

A model for quantitative pathway analysis of plant pest introduction to the EU territory by trade

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PURPOSE

Quantitative Pathway Analysis

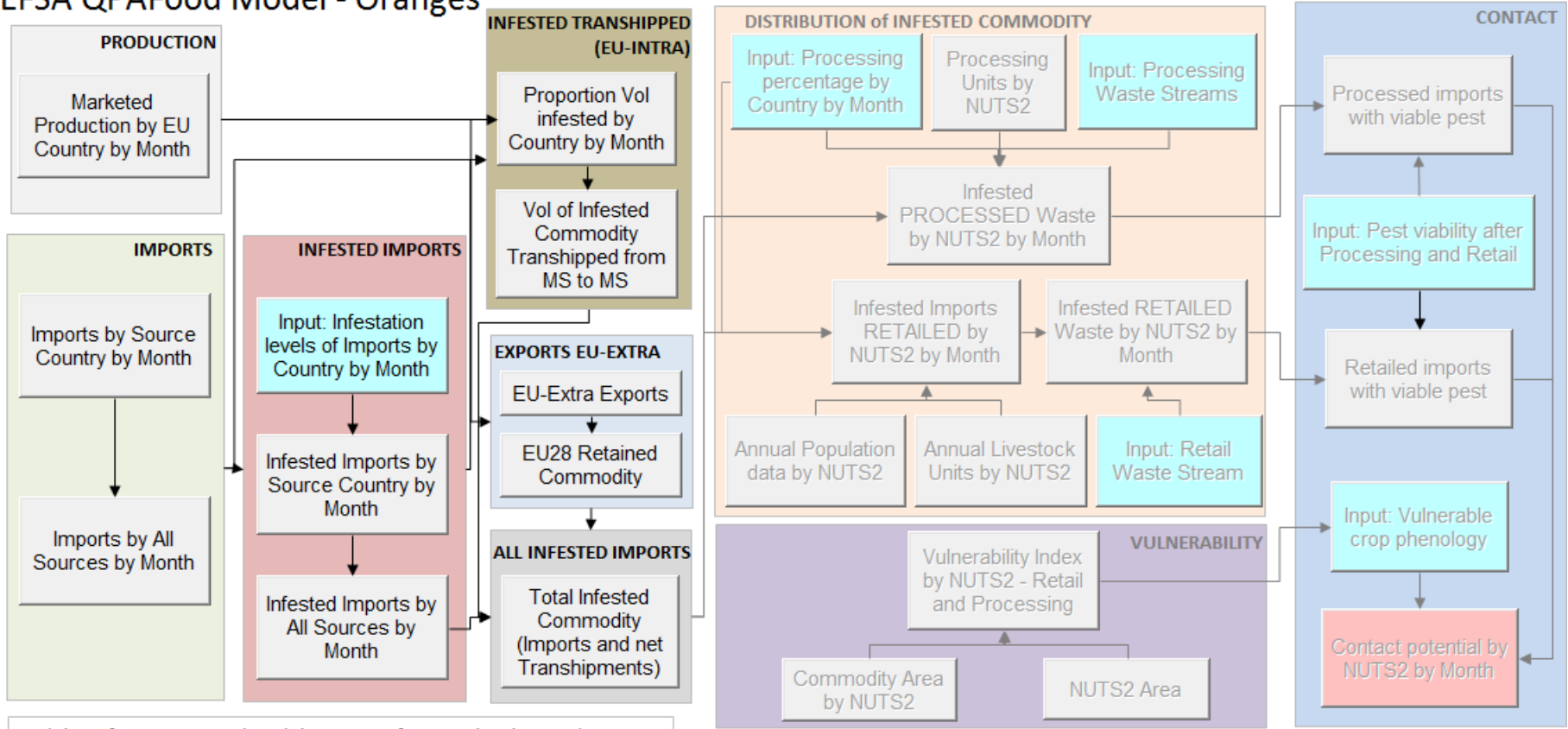
- **General model**
 - Trade, distribution, use and contact
 - Monthly time scale and EU NUTS2 spatial scale
 - Multiple sources to all EU for single pest species
- **Initial EFSA development** (Extra EU sources)
 - Apple (*Cydia prunivora*)
 - Orange (*Xanthomonas citri citri*)
 - Plum (*Conotrachelus nenuphar*)
 - Wheat (*Listronotus bonariensis*)
 - <https://www.efsa.europa.eu/en/supporting/pub/1062e>
- **Current DROPSEA development** (Intra/Extra EU sources)
 - Multiple commodity/Host (*Drosophila suzukii*)
 - <http://dropsaproject.eu/>

GENERAL MODEL STRUCTURE

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- **Excel based, VB macros and @Risk**
 - **Model has two modules**
 - **Module 1**
 - World trade into Europe
 - Infested trade
 - Production
 - EU transshipments of infested trade
 - Extra-EU exports
 - Infested trade in each MS by month
 - **Module 2**
 - Distribution of infested trade in each MS to NUTS2 regions
 - Retail
 - Processing
 - Vulnerability by NUTS2
 - Phenological susceptibility by zone by month
 - Output tables and Summary graphs

