

Emergence of *Aedes japonicus* in Central Europe



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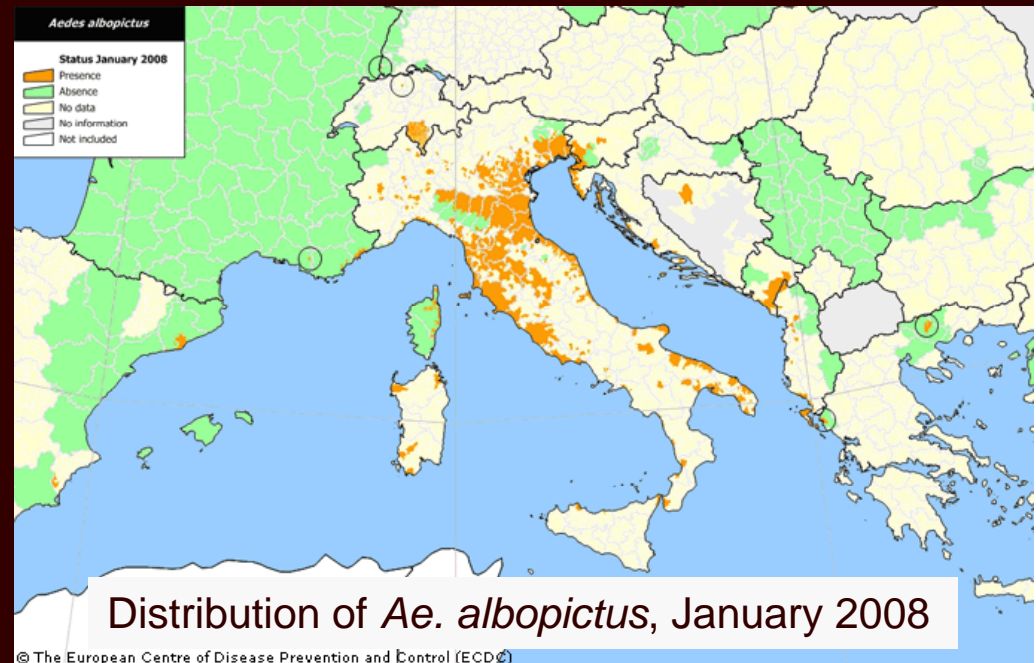


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Ae. japonicus in Central Europe

- July 2008: complaints about insect nuisance (canton Aargau, north of the Alps); mosquito specimen resembling *Ae. albopictus* (tiger mosquito)
- Same area from which *Ae. albopictus* was reported in 2007 based on photography of incomplete insect



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- July 2008: complaints about insect nuisance (canton Aargau, north of the Alps); mosquito specimen resembling *Ae. albopictus* (tiger mosquito)
- Same area from which *Ae. albopictus* was reported in 2007 based on photography of incomplete insect
- Morphology: neither belonging to *Ae. albopictus* nor to any indigenous species known from Europe
- Field investigation in order to
 - (1) collect more specimens from this species
 - (2) check if *Ae. albopictus* has established

[*Ae. japonicus* in Central Europe]

- First results:
 - identification of *Ae. japonicus* (morphology, mt COI sequence)
 - present at several sites
 - re-examination of photographed specimen, assumed to be *Ae. albopictus*, from the same area in 2007 reveals *Ae. japonicus*
- First finding of *Ae. japonicus* in Switzerland

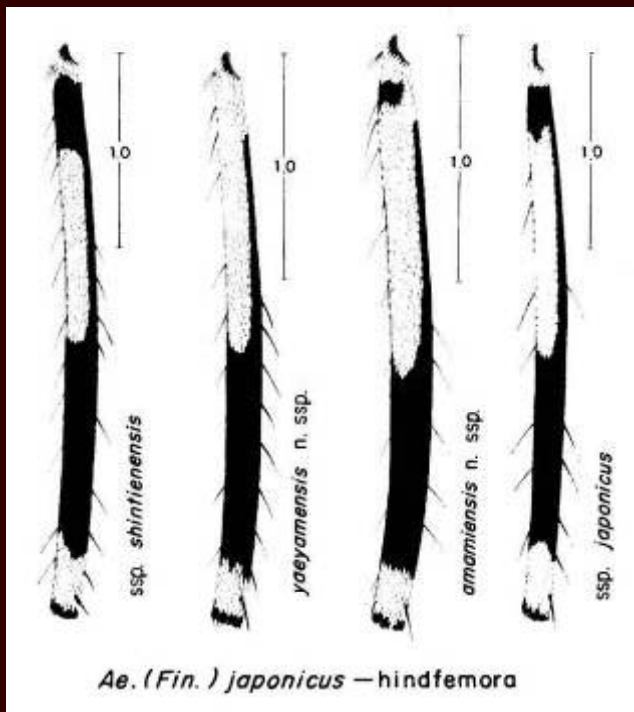


Aedes japonicus

‘Asian bush mosquito’; ‘Asian rock pool mosquito’

