, 15, 32, 69, 148 and 320 mg MCPP-p DMA l^{-1}
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Flow through (4 litres per hour)
Measurement of exposure concentrations	Yes (85.5–110.1% of nominal concentrations)
Measurement of water quality parameters	Yes (pH 7.4–8.1, temperature = 13–15°C)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out using an OECD method and there was measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Mullerschon 1990 Cited in EU DAR 1999

Information on the test species	
Test species used	*Daphnia magna*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Less than 24 hours old

Information on the test design	
Methodology used	28-day study carried out according to OECD Guideline 202, Section 2
Form of the test substance	MCPP DMA (91.6% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	O, 2.5, 7.4, 22.2, 66.7 and 200 mg l^{-1} (as nominals)
Number of replicates per concentration	1
Number of organisms per replicate	10
Nature of test system (static, semi-static or flow-through, duration, feeding)	Semi static test medium renewed three times per week, 28 days, feeding
Measurement of exposure concentrations	No
Measurement of water quality parameters	Yes (pH 8, temperature = 20°C, photoperiod 16 hours light/day 500–2,000 Lux)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was carried out using an OECD method, but there was no measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Munk 1989 Cited in EU DAR 1999

Information on the test species	
Test species used	*Lepomis macrochirus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Length = 5.7 cm and weight = 2.1 g

Information on the test design	
Methodology used	96-hour study using US EPA Subdivision E 72-1
Form of the test substance	Mecoprop-p (91.4% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 50 and 100 mg l^{-1} (as nominals)
Number of replicates per concentration	1–3
Number of organisms per replicate	10
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static, 96 hours, no feeding
Measurement of exposure concentrations	Yes (97% of nominal concentrations)
Measurement of water quality parameters	Yes (pH 8.0, temperature = 22°C, dissolved oxygen concentration = 7.9–8.3 mg O_2 l^{-1})
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out to an OECD method with a flow-through regime and measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Munk 1993 Cited in EU DAR 1999

Information on the test species	
Test species used	*Oncorhynchus mykiss* Walbaum 1792
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Length = 6.0 cm and weight = 1.9 g

Information on the test design	
Methodology used	28-day flow through study carried out according to OECD Guideline 204
Form of the test substance	MCPP-p acid (92.7% pure)
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	0, 1, 10, 50 and 100 mg l^{-1} (as nominals)
Number of replicates per concentration	-
Number of organisms per replicate	20 fish per test group exposed to the five test concentrations
Nature of test system (static, semi-static or flow-through, duration, feeding)	Flow through (10 litres per hour)
Measurement of exposure concentrations	Yes [96% (88.8–105.1%)]
Measurement of water quality parameters	Yes (pH 8.4, temperature = 16°C, flow rate = 10 litres/hour, photo period 16 hours light/day)
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	The study was of good quality being carried out to an OECD method with a flow-through regime and measurement of exposure concentrations.

Reliability of study	**Reliable**
Relevance of study	**Relevant**
Klimisch Code	**1**

Reference	Nitschke *et al.* 1999

Information on the test species	
Test species used	*Lemna minor*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	The method is reasonably well described
Form of the test substance	Mecoprop – racemate
Source of the test substance	Dr. Ehrenstorfer GmbH (Germany)
Type and source of the exposure medium	Not clear
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Not stated
Measurement of water quality parameters	Stock solutions measured
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	OECD method followed although full details not given in paper.

Reliability of study	**Reliable (with restrictions)**
Relevance of study	**Relevant**
Klimisch Code	**2**

Reference	Nitschke *et al.* 1999

Information on the test species	
Test species used	*Daphnia magna* Straus
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Performed according to DIN 38412-L11.
Form of the test substance	Mecoprop – racemate
Source of the test substance	Dr. Ehrenstorfer GmbH (Germany)
Type and source of the exposure medium	Not clear
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Stock solutions measured
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	DIN method followed although full details not given in paper.

Reliability of study	**Reliable (with restrictions)**
Relevance of study	**Relevant**
Klimisch Code	**2**

Reference	Nitschke *et al.* 1999

Information on the test species	
Test species used	*Scenedesmus subspicatus* CHODAT
Source of the test organisms	8681 SAG
Holding conditions prior to test	Not stated
Life stage of the test species used	Exponentially growing

Information on the test design	
Methodology used	The method is reasonably well described.
Form of the test substance	Mecoprop – racemate
Source of the test substance	Dr. Ehrenstorfer GmbH (Germany)
Type and source of the exposure medium	Not clear
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Stock solutions measured
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	EN 28692
Overall comment on quality	EN method followed although full details not given in paper.