General Model Module 1 – Screenshot of Main page

EFSA QPAFood Model - Oranges

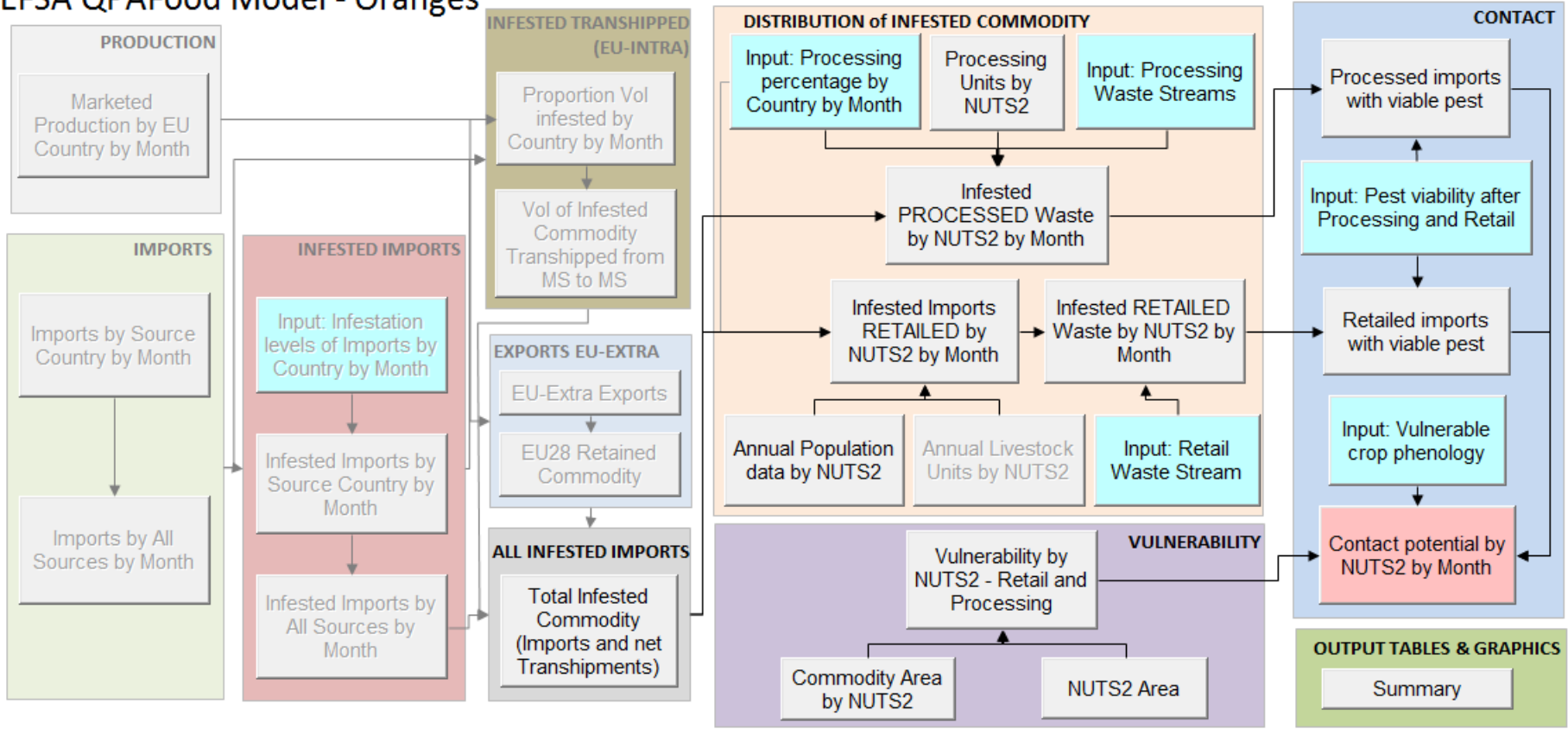


Module 1 of EFSA QPA Food Model: Import, Infestation levels, Transshipment

Parameter Details Table

General Model Module 2 – Screenshot of Main page

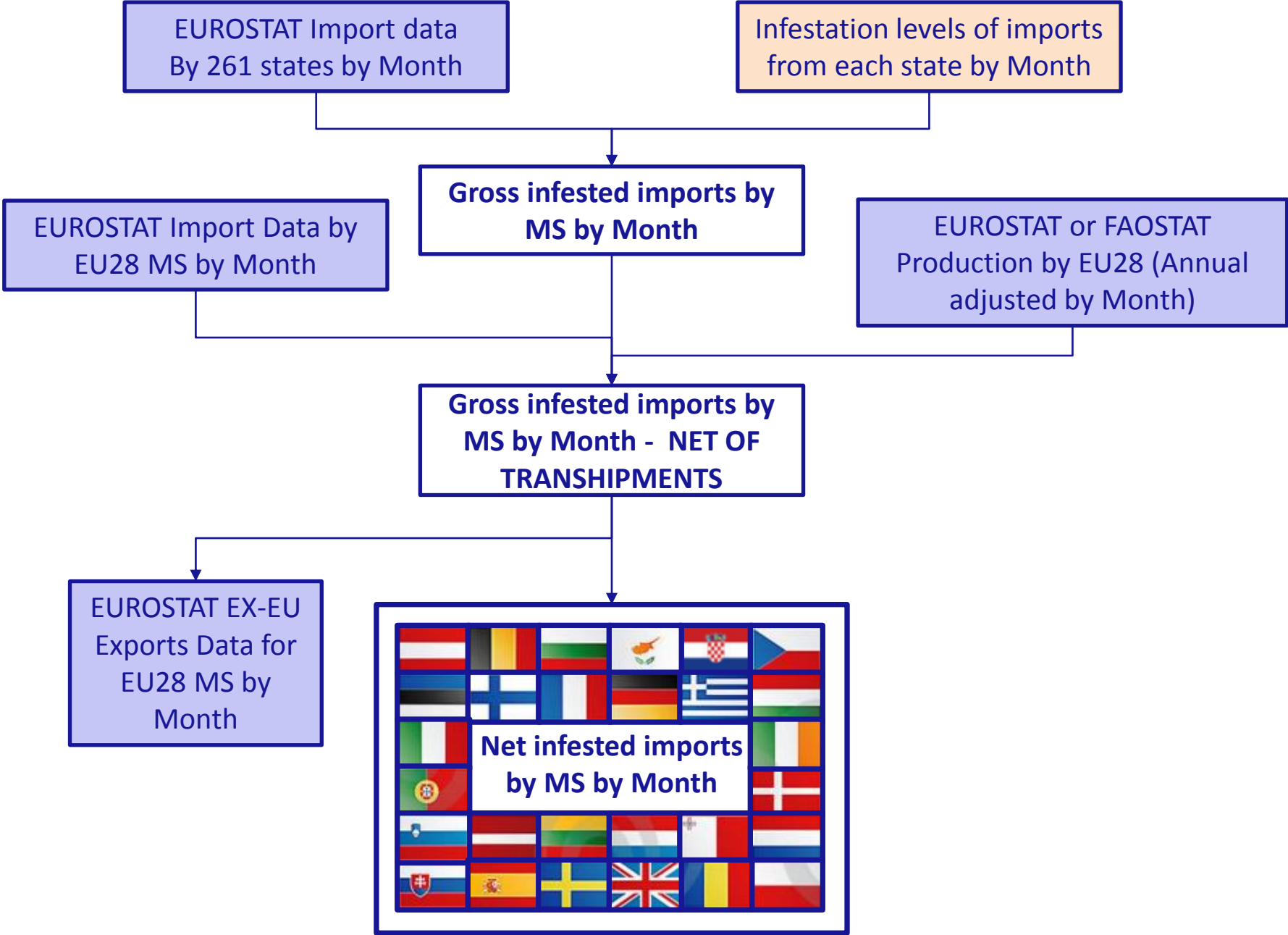
EFSA QPAFood Model - Oranges



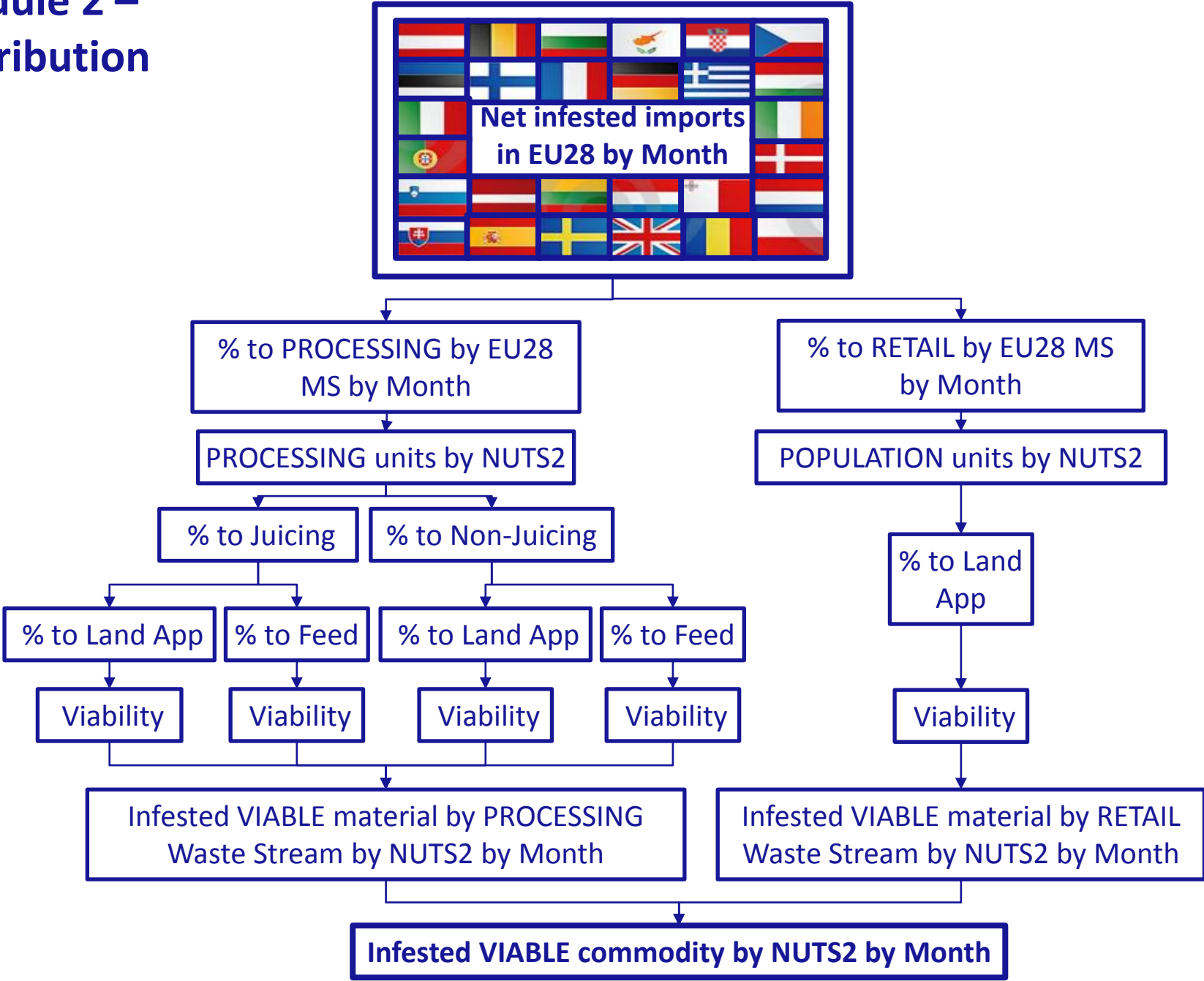
Module 2 of EFSA QPA Food Model: Distribution, Waste, Vulnerability and Contact