Aedes (Finlaya) japonicus (Theobald, 1901)

(=*Ochlerotatus japonicus sensu* Reinert et al. 2004)



4 sub-species

Ae. japonicus amamiensis (Tanaka et al. 1979)

Ae. japonicus japonicus (Theobald, 1901)

Ae. japonicus shintienensis (Tsai et Lien, 1950)

Ae. japonicus yaeyamensis (Tanaka et al. 1979)

Differ in tibia ornamentation

Breed in rock pools as well as in artificial container habitats

Eggs: resistant to desiccation, winter diapause

Ae. japonicus: diagnostic characters of adults



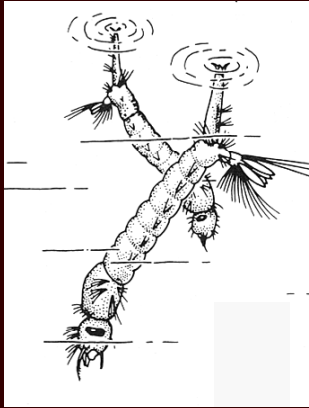
Black and white mosquito, usually large, similar to *Ae. albopictus*, but **differs in ornamentation of:**

- mesonotum
- palpi extremity
- fourth tarsomere



Ae. albopictus

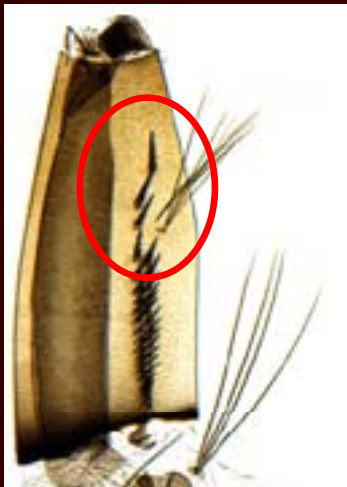
Ae. japonicus



Ae. japonicus: diagnostic characters of larvae

Usually large larvae, differ from other mosquitoes of Europe by:

- Pecten with one or more distal strong spines, widely spaced



Similar species in containers: *Ae. atropalpus*

- Frontal setae 5-C and 6-C
 - branched for *Ae. japonicus*
 - single for *Ae. atropalpus*



[*Ae. japonicus* – an invasive vector species]

- Transported by human activities, e.g. used tyre trade
- ➔ Known as an invasive species



The screenshot shows the Global Invasive Species Database (ISSG) website. The header includes the text "GLOBAL INVASIVE SPECIES DATABASE" and three buttons: "100 OF THE WORST", "DONATIONS", and "HOME". Below the header, there are navigation tabs for "Standard Search", "Taxonomic", and "Site Index". The main content area displays the species name "*Ochlerotatus japonicus japonicus* (insect)" and a set of navigation tabs: "Ecology", "Distribution", "Management Info", "Impact Info", "References and Links", and "Contacts". A "PRINTER VERSION" button is also visible. Below the tabs, the following taxonomic information is provided:

Taxonomic name: *Ochlerotatus japonicus japonicus* (Theobald, 1901)
Synonyms: *Aedes japonicus* (Reinert, 2000)
Common names: Asian rock pool mosquito (English-United States)
Organism type: insect

[*Ae. japonicus* – recent territorial expansion]

