# The use of recovery endpoints in aquatic risk assessments: what about isolated waterbodies?

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## Introduction

Under Regulation (EC) 1107/2009, it is increasingly difficult to demonstrate acceptable risks to aquatic organisms at Tier I. Therefore, it is often necessary to turn to higher-tier approaches, with one such tool being mesocosm studies. Under the current aquatic guidance document (EFSA 2013), two types of endpoint can be generated from mesocosm studies: no observed effect concentration (NOECs) and no observed adverse effect concentration (NOEAC). The NOEAC represents a concentration at which aquatic communities will experience transitory effects but can recover within a period of time. The acceptability of different magnitudes of effects depends on the time period required for recovery i.e. a small effect can last for months, a medium effect can last for weeks, a large effect can last for days. Regulatory authorities are often cautious about using NOEAC endpoints in the risk assessment due to concerns that recovery in real waterbodies may not occur, particularly in physically isolated waterbodies that do not benefit from unaffected areas upstream acting as a source for recolonization. In situations where the impacted surface water body is isolated from other water bodies, the time required for an impacted community to recover may be higher, which could influence whether an effect is considered acceptable under EFSA (2013). Individual species traits outside of their sensitivity to pesticides such as dispersal ability, timing of dispersal and generation time play an important role in their ability to recover; however, these factors may also determine whether a species is present in isolated water bodies prior to a disturbance event. One important component of this topic which could readily be assessed with available data is the degree of isolation of water bodies in heavily agricultural landscapes.

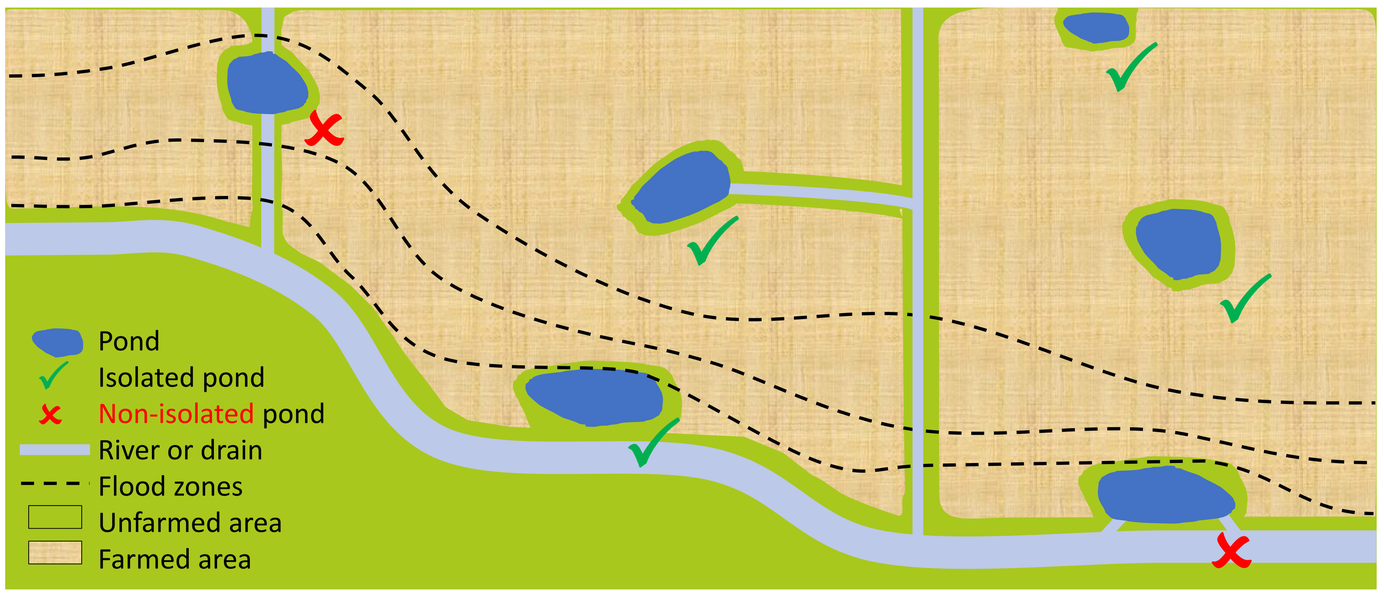
## Aim

This poster assessed the degree of isolation of ponds within agricultural landscapes in England and Wales based on analysis of open GIS datasets including a database of UK lakes[1] (restricted to 2 ha).