Parameter Details Table

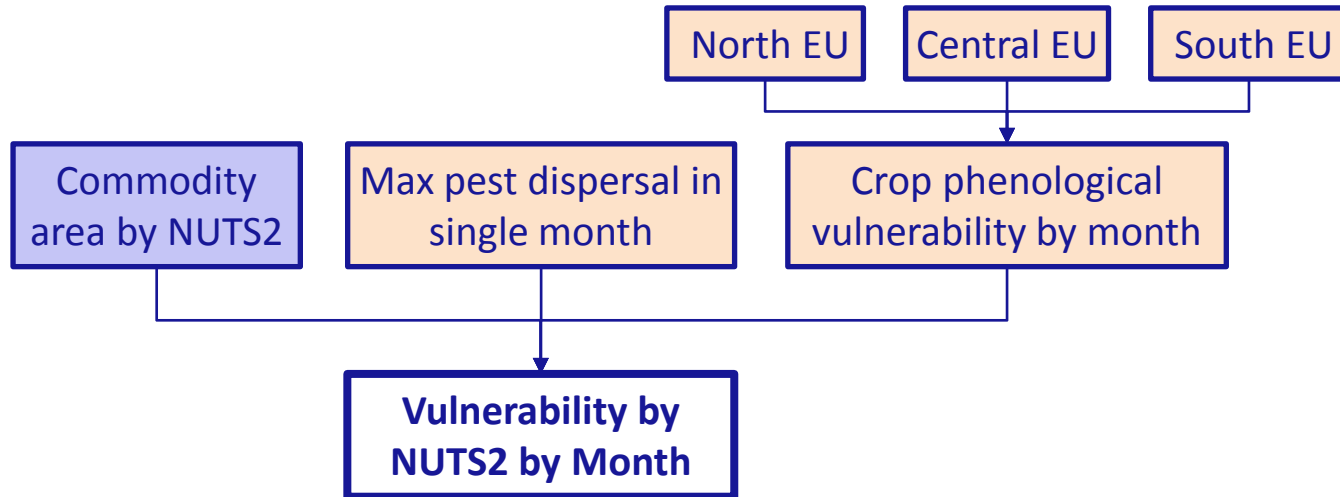
Module 1



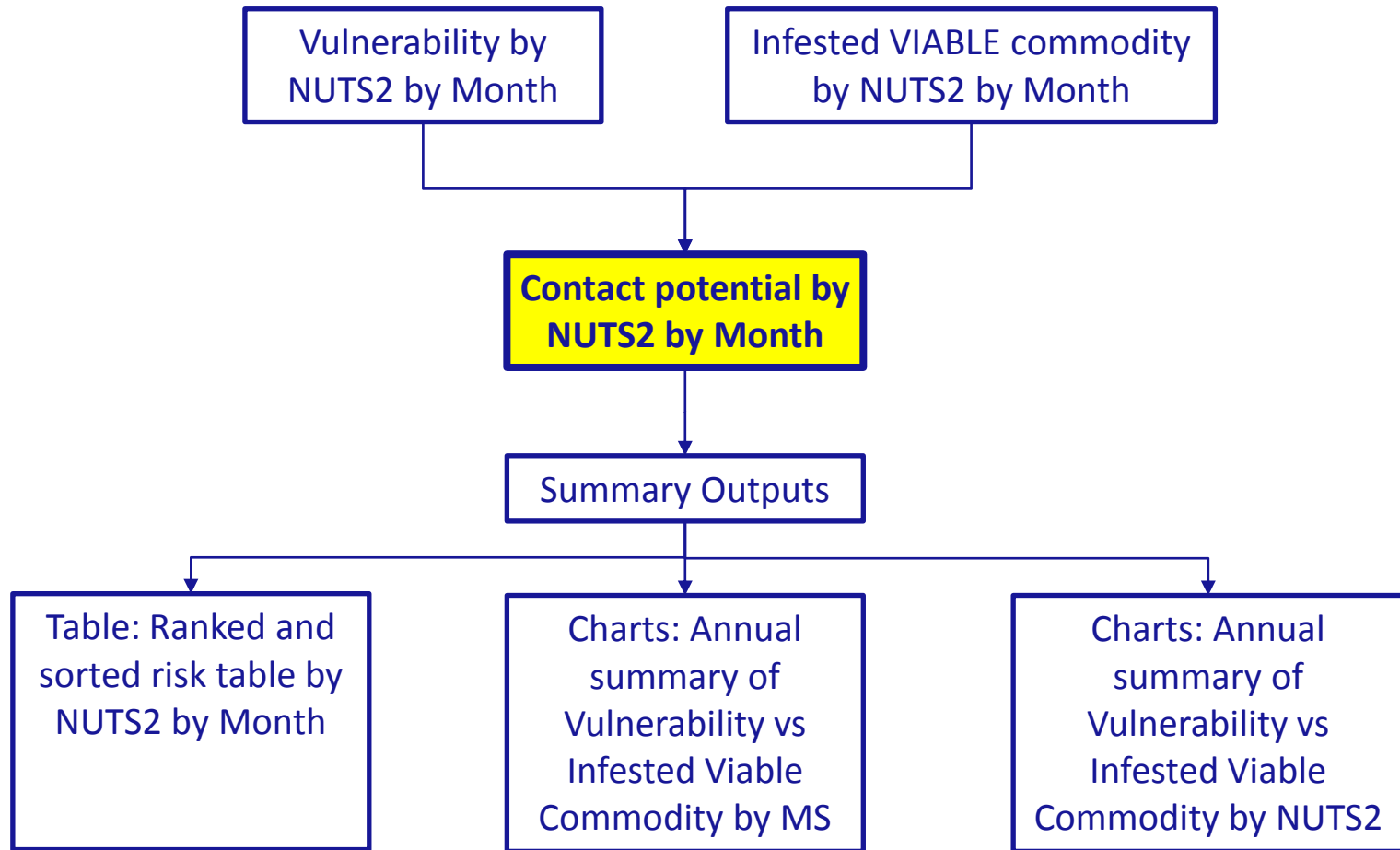
Module 2 – Distribution



Module 2 - Vulnerability



Module 2 - Outputs



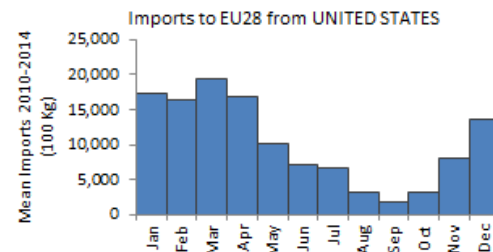
GENERAL MODEL INPUTS – APPLE EXAMPLE

Commodity import volumes (100 Kg) by SOURCE


UNITED STATES

These data are taken directly from EuroStat and include all imports of the commodity concerned from all the world's countries (including the EU MS) to all EU member states.

The table below shows the imports to all EU MS from the country selected in the menu above. The figures show the averages for the period 2010 to 2014 or, by changing the value in the Dropdown box below, to individual year data only. Changing the year choice here changes the year choices in all subsequent sheets. Colons (:) indicate no trade in that month.