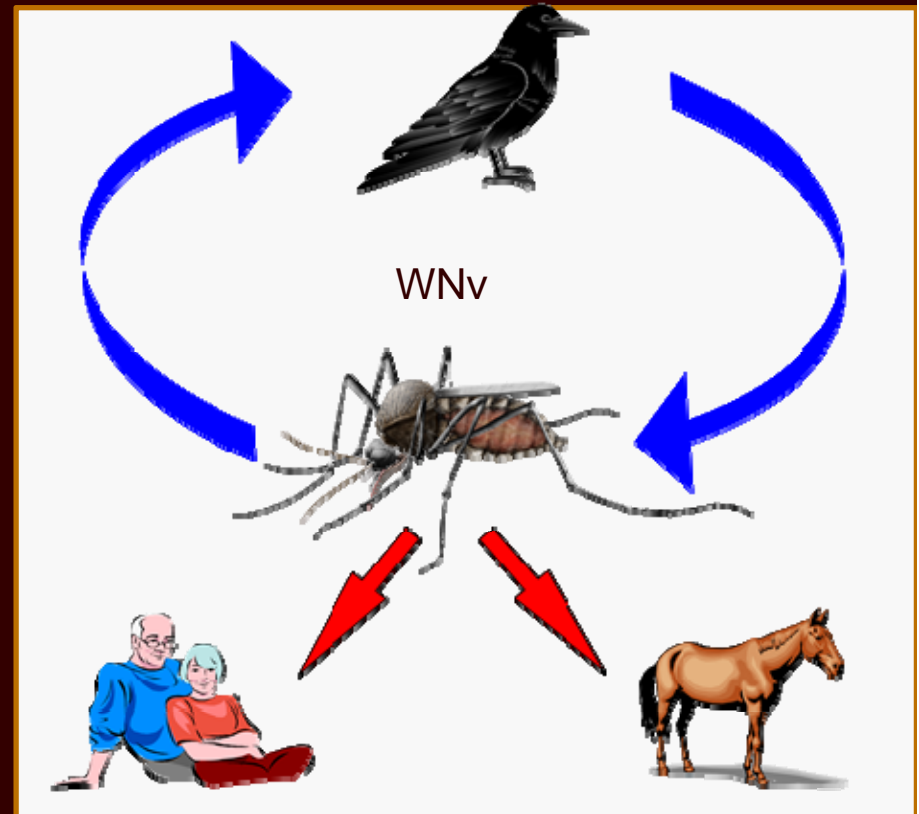
- Intercepted in New Zealand (1993, 1998 & 1999)
(Laird *et al.* 1994; Fonseca *et al.* 2001)
- First established outside its native range in the USA in 1998, spread to 22 states incl. Hawaii, and parts of Canada
(Williges *et al.*, 2008)
- Europe:
 - **France (Normandie), 2000**: detected on a platform for imported used tyres (then eliminated) (Schaffner *et al.*, 2003)
 - **Belgium, since 2002**: established, but restricted to two storages of used tyres (Versteirt *et al.*, 2009)

[*Ae. japonicus* – vector role]

Vector role under natural conditions unknown

- Laboratory vector of several arboviruses e.g. JEv, WNV
- WNV regularly detected in field-caught *Ae. japonicus*
- Feeds on mammals and birds

Bridge vector candidate



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 - present at several sites
 - re-examination of photographed specimen, assumed to be *Ae. albopictus*, from the same area in 2007 reveals *Ae. japonicus*
- First finding of *Ae. japonicus* in Switzerland, known vector competence, 'invasive' character
 - ⇒ further investigate its status in that area (i.e. distribution, abundance, biting activity)

[*Ae. japonicus* in Central Europe: expanded field investigations]

Distribution

- Focus on **larval collections in potential breeding sites**
 - **flower vases in cemeteries** particularly useful for assessing the presence and abundance of the species
 - Most of the checked cemeteries (86.6%, n=134) provided three or more vases containing rain water
 - Vases generally positive when the species is present (91.2 %, n=34)
 - Cemeteries easily accessible





[*Ae. japonicus* in Central Europe: expanded field investigations]

- Surveyed area extended in all directions to obtain a crown of negative sites surrounding the identified distribution area
 - Negative sites = presence of at least one potential breeding site showing mosquito larvae or three without mosquito larvae
- Some **specific sites** also checked because of their possible role as introduction point (used tyre storage, airport surrounding area)