## Methods

A UK lakes GIS database was used to develop a list of isolated ponds in UK agricultural land. The database was filtered to identify ponds (maximum size of 2 ha. size used as proxy) within primarily agricultural land (1 km grid square contained 90% agricultural land) based on a UK land cover GIS layer. Distance from ponds to the nearest other water features was used as a proxy for degree of isolation. Distance to the nearest water feature was initially calculated based on analysis of proximity to a UK drainage network GIS layer. Proximity calculations were manually checked against aerial photography and basemaps to confirm pond distance was accurate. This took account of additional drainage network features not mapped in the UK drainage layer and other static water bodies. Distance was calculated manually where the calculated distance was identified as inaccurate. Additional layers were then used to identify details of the landscape in which each pond occurred (i.e. pond in Environment Agency (EA) Flood Zone 2/3, EA region of pond, aquatic ecosystems in agricultural landscapes[2] (referred to as agro-ecosystem hereafter) of pond). For the small proportion of highly isolated ponds further manual assessment of aerial photography and basemaps was conducted. This was used to assess the local landscape details of ponds by identifying the farming landscape in which ponds occurred (e.g. farmhouse environs, field centre, field margin etc.) and the level of buffering that exists between ponds and agricultural fields (e.g. pond separated from field by natural area, hedgerow, farm buildings etc.) to obtain some quantification of the level of pesticide exposure risk.

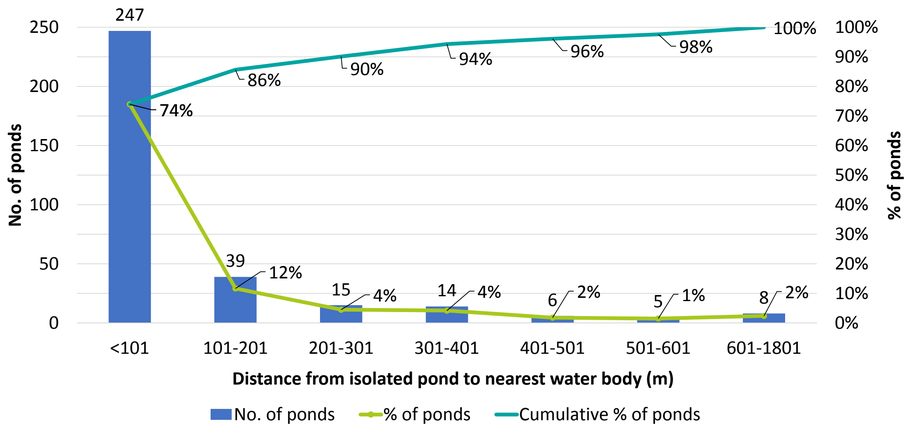
**Figure 1: Isolated ponds in the agricultural landscape. Representation of isolated ponds used in this analysis**




Ponds occur at various locations within the landscape. The focus of this study is isolated ponds, however, the GIS layer used did not distinguish between water bodies which form part of the river network and not. Ponds were considered to be isolated if they were not part of the river and drainage network. Ponds at the beginning of the drainage network were included as isolated ponds. Isolated (✓) and non-isolated (×) ponds are illustrated in Figure 1.

## Results and discussion

**Figure 2: Water body proximity range categories of isolated ponds expressed as number of ponds, % of ponds and cumulative % of ponds.**




- As illustrated in Figure 2, the majority (74%) of isolated ponds in heavily agricultural landscapes are within 101 m of other water bodies. 90% of these isolated ponds are within 301 m of other water bodies.

- A similar overall pattern was observed when ponds were separated based on the agro-ecosystem landscape in which they occurred (Figure 3). The majority of ponds were again within 101 m of another water body with a minimum of 50% (based on a combined category covering only 10 ponds) and a maximum of 93% ("Warplands, fenlands and associated low terraces" covering 81 ponds).

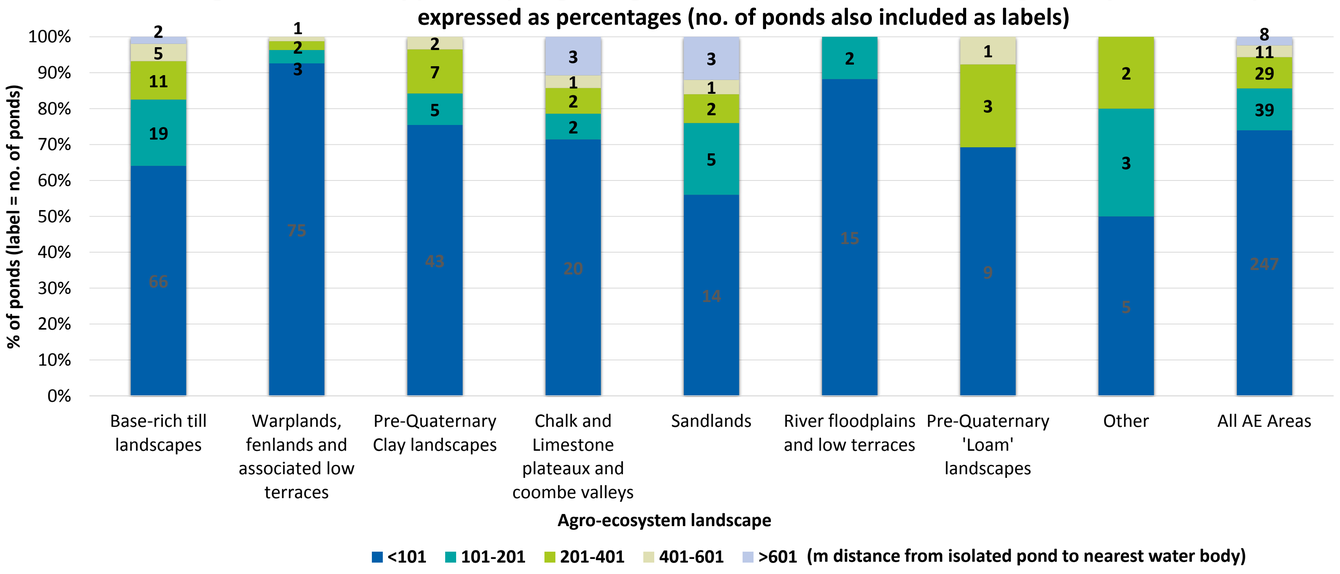
- The presence of isolated ponds within flood zones would allow for a potential source of recolonization. As shown in Table 1, isolated ponds further than 101m from other water bodies were not consistently located within flood zones.