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Mean Imports 2010-2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Thousands
AUSTRIA	:	:	:	:	:	:	:	:	:	:	:	:	:
BELGIUM (and LUXBG -> 1998)	:	:	72	68	:	:	:	2	67	:	:	134	:
BULGARIA	:	:	:	:	:	:	:	:	:	:	:	:	:
CYPRUS	:	:	:	:	:	:	:	:	:	:	:	:	:
CZECH REPUBLIC (CS->1992)	:	:	:	:	:	:	:	:	:	:	:	:	:
GERMANY (incl DD from 1991)	:	:	:	:	:	:	:	:	:	:	:	:	:
DENMARK	:	:	:	:	:	:	:	:	:	:	:	:	:
ESTONIA	:	:	:	:	:	:	:	:	:	:	:	:	:
SPAIN	:	:	:	:	:	148	:	:	:	:	:	:	:
FINLAND	:	:	:	:	:	:	:	:	:	:	2,264	5,556	:
FRANCE	:	35	33	0	42	:	34	:	:	:	:	:	:
UNITED KINGDOM	16,539	15,978	18,421	16,536	9,899	6,937	6,607	3,074	1,781	3,237	5,578	7,078	
GREECE	:	:	:	:	:	:	:	:	:	:	:	:	:
CROATIA	:	:	:	:	:	:	:	:	:	:	:	:	:
HUNGARY	:	:	:	:	:	:	:	:	:	:	:	:	:
IRELAND	73	73	75	72	142	:	:	:	:	34	15	36	:
ITALY	:	:	:	:	:	:	:	:	:	:	:	:	:
LITHUANIA	:	:	:	:	:	:	:	:	:	:	:	:	:
LUXEMBOURG	:	:	:	:	:	:	:	:	:	:	:	:	:
LATVIA	:	:	:	:	:	:	:	:	:	:	:	:	:
MALTA	:	:	:	:	:	:	:	:	:	:	:	:	:
NETHERLANDS	83	75	277	95	:	:	:	:	:	:	0	0	:
POLAND	:	:	:	:	:	:	:	:	:	:	:	:	:
PORTUGAL	:	:	:	:	:	:	:	:	:	:	:	:	:
ROMANIA	:	:	:	:	:	:	:	:	:	:	:	:	:
SWEDEN	693	300	480	74	37	:	:	:	:	:	189	794	:
SLOVENIA	:	:	:	:	:	:	:	:	:	:	:	:	:
SLOVAKIA	:	:	:	:	:	:	:	:	:	:	:	:	:
	17,388	16,460	19,358	16,846	10,120	7,085	6,642	3,076	1,848	3,271	8,047	13,599	

GENERAL MODEL INPUTS – APPLE EXAMPLE


Infested volume (100 Kg) imported to the EU28 from ALL source countries

The table below shows the imports of INFESTED commodity to each EU MS from ALL countries (including EU MS). The figures show the averages for the period 2010 to 2014.

If the infestation rates associated with any source country have been changed in 'Infestation levels of imports by country by month' (accessed from the main page) the button below runs a macro to collate the new figures. This may take some minutes.

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Click to get INFESTED IMPORT data for all source countries

													Annual infested imports (100 Kg)
Based on: Mean Imports 2010-2014													0 10
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
AUSTRIA	0	0	0	0	0	0	0	0	0	0	0	0	
BELGIUM (and LUXBG -> 1998)	0	0	0.004118	0.00389	0	0	0	0.000126	0.003844	0	0	0.007688	
BULGARIA	0	0	0	0	0	0	0	0	0	0	0	0	
CYPRUS	0	0	0	0	0	0	0	0	0	0	0	0	
CZECH REPUBLIC (CS->1992)	0	0	0	0	0	0	0	0	0	0	0	0	
GERMANY (incl DD from 1991)	0	0	0	0	0	0	0	0	0	0	0	0	
DENMARK	0	0	0	0	0	0	0	0	0	0	0	0	
ESTONIA	0	0	0	0	0	0	0	0	0	0	0	0	
SPAIN	0	0	0	0	0	0.008477	0	0	0	0	0	0	
FINLAND	0	0	0	0	0	0	0	0	0	0	0.129524	0.31992	
FRANCE	0	0.002002	0.001876	1.14E-05	0.002425	0	0.001968	0	0	0	0	0	
UNITED KINGDOM	0.998437	0.984504	1.130421	0.989995	0.594011	0.41089	0.381924	0.178132	0.101873	0.225631	0.373207	0.461444	
GREECE	0	0	0	0	0	0	0	0	0	0	0	0	
CROATIA	0	0	0	0	0	0	0	0	0	0	0	0	
HUNGARY	0	0	0	0	0	0	0	0	0	0	0	0	
IRELAND	0.004187	0.004153	0.004301	0.004118	0.008111	0	0	0	0	0.001945	0.000881	0.002048	
ITALY	0	0	0	0	0	0	0	0	0	0	0	0	
LITHUANIA	0	0	0	0	0	0	0	0	0	0	0	0	
LUXEMBOURG	0	0	0	0	0	0	0	0	0	0	0	0	
LATVIA	0	0	0	0	0	0	0	0	0	0	0	0	
MALTA	0	0	0	0	0	0	0	0	0	0	0	0	
NETHERLANDS	0.004736	0.004267	0.015867	0.005445	0	0	0	0	0	0	1.14E-05	2.29E-05	
POLAND	0	0	0	0	0	0	0	0	0	0	0	0	
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	0	
ROMANIA	0	0	0	0	0	0	0	0	0	0	0	0	
SWEDEN	0.039628	0.017183	0.027467	0.004233	0.002116	0	0	0	0	0	0.010811	0.04544	
SLOVENIA	0	0	0	0	0	0	0	0	0	0	0	0	
SLOVAKIA	0	0	0	0	0	0	0	0	0	0	0	0	
	1.05	1.01	1.18	1.01	0.61	0.42	0.38	0.18	0.11	0.23	0.51	0.84	

GENERAL MODEL INPUTS – APPLE EXAMPLE

Volume of infested commodity that is transhipped between MS (100 Kg)





























This sheet shows two tables (scroll down for the second):

- 1) The first shows the total Volume of the infested commodity that is transhipped to each MS from other member states. It is calculated by (Import volumes from MS to each MS x Proportion of total volume from the exporting MS which is Infested), summed across all MS.
- 2) The lower table shows the volume of imported infested commodity that is exported from each MS to other MS. It is calculated by (Vol of Transhipped exports x Proportion of total volume from the exporting MS which is Infested).

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Click to get INFESTED
TRANSHIPPED IMPORTs from
EU28 MS to each EU28 country