Results – Distribution of *Ae. japonicus* in Central Europe 2008

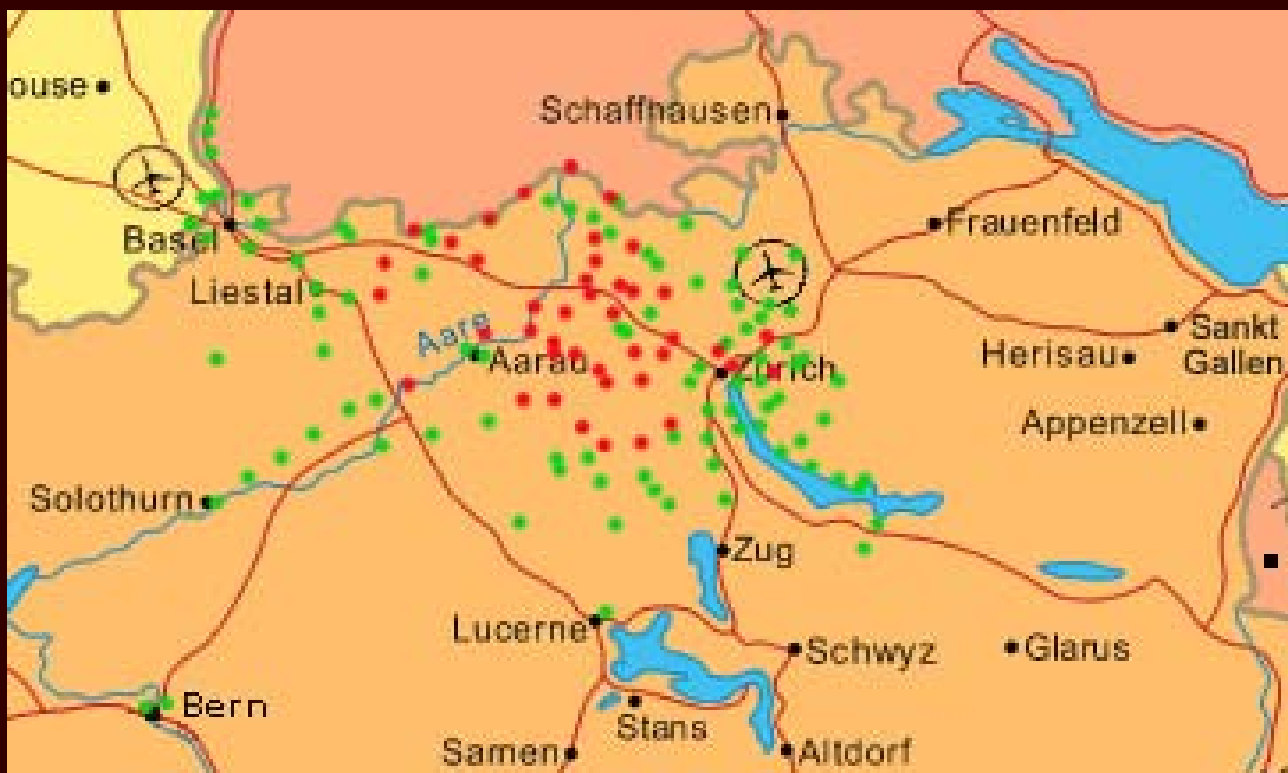


Fig.: Positive and negative sites observed in the investigated area (CH, DE and FR), Aug. 14th to Nov. 6th, 2008

- *Ae. japonicus* in CH in area of approx. 1,400 sq km
- present in bordering Germany (Baden-Württemberg)

Tab.: Investigated municipalities per country and administrative unit level 3

Country	Switzerland (Canton)									Germany (Kreis)		France (Dép.)	Total
	AG	BL	BS	BE	LU	SZ	SO	ZG	ZH	Lörrach	Waldshut	Haut-Rhin	
<i>Ae. japonicus</i> present	29	2	0	0	1	0	1	0	3	0	2	0	38
<i>Ae. japonicus</i> absent	22	6	1	2	5	2	6	1	30	4	3	3	85
Total no	51	8	1	2	6	2	7	1	33	4	5	3	123