Reliability of study	**Reliable (with restrictions)**
Relevance of study	**Relevant**
Klimisch Code	**2**

Reference	Office of Pesticide Programs Cited by PAN Pesticides Database

Information on the test species	
Test species used	*Daphnia magna*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	Not stated

Information on the test design	
Methodology used	Limited information
Form of the test substance	Technical product
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Not stated
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Paper not available for full details, therefore unable to give an overall comment.

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	Office of Pesticide Programs Cited by PAN Pesticides Database

Information on the test species	
Test species used	*Lepomis machrochirus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	0.9 g

Information on the test design	
Methodology used	Limited information
Form of the test substance	Technical product
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Not stated
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Paper not available for full details, therefore unable to give an overall comment.

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

Reference	Office of Pesticide Programs Cited by PAN Pesticides Database

Information on the test species	
Test species used	*Lepomis machrochirus*
Source of the test organisms	Not stated
Holding conditions prior to test	Not stated
Life stage of the test species used	2.0 g weight

Information on the test design	
Methodology used	Limited information
Form of the test substance	MCPP, dimethylamine salt
Source of the test substance	Not stated
Type and source of the exposure medium	Not stated
Test concentrations used	Not stated
Number of replicates per concentration	Not stated
Number of organisms per replicate	Not stated
Nature of test system (static, semi-static or flow-through, duration, feeding)	Static
Measurement of exposure concentrations	Not stated
Measurement of water quality parameters	Not stated
Test validity criteria satisfied	Not stated
Water quality criteria satisfied	Not stated
Study conducted to GLP	Not stated
Overall comment on quality	Paper not available for full details, therefore unable to give an overall comment.

Reliability of study	**Not assignable**
Relevance of study	**Relevant**
Klimisch Code	**4**

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Contents

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References

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HENLEY, M.A., 1998. Approaches to Data Collection. Scientific Research Matters, 7 (2), 152-165.

SMITH, G.A. AND KEENE, B., 1995. Habitat Decline in the UK. 2nd ed. London: Collins.

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Book	SMITH, G.A. AND KEENE, B., 1995. Habitat Decline in the UK. 2nd ed. London: Collins.
Journal	HENLEY, M.A., 1998. Approaches to Data Collection. Scientific Research Matters, 7 (2), 152-165.
Newspaper	THE TIMES, 2005. Woodland conservation. The Times, 4 June, p.30a.
Government author	Great Britain. Parliament. House of Commons. International Development Committee (2001) The Globalisation White Paper. Report, together with minutes of evidence, appendices and proceedings of the committee. London: The Stationery Office (HC 2000-2001 (208)).
Web pages/sites and e-books	HOLLAND, M., 2004. Guide to citing Internet sources [online]. Poole, Bournemouth University. Available from: http://www.bournemouth.ac.uk/library/using/guide_to_citing_internet_source.html [Accessed 4 November 2004]
e-journals	KORB, K.B., 1995 Persons and things: book review of Bringsjord on Robot Consciousness. Psycoloquy [online], 6 (15). Available from: http://psycprints.ecs.soton.ac.uk/archive/00000462/ [Accessed 20 May 2004].
Unpublished works	FOSSIE, P., 1985 Salmonids of the Orange River. Unpublished MSc. thesis. University of Plymouth.

Bibliography

Optional

List of abbreviations

AA	annual average
a.e.	acid equivalents
AF	assessment factor
BCF	bioconcentration factor
bw	body weight
CAS	Chemical Abstracts Service
DAR	Draft Assessment Report
EC50	Concentration effective against 50% of the organisms tested
EQS	Environmental Quality Standard
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act [US]
GLP	Good Laboratory Practice (OECD)
LC50	Concentration lethal to 50% of the organisms tested
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
lt	long term
MAC	maximum allowable concentration
MCPP	mecoprop
MCPP-p	mecoprop-p
MCPP DMA	dimethylamine salt of mecoprop
MCPP-p DMA	dimethylamine salt of mecoprop-p
ND	no data
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOECb	no observed effect concentration (biomass)
OECD	Organization for Economic Co-operation and Development
PNEC	predicted no-effect concentration
SSD	species sensitivity distribution
st	short term
TGD	Technical Guidance Document
UKTAG	UK Technical Advisory Group
US EPA	US Environmental Protection Agency
UV	ultraviolet
WFD	Water Framework Directive
WHO	World Health Organization

Glossary

Optional

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