INFESTED TRANSHIPPED IMPORTS

Mean Inf. Trans. Imps. 2010-2014	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Volume of infested commodity transhipped to EU28 (100Kg)
AUSTRIA	7.06E-07	3.01E-06	1.08E-05	4.61E-06	8.34E-07	5.68E-07	1.93E-07	1.93E-05	1.41E-06	0	5.53E-08	2.54E-06	
BELGIUM (and LUXBG -> 1998)	0.002758	0.003632	0.004537	0.000787	0.000387	0.000663	0.000686	0.001025	0.000216	0.001264	0.003675	0.001487	
BULGARIA	7.75E-08	2.1E-07	7.65E-07	1.91E-07	4.7E-07	1.64E-06	0	0	0	0	3.75E-11	4.18E-11	
CYPRUS	5.51E-08	3.31E-08	3.49E-07	2.28E-07	0	0	0	0	2.39E-07	0	3.11E-09	0	
CZECH REPUBLIC (CS->1992)	7.28E-05	3.3E-05	0.000152	7.38E-05	2.55E-06	3.11E-06	7.54E-07	1.29E-06	1.53E-05	3.91E-07	5.12E-07	0.000136	
GERMANY (incl DD from 1991)	0.000519	0.000789	0.008401	0.004509	0.005004	0.004314	0.002407	0.000382	0.001144	0.000475	0.001592	0.000976	
DENMARK	7.97E-05	8.31E-05	0.000198	0.000199	0.000118	3.61E-05	4.04E-05	8.47E-06	1.69E-05	8.99E-06	5.98E-05	0.000102	
ESTONIA	6.03E-06	6.1E-06	3.06E-05	1.12E-05	3.38E-07	6.71E-08	2.04E-07	1.11E-07	1.31E-06	0	0.000135	0.000321	
SPAIN	0.00295	0.008135	0.011326	0.001924	0.002063	0.001302	0.000535	0.000199	0.000737	0.001324	0.004148	0.01025	
FINLAND	0.000146	0.000129	0.000327	6.29E-05	1.89E-05	0	8.19E-05	8.48E-05	1.31E-08	0	3.45E-05	0.000418	
FRANCE	0.002687	0.001222	0.002266	0.00164	0.001422	0.000862	0.000441	0.000403	0.000555	0.00057	0.001277	0.001866	
UNITED KINGDOM	0.000488	0.000732	0.001719	0.000591	0.000999	3.67E-05	8.77E-05	2.79E-06	0.00011	0.000139	4.73E-05	0.000406	
GREECE	2.31E-07	1.06E-06	5.15E-06	7.1E-06	2.98E-07	7.2E-06	4.2E-07	7.62E-08	3.07E-08	0	3.63E-10	2.74E-07	
CROATIA	0	3.81E-08	4.74E-07	3.16E-08	0	3.26E-08	0	0	0	0	4.5E-11	6.68E-11	
HUNGARY	2.65E-08	1.15E-06	1.25E-05	1.63E-07	3.68E-09	1.06E-07	7.17E-09	0	9.07E-07	0	9.91E-07	3E-07	
IRELAND	0.011392	0.01043	0.01214	0.009808	0.00658	0.00657	0.005929	0.004067	0.001816	0.006406	0.007857	0.007707	
ITALY	1.15E-06	6.13E-06	1.93E-05	1.09E-05	6.53E-06	8.88E-05	4.1E-05	9.85E-08	1.9E-06	0	2.53E-05	1.72E-06	
LITHUANIA	0.002968	0.00434	0.004302	0.004581	0.001064	0.001164	0.000546	7.7E-05	6.54E-05	0.000402	0.001577	0.002535	
LUXEMBOURG	1.12E-06	2.76E-06	5.6E-05	5.1E-05	1.43E-06	0	1.15E-06	1.31E-06	2.44E-05	0	1.67E-09	4.9E-05	
LATVIA	3.17E-05	3.43E-05	7.13E-05	5.3E-05	1.27E-08	9.56E-08	1.6E-08	4.07E-08	1.23E-07	0	2.33E-08	9.54E-06	
MALTA	8.68E-07	1.21E-06	2.2E-06	1.4E-06	0	3.82E-07	0	0	2.19E-09	0	1.2E-09	9.94E-10	
NETHERLANDS	0.003312	0.003949	0.004028	0.003258	0.001563	0.001152	0.001867	0.000884	0.000518	0.001015	0.001199	0.001359	
POLAND	2.42E-05	5.29E-05	0.000202	5.72E-05	8.68E-07	2.39E-05	1.11E-06	6.21E-07	7.75E-06	2.75E-05	8.66E-05	1.33E-05	
PORTUGAL	6.9E-06	3.26E-05	3.97E-06	2.79E-06	5.62E-05	0.000186	4.14E-05	1.37E-07	2.1E-07	0	1.69E-10	1.63E-06	
ROMANIA	2.37E-06	4.4E-06	2.56E-05	1.07E-05	2.52E-07	2.05E-06	0	4.64E-08	1.1E-08	0	3.92E-09	2.29E-07	
SWEDEN	5.04E-05	5.9E-05	0.000271	0.000115	4.21E-05	1.38E-06	3.73E-06	1.77E-06	1.23E-05	0	2.04E-05	2.76E-05	
SLOVENIA	8.73E-07	4.05E-07	1.56E-06	6.66E-08	4.09E-08	0	4.08E-08	0	0	0	8.62E-11	1.75E-09	
SLOVAKIA	5.67E-06	1.18E-05	7.98E-05	3.95E-05	0	4.92E-07	1.09E-07	9.16E-07	7.45E-06	0	5.7E-09	1.92E-05	
	0.0275	0.0337	0.0502	0.0278	0.0193	0.0164	0.0127	0.0072	0.0053	0.0116	0.0217	0.0277	

GENERAL MODEL INPUTS – APPLE EXAMPLE

Calculated from two tables above

DIRECT and NET TRANSHIPPED INFECTED IMPORTS

Mean Imp. & Net Trans. 2010-2014

Volume of infested
commodity transhipped
to EU28 (100 Kg)

	7.06E-07	3.01E-06	1.08E-05	4.61E-06	8.34E-07	5.68E-07	1.93E-07	1.93E-05	1.41E-06	0	5.53E-08	2.54E-06
AUSTRIA	0.002758	0.003632	0.006277	0.0026	0.000387	0.000663	0.000686	0.001064	0.002003	0.001264	0.003675	0.006121
BELGIUM (and LUXBG -> 1998)	7.75E-08	2.1E-07	7.65E-07	1.91E-07	4.7E-07	1.64E-06	0	0	0	0	3.75E-11	4.18E-11
BULGARIA	5.51E-08	3.31E-08	3.49E-07	2.28E-07	0	0	0	0	2.39E-07	0	3.11E-09	0
CYPRUS	7.28E-05	3.3E-05	0.000152	7.38E-05	2.55E-06	3.11E-06	7.54E-07	1.29E-06	1.53E-05	3.91E-07	5.12E-07	0.000136
CZECH REPUBLIC (CS->1992)	0.000519	0.000789	0.008401	0.004509	0.005004	0.004314	0.002407	0.000382	0.001144	0.000475	0.001592	0.000976
GERMANY (incl DD from 1991)	7.97E-05	8.31E-05	0.000198	0.000199	0.000118	3.61E-05	4.04E-05	8.47E-06	1.69E-05	8.99E-06	5.98E-05	0.000102
DENMARK	6.03E-06	6.1E-06	3.06E-05	1.12E-05	3.38E-07	6.71E-08	2.04E-07	1.11E-07	1.31E-06	0	0.000135	0.000321
ESTONIA	0.00295	0.008135	0.011326	0.001924	0.002063	0.008169	0.000535	0.000199	0.000737	0.001324	0.004148	0.01025
SPAIN	0.000146	0.000129	0.000327	6.29E-05	1.89E-05	0	8.19E-05	8.48E-05	1.31E-08	0	0.129358	0.319747
FINLAND	0.002687	0.00237	0.003246	0.001647	0.003001	0.000862	0.001882	0.000403	0.000555	0.00057	0.001277	0.001866
FRANCE	0.972844	0.953476	1.091247	0.966061	0.577058	0.395068	0.369712	0.171025	0.098637	0.214187	0.351481	0.437237
UNITED KINGDOM	2.31E-07	1.06E-06	5.15E-06	7.1E-06	2.98E-07	7.2E-06	4.2E-07	7.62E-08	3.07E-08	0	3.63E-10	2.74E-07
GREECE	0	3.81E-08	4.74E-07	3.16E-08	0	3.26E-08	0	0	0	0	4.5E-11	6.68E-11
CROATIA	2.65E-08	1.15E-06	1.25E-05	1.63E-07	3.68E-09	1.06E-07	7.17E-09	0	9.07E-07	0	9.91E-07	3E-07
HUNGARY	0.015301	0.014226	0.016012	0.013611	0.013888	0.00657	0.005929	0.004067	0.001816	0.008173	0.008684	0.009611
IRELAND	1.15E-06	6.13E-06	1.93E-05	1.09E-05	6.53E-06	8.88E-05	4.1E-05	9.85E-08	1.9E-06	0	2.53E-05	1.72E-06
ITALY	0.002968	0.00434	0.004302	0.004581	0.001064	0.001164	0.000546	7.7E-05	6.54E-05	0.000402	0.001577	0.002535
LITHUANIA	1.12E-06	2.76E-06	5.6E-05	5.1E-05	1.43E-06	0	1.15E-06	1.31E-06	2.44E-05	0	1.67E-09	4.9E-05
LUXEMBOURG	3.17E-05	3.43E-05	7.13E-05	5.3E-05	1.27E-08	9.56E-08	1.6E-08	4.07E-08	1.23E-07	0	2.33E-08	9.54E-06
LATVIA	8.68E-07	1.21E-06	2.2E-06	1.4E-06	0	3.82E-07	0	0	2.19E-09	0	1.2E-09	9.94E-10
MALTA	0.006271	0.006228	0.012423	0.006463	0.001563	0.001152	0.001867	0.000884	0.000518	0.001015	0.001206	0.001374
NETHERLANDS	2.42E-05	5.29E-05	0.000202	5.72E-05	8.68E-07	2.39E-05	1.11E-06	6.21E-07	7.75E-06	2.75E-05	8.66E-05	1.33E-05
POLAND	6.9E-06	3.26E-05	3.97E-05	2.79E-06	5.62E-05	0.000186	4.14E-05	1.37E-07	2.1E-07	0	1.69E-10	1.63E-06
PORTUGAL	2.37E-06	4.4E-06	2.56E-05	1.07E-05	2.52E-07	2.05E-06	0	4.64E-08	1.1E-08	0	3.92E-09	2.29E-07
ROMANIA	0.039308	0.017012	0.027388	0.004295	0.002115	1.38E-06	3.73E-06	1.77E-06	1.23E-05	0	0.010683	0.044685
SWEDEN	8.73E-07	4.05E-07	1.56E-06	6.66E-08	4.09E-08	0	4.08E-08	0	0	0	8.62E-11	1.75E-09
SLOVENIA	5.67E-06	1.18E-05	7.98E-05	3.95E-05	0	4.92E-07	1.09E-07	9.16E-07	7.45E-06	0	5.7E-09	1.92E-05
SLOVAKIA	1.045988	1.010612	1.181856	1.006278	0.606351	0.418315	0.383777	0.17822	0.105565	0.227447	0.513988	0.835059