Results – Distribution of *Ae. japonicus* in Central Europe 2009



Results – Distribution of *Ae. japonicus* in Central Europe 2009

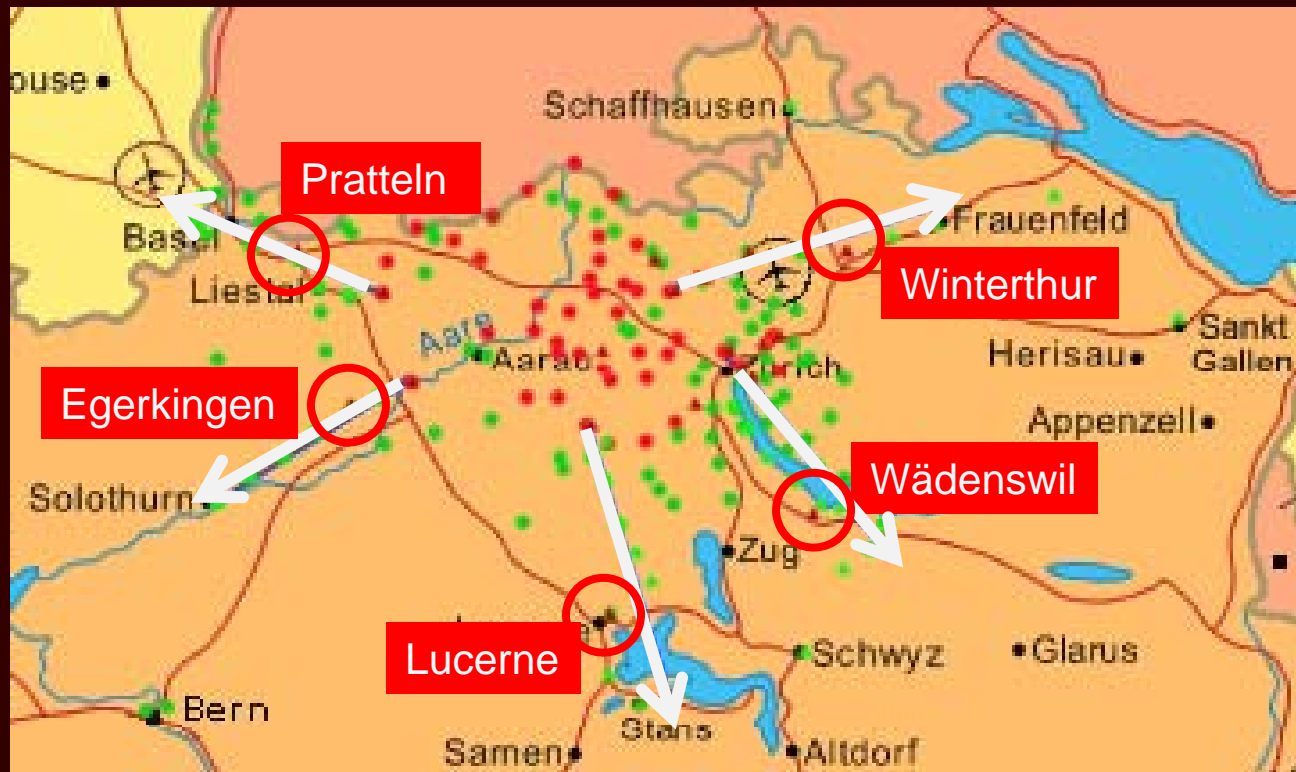


Fig.: Positive and negative sites observed in the investigated area (CH, DE and FR)

- 2009: 50 municipalities investigated
- 12 new pos. (9 by sampling, 3 complaints)
- ➔ Territorial extension in all direction
- ➔ *Ae. japonicus* in CH in area of approx. 2,500 sq km

Tab.: Investigated municipalities per country and administrative unit level 3, 2008-09

Country	Switzerland											G		F	Total
	AG	BL	BS	BE	LU	NW	SH	SO	SZ	ZG	ZH	Lö	Wh	H-R	
<i>Ae. japonicus</i> present	29+3	2+1	0	0	1+1	0	0	1+1	0	0	3+7	0	2	0	38+13
<i>Ae. japonicus</i> absent	21	7	1	2	7	2	1	6	5	2	26	4	3	3	91
Total no	53	10	1	2	9	2	1	8	5	2	36	4	5	3	142

Results – Mosquito species collected in man-made breeding sites

617/3542 investigated breeding vessels
with mosquito larvae

<i>Ae. geniculatus</i>	9
<i>Ae. japonicus</i>	160
<i>An. maculipennis</i>	5
<i>An. plumbeus</i>	36
<i>Cs. annulata</i>	3
<i>Cs. longiareolata</i>	3
<i>Cx. pipiens</i> , <i>Cx. hortensis</i>	501
<i>Cx. territans</i>	1
<i>Cx. torrentium</i>	3