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GENERAL MODEL OUTPUTS – APPLE EXAMPLE

Apple risk (infested volume.km².month); UK NUTS2

NUTS2 Region	Infested volume (100s Kg) in contact with 1 km ² of vulnerable crop											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UKC1 - Tees Valley and Durham	0	0	0	0	1.32E-07	9.06E-08	8.47E-08	3.92E-08	2.26E-08	3E-08	0	0
UKC2 - Northumberland and Tyne	0	0	0	0	0	2.51E-08	6.04E-08	2.79E-08	1.61E-08	0	0	0
UKD1 - Cumbria	0	0	0	0	0	2.81E-10	6.76E-10	3.13E-10	1.8E-10	0	0	0
UKD3 - Greater Manchester	0	0	0	0	2.38E-08	1.63E-08	1.52E-08	7.05E-09	4.06E-09	5.4E-09	0	0
UKD4 - Lancashire	0	0	0	0	4.03E-08	2.76E-08	2.58E-08	1.2E-08	6.89E-09	9.15E-09	0	0
UKD6 - Cheshire	0	0	0	0	3.59E-08	2.46E-08	2.3E-08	1.06E-08	6.13E-09	8.14E-09	0	0
UKD7 - Merseyside	0	0	0	0	4.13E-08	2.83E-08	2.65E-08	1.22E-08	7.06E-09	9.38E-09	0	0
UKE1 - East Yorkshire and Northe	0	0	0	0	2.51E-07	1.72E-07	1.61E-07	7.45E-08	4.29E-08	5.7E-08	0	0
UKE2 - North Yorkshire	0	0	0	0	1.25E-07	8.58E-08	8.03E-08	3.72E-08	2.14E-08	2.85E-08	0	0
UKE3 - South Yorkshire	0	0	0	0	1.44E-07	9.83E-08	9.2E-08	4.26E-08	2.46E-08	3.26E-08	0	0
UKE4 - West Yorkshire	0	0	0	0	1.34E-07	9.16E-08	8.57E-08	3.96E-08	2.29E-08	3.03E-08	0	0
UKF1 - Derbyshire and Nottingham	0	0	0	0	3.33E-07	2.28E-07	2.13E-07	9.86E-08	5.69E-08	7.55E-08	0	0
UKF2 - Leicestershire, Rutland an	0	0	0	0	4.14E-07	2.84E-07	2.66E-07	1.23E-07	7.08E-08	9.4E-08	0	0
UKF3 - Lincolnshire	0	0	0	0	1.86E-07	1.27E-07	1.19E-07	5.51E-08	3.18E-08	4.22E-08	0	0
UKG1 - Herefordshire, Worcesters	0	0	0	0	2.77E-07	1.9E-07	1.77E-07	8.21E-08	4.73E-08	6.28E-08	0	0
UKG2 - Shropshire and Staffordsh	0	0	0	0	2.02E-07	1.38E-07	1.29E-07	5.99E-08	3.45E-08	4.58E-08	0	0
UKG3 - West Midlands	0	0	0	0	2.41E-07	1.65E-07	1.54E-07	7.13E-08	4.11E-08	5.46E-08	0	0
UKH1 - East Anglia	0	0	0	0	8.31E-07	5.69E-07	5.33E-07	2.46E-07	1.42E-07	1.89E-07	0	0
UKH2 - Bedfordshire and Hertford	0	0	0	0	2.55E-07	1.75E-07	1.64E-07	7.57E-08	4.36E-08	5.79E-08	0	0
UKH3 - Essex	0	0	0	0	3.07E-07	2.1E-07	1.97E-07	9.11E-08	5.26E-08	6.98E-08	0	0