Results – abundance of mosquito species

⇒ Vase index = percentage of cemetery vases with mosquito larvae

Tab.: Occurrence of mosquitoes in vases in cemeteries

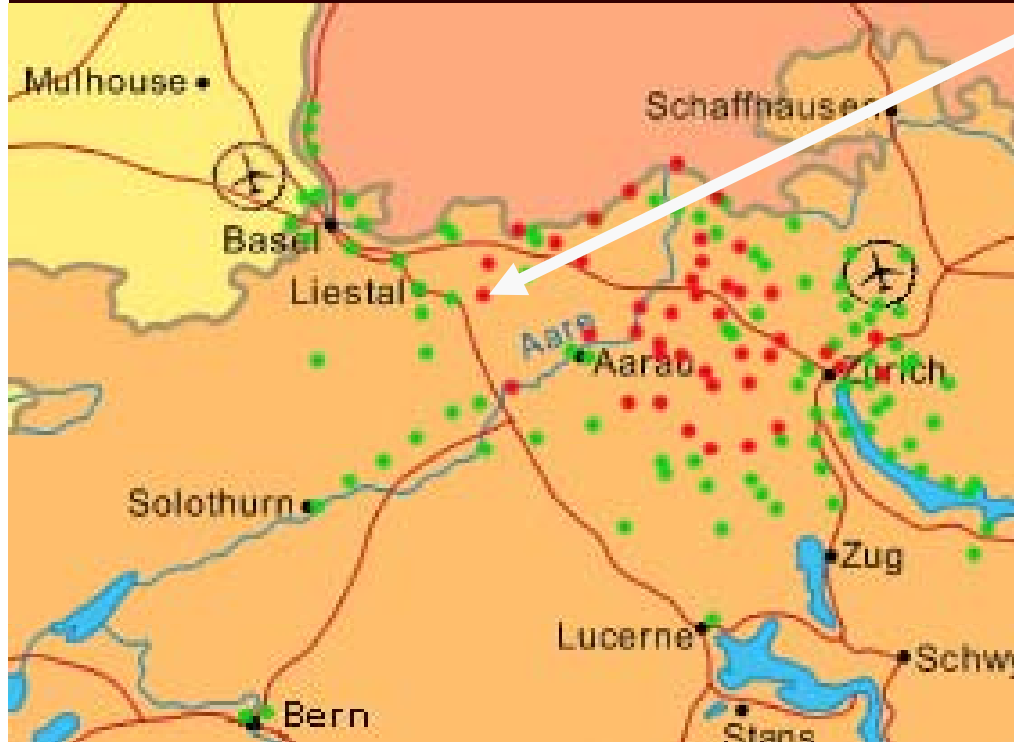
pos. = mosquitoes present

	Vases	All mosquitoes		<i>Ae. japonicus</i>		<i>Cx. pipiens</i> , <i>Cx. hortensis</i>	
	no total	no pos.	mean index	no pos.	mean index	no pos.	mean index
<i>Ae. japonicus</i> present (n=33)	833	193	29.1	118	21.4	96	11.8*
<i>Ae. japonicus</i> absent (n=93)	2186	244	10.0	0	0.0	231	9.4
Whole studied area	3019	437	15.0	118	5.6	327	10.0

* significantly lower index values compared to index values for *Ae. japonicus* (Friedman-test: $P < 0.01$; post hoc test: $p < 0.05$)

- *Ae. japonicus*, if present, is more abundant in vases than the most common species *Cx. pipiens*
- Larval competition? No significant difference of index values for *Cx. pipiens* regardless whether *Ae. japonicus* is present or not (Mann-Whitney test, $p > 0.05$)

Results – Putative introduction sites of *Ae. japonicus*



- One used tyre storage colonized
 - no import of used tyres declared,
 - located at border of colonized area, only a few specimens
 - ➔ unlikely to be the introduction point
- No other company importing suitable goods identified
- *Ae. japonicus* not present in vicinity of airports

➔ No obvious way of introduction identified as yet (terrestrial vehicles?)

Summary

- *Aedes japonicus*
 - Present in Switzerland (area of approx. 2,500 sq km) and in bordering Germany
 - First finding of proliferation and spread of an invasive mosquito in Central Europe
 - Breeds in urbanized environments in man-made sites
 - If present, more abundant in vases than the most common species *Culex pipiens*
 - No obvious way of introduction identified as yet
- *Ae. albopictus*: its identification in 2007 (Switzerland, north of the Alps) based on a photographed specimen is erroneous

Outlook

- Need for further studies on *Ae. japonicus*:
 - assess its spread
 - assess larval competition with local container breeding species
 - assess its vector competence and vector capacity in the local environment
- Invasive and vector potentials render this species a potential threat for animal and human health, and justify the implementation of preventive surveillance and control measures
 - Funding requested from national and international agencies

Acknowledgments

Field investigation: Hans-Peter Mueller; Ruth Hochstrasser

Statistical analysis: Daniel Hegglin



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***FVO – National reference center for epizootic-
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