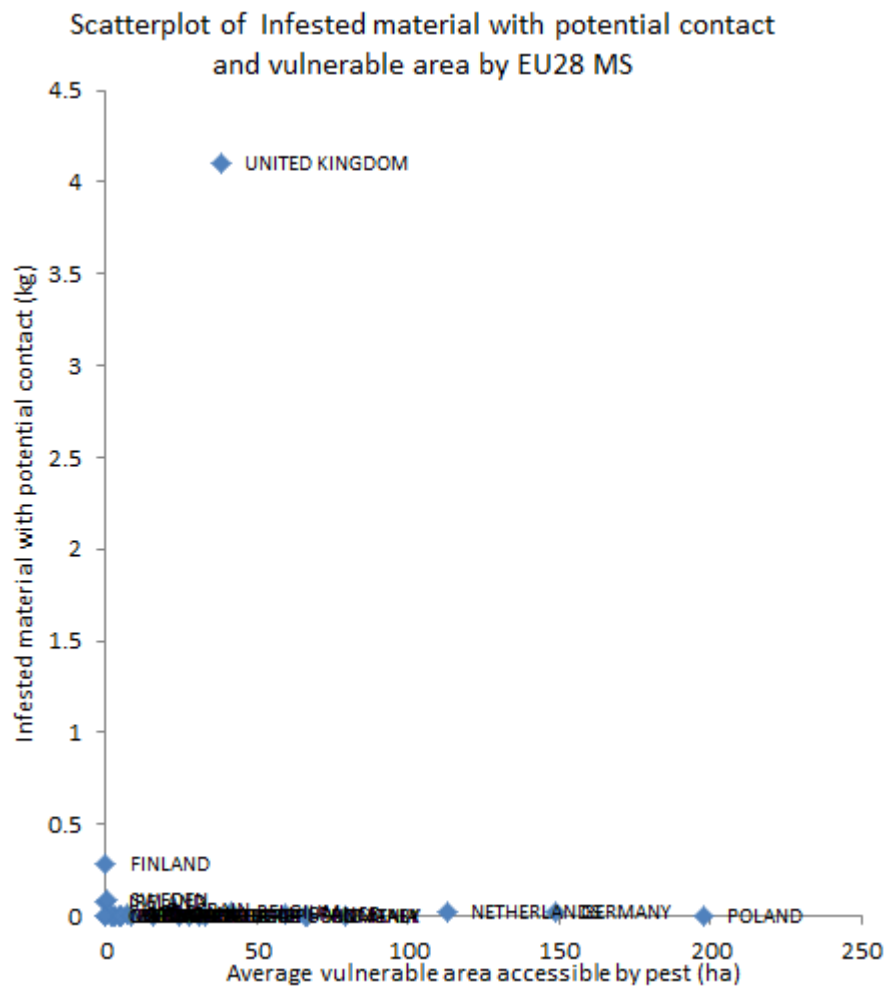
GENERAL MODEL OUTPUTS – APPLE EXAMPLE

Self sorting table showing only Top 50 risk

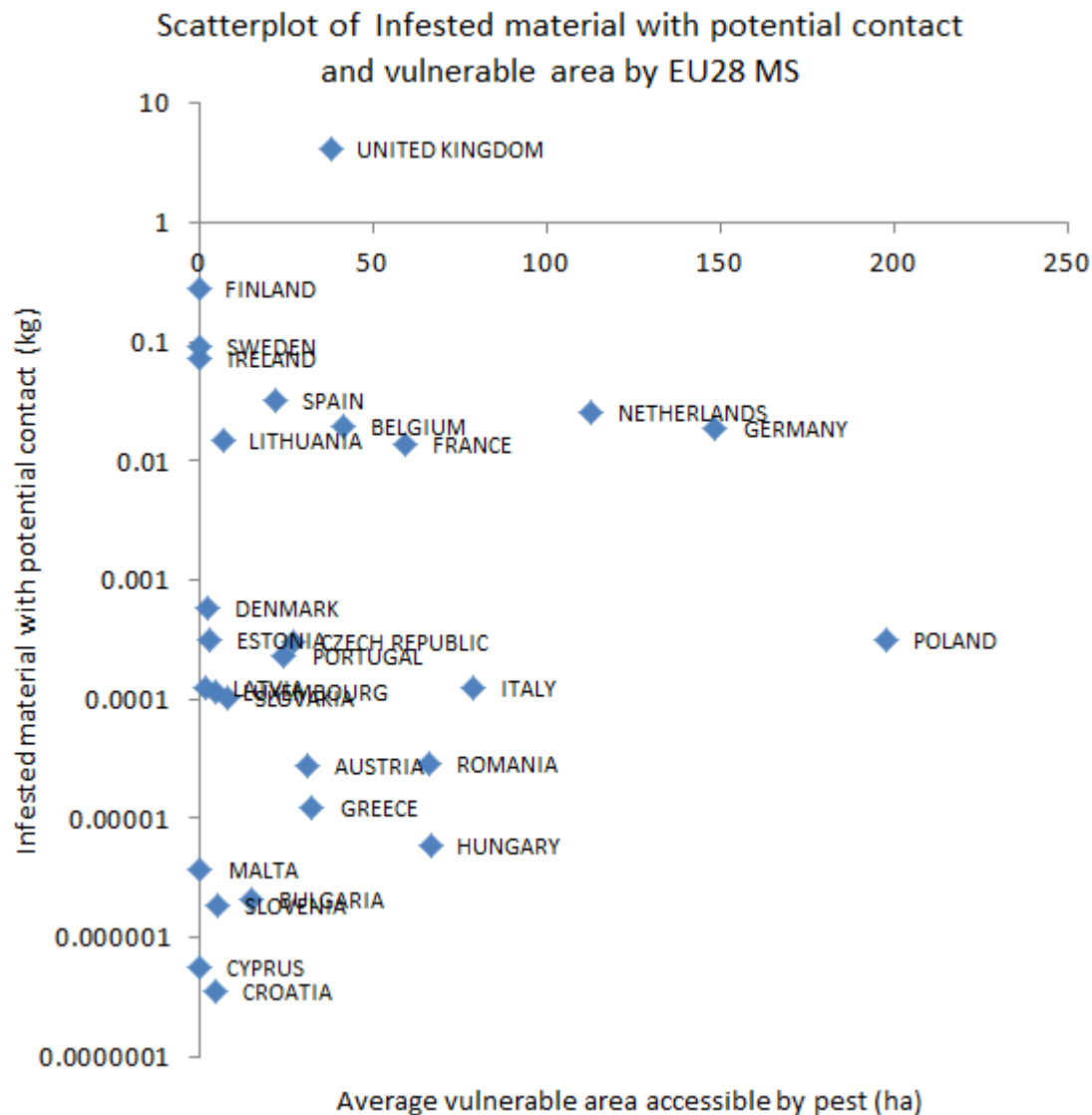
Rank	NUTS2 Region	Month	Risk	% Risk
1	UKH1 - East Anglia	May	8.31E-07	4.0%
2	UKH1 - East Anglia	Jun	5.69E-07	2.7%
3	UKH1 - East Anglia	Jul	5.33E-07	2.5%
4	UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	May	4.76E-07	2.3%
5	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	May	4.64E-07	2.2%
6	UKF2 - Leicestershire, Rutland and Northamptonshire	May	4.14E-07	2.0%
7	UKJ3 - Hampshire and Isle of Wight	May	3.35E-07	1.6%
8	UKF1 - Derbyshire and Nottinghamshire	May	3.33E-07	1.6%
9	UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	Jun	3.26E-07	1.6%
10	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	Jun	3.18E-07	1.5%
11	UKH3 - Essex	May	3.07E-07	1.5%
12	UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	Jul	3.05E-07	1.5%
13	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	Jul	2.97E-07	1.4%
14	UKF2 - Leicestershire, Rutland and Northamptonshire	Jun	2.84E-07	1.4%
15	UKG1 - Herefordshire, Worcestershire and Warwickshire	May	2.77E-07	1.3%
16	UKJ4 - Kent	May	2.69E-07	1.3%

... continues

GENERAL MODEL OUTPUTS – APPLE EXAMPLE

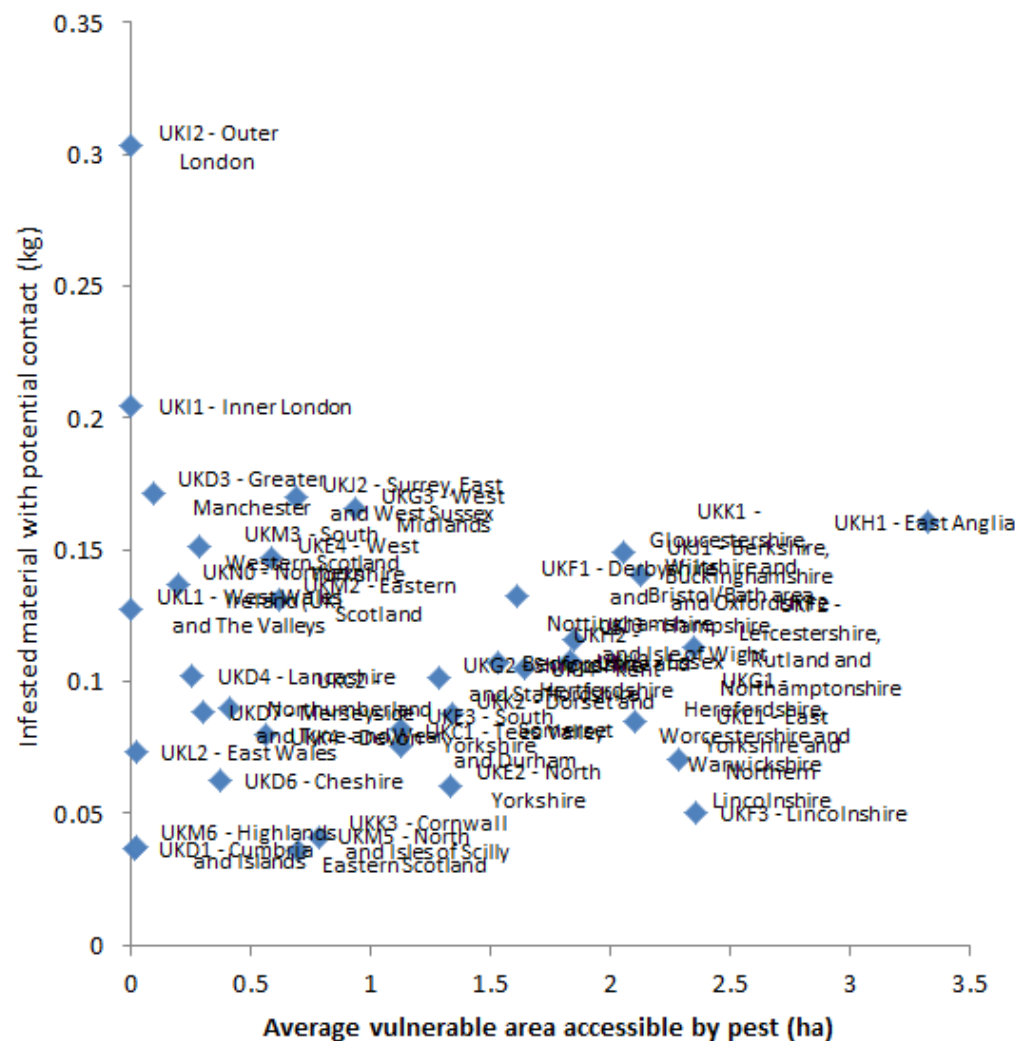


GENERAL MODEL OUTPUTS – APPLE EXAMPLE



GENERAL MODEL OUTPUTS – APPLE EXAMPLE

UNITED KINGDOM



CONCLUSIONS

QPAFood Cases

■ General model

- Individual and “clustered” pathways
- Trade, production components plus retail (fruit)/feed (wheat) use defines greatest risk
- High volume trade where end use occurs close to host crops at susceptible stages has greatest pest risk
- Spatial and temporal management of trade chains could reduce risks without more direct treatment
- Higher volume but lower risk for urban regions



CONCLUSIONS

QPAFood Detail


■ General model

- Trade and production data are available for major commodities; aggregated for minor ones
- Retail distribution can approximate population
- Processing detail is poor (proportion, location, waste)
- Infestation distributions are highly skewed
- High uncertainty on pest load and release rate
- Uncertainty in parameters allows for different levels of data input
- Spatial and temporal scale gives different risk
- Release point numbers are hard to estimate
- Waste at consumer level is riskiest stream for fruit; losses at mills and feed use is riskiest for wheat



CONCLUSIONS

QPAFood Summary

- 
- Demonstrates feasibility of practical modular approach
 - Allows a broad flexible definition of “pathways”
 - Data availability is good on trade, production, retail
 - Less good on processing proportion and location; release kernels
 - Good potential for analysis of major commodities with existing data; aggregated data on minor commodities
 - New trade needs scenario analysis, so models have been designed to do this
 - Good potential for forensic analyses
 - Further potential for human-assisted spread analysis for intra-EU trade



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QPAFood model parameterised for movement of *Drosophila suzukii* into and within the EU

Imperial College
London



QPAFood Module 1 application to *Drosophila suzukii*

- Module 1 calculations for polyphagous pests such as *D. suzukii*
 - Series of Module 1 calculations
 - 12 main commodity groups were identified
 - *D. suzukii* sources inside and outside EU28 taken into account
 - Total of 34 source countries, worldwide
 - Infestation rate scenario according to country status with respect to *D. suzukii* – widespread, present, few or absent



Potentially infested annual import volumes of 12 commodities

Some countries are net
importers of an
infested commodity
and **Red cells** highlight
highest net import
volumes

Some countries are net
exporters of an
infested commodity
and **Blue cells** highlight
highest net export
volumes

Imperial College
London



Mean direct imports plus net transhipments 2011-2015	Apple	Blueberry	Cherry	Currant	Fig	Grape	Kiwi	Peach	Pear	Plum	Raspberry	Strawberry
AUSTRIA	126	0	2	0	1	47	16	57	28	10	8	38
BELGIUM (and LUXBG -> 1998)	153	0	9	0	3	64	25	96	42	20	3	30
BULGARIA	13	0	0	0	0	3	0	1	1	0	0	0
CYPRUS	10	0	0	0	0	0	0	0	2	0	0	0
CZECH REPUBLIC (CS->1992)	12	0	0	-1	1	59	11	54	11	5	0	17
GERMANY (incl DD from 1991)	798	0	20	3	4	355	121	477	178	58	13	162
DENMARK	93	0	1	0	1	26	6	29	24	10	1	12
ESTONIA	7	0	0	0	0	5	1	4	3	1	0	1
SPAIN	272	0	-22	0	-6	-84	84	-542	-35	-64	-5	-220
FINLAND	67	0	1	0	0	21	5	15	18	4	0	2
FRANCE	-236	0	9	0	12	248	38	207	90	13	12	138
UNITED KINGDOM	559	0	33	1	3	202	32	141	130	67	17	72
GREECE	19	0	0	0	0	1	1	2	8	0	0	1
CROATIA	-2	0	0	0	0	11	5	17	7	1	0	2
HUNGARY	20	0	0	0	0	8	7	10	2	0	0	3
IRELAND	64	0	1	0	0	13	4	7	6	3	2	2
ITALY	-520	0	3	2	-3	-386	-190	-98	-33	-19	6	51
LITHUANIA	85	0	2	0	0	24	14	56	43	4	1	6
LUXEMBOURG	5	0	0	0	0	3	1	2	1	1	0	2
LATVIA	11	0	0	0	0	5	3	8	4	1	0	1
MALTA	8	0	0	0	0	2	1	3	1	1	0	0
NETHERLANDS	-22	0	1	0	1	51	26	46	-168	11	-1	-9
POLAND	39	0	1	0	1	176	40	176	32	16	2	20
PORTUGAL	77	0	4	0	2	40	7	76	4	10	0	26
ROMANIA	50	0	0	0	0	23	5	26	15	1	0	1
SWEDEN	120	0	2	0	1	30	14	45	34	8	1	8
SLOVENIA	1	0	0	0	0	7	3	16	5	2	0	3
SLOVAKIA	35	0	0	0	0	23	7	21	5	2	0	3

Potential infested import volume/yr

	Blueberry		Currant		Grape		Peach	
	Apple	Cherry	Fig		Kiwi			
GERMANY (incl DD from 1991)	798	0 20	3 4		355 121		477	
DENMARK	93	0 1	0 1		26 6		29	
ESTONIA	7	0 0	0 0		5 1		4	
SPAIN	272	0 -22	0 -6		-84 84		-542	

Mean direct imports plus net transshipments 2011-2015

	Apple	Blueberry	Cherry	Currant	Fig	Grape	Kiwi	Peach	Plum	Raspberry	Strawberry
AUSTRIA	126	0	2	0	1	47	16	57	28	10	8
BELGIUM (incl DD from 1991)	153	0	9	0	3	64	25	96	42	20	3
BULGARIA	13	0	0	0	0	3	0	1	1	0	0
CYPRUS	0	0	0	0	0	0	0	0	2	0	0
CZECH REPUBLIC (CS > 1992)	12	0	-1	1	59	11	54	11	5	0	17
GERMANY (incl DD from 1991)	798	0	20	3	4	355	121	477	178	58	162
DENMARK	93	0	1	0	1	26	6	29	24	10	1
ESTONIA	7	0	0	0	0	5	1	4	3	1	0
FINLAND	67	0	-22	0	-6	84	54	-35	64	-5	-228
FRANCE	236	0	9	0	12	248	38	207	90	13	12
UNITED KINGDOM	559	0	33	1	3	202	32	141	130	67	17
GREECE	19	0	0	0	0	1	1	2	8	0	0
CROATIA	-2	0	0	0	0	11	5	17	7	1	0
HUNGARY	20	0	0	0	0	8	7	10	2	0	3
IRELAND	64	0	1	0	0	13	4	7	6	3	2
ITALY	-50	0	3	2	-3	388	-190	-98	-33	-19	6
LITHUANIA	85	0	2	0	0	24	14	56	43	4	1
LUXEMBOURG	5	0	0	0	0	3	1	2	1	1	0
LATVIA	11	0	0	0	0	5	3	8	4	1	0
MALTA	8	0	0	0	0	2	1	3	1	1	0
NETHERLANDS	-22	0	1	0	1	51	26	46	-188	11	-1
POLAND	39	0	1	0	1	176	40	176	32	16	2
PORTUGAL	77	0	4	0	2	40	7	76	4	10	0
ROMANIA	50	0	0	0	0	23	5	26	15	1	0
SWEDEN	120	0	2	0	1	30	14	45	34	8	1
SLOVENIA	1	0	0	0	0	7	3	16	5	2	0
SLOVAKIA	35	0	0	0	0	23	7	21	5	2	0

Examples from table:

Red cells Germany is a large net importer of Apple, Grape, Kiwi and Peach; Spain is also a large net importer of Apple and Kiwi

Blue cells Spain is a large net exporter of Peach and Grape



% net IMPORT risk from *D. suzukii*

	Apple	Blueberry	Cherry	Currant	Fig	Grape	Kiwi	Peach	Pear	Plum	Raspberry	Strawberry
GERMANY (incl DD from 1991)	36	0	1	0	0	16	6	22	8	3	1	7
DENMARK	46	0	1	0	0	13	3	14	12	5	0	6
ESTONIA	30	0	2	0	0	23	6	18	13	3	0	6
SPAIN	76	0					24					

76% of Spain's net import risk comes from apple and 24% from kiwi, most other commodities are net exports

Germany, Denmark and Estonia all have large % of their import risk from apple, grape, peach and pear; no net exports with respect to risk



% net EXPORT risk from *D. suzukii*

	Apple	Blueberry	Cherry	Currant	Fig	Grape	Kiwi	Peach	Pear	Plum	Raspberry	Strawberry
ITALY	42				0	31	15	8	3	2		
NETHERLANDS	11			0					84		0	5

Apple, grape and kiwi are largest contributors to potential export risk from Italy
 Pear (especially), apple and strawberry are largest contributors to potential export risk from the Netherlands

In both countries these risks are associated partly with home-produced commodity and partly with transhipped commodity

Next steps: Trade pathways

- Decline in pest viability in imports for commodities that are stored for long periods – apple and pear
 - Now infestation of apple and pear relative to other more perishable commodities is probably over-estimated
- Differences between potential infestation burden (per unit weight) between fruit commodities
- Provide gross infested imports separately from gross infested exports
 - Net import/export works when pest sources are all outside EU so only ‘exports’ are due to transshipment

Next steps: Distribution, transfer and management

- Set up Module 2 to allow estimates of pest transfer risk, from imports to local production in NUTS2 regions, to be calculated for *D. suzukii*
- Consider which other alert-list pests could usefully be evaluated in DROPSA using QPAFood and apply model
- Use parameterised models to explore predicted effect of management scenarios
 - Import and/or export of infested material is reduced by specific countries or at specific times of year