**Table 1: Percentage of isolated ponds in Environment Agency Flood Zones for a range water body proximity range categories**

| Nearest water body (m) | In EA Flood Zone? | |
|---|---|---|
| | No | FZ 2 or 3 |
| <101 | 55% | 45% |
| 101-201 | 92% | 8% |
| 201-301 | 87% | 13% |
| 301-401 | 100% | 0% |
| 401-501 | 83% | 17% |
| >501 | 100% | 0% |

- For the small proportion of highly isolated ponds which occurred at distance greater than 300m from other water bodies (33 ponds, approx. 10% of total), further assessment of potential for exposure to pesticide was conducted based on the location of ponds relative to agricultural fields and the degree of buffering between ponds and agricultural fields. (Table 2).

**Figure 3: Water body proximity range categories of isolated ponds in different agro-ecosystem landscapes expressed as percentages (no. of ponds also included as labels)**




- As presented in Table 2, isolated ponds >301 m from other water bodies were generally well buffered. All ponds except one were buffered from agricultural field by some form of 3D structure (hedges, trees, woodland, farm building). Some ponds were separated from agricultural fields to such an extent that pesticide exposure would be highly unlikely. Only one pond was identified as being without any form of buffer. 17 of 33 ponds were within farmyard and house complexes with some ponds also identified as reservoirs.

**Table 2: Local landscape features relevant to pesticide exposure of highly isolated ponds (>301 m from other water bodies)**

| Nearest waterbody (m) | Nearest waterbody grouping (m) | Location of pond | Buffer type between pond and field | EA Region | Agro-ecosystem landscape |
|---|---|---|---|---|---|
| 308 | 301-401 | Farm complex | Woodland buffer | Anglian Region | Base-rich till landscapes |
| 325 | 301-401 | Farm complex | Woodland buffer | Midlands Region | Sandlands |
| 350 | 301-401 | Field centre | Tree buffer | North East Region | Sandlands |
| 355 | 301-401 | Field margin | Woodland buffer | North East Region | Base-poor till landscapes |
| 360 | 301-401 | Field centre | Tree buffer | Midlands Region | Base-rich till landscapes |
| 367 | 301-401 | Farm complex | Tree buffer | Anglian Region | Base-rich till landscapes |
| 367 | 301-401 | Farm complex | Tree buffer | EA Wales | Pre-Quaternary 'Loam' landscapes |
| 367 | 301-401 | Farm complex | Tree buffer | EA Wales | Pre-Quaternary 'Loam' landscapes |
| 371 | 301-401 | Farm complex | Tree buffer | Midlands Region | Pre-Quaternary 'Loam' landscapes |
| 372 | 301-401 | Field margin | Tree buffer | Midlands Region | Pre-Quaternary Clay landscapes |
| 375 | 301-401 | Farm complex | Tree buffer | Anglian Region | Pre-Quaternary Clay landscapes |
| 375 | 301-401 | Farm complex | Extensive buffer | Midlands Region | Pre-Quaternary Clay landscapes |
| 380 | 301-401 | Industrial | Tree buffer | Anglian Region | Chalk and Limestone plateaux and coombe valleys |
| 385 | 301-401 | Farm complex | Tree and hedge buffer | North East Region | Base-rich till landscapes |
| 419 | 401-501 | Field margin | Woodland buffer | North East Region | Warplands, fenlands and associated low terraces |
| 450 | 401-501 | Field margin | Woodland buffer | Anglian Region | Chalk and Limestone plateaux and coombe valleys |
| 459 | 401-501 | Farm complex | Woodland buffer | North East Region | Base-rich till landscapes |
| 478 | 401-501 | Field margin | Tree buffer | Anglian Region | Pre-Quaternary Clay landscapes |
| 478 | 401-501 | Farm complex | Extensive buffer | North East Region | Base-rich till landscapes |
| 479 | 401-501 | Field centre | Woodland buffer | North East Region | Base-rich till landscapes |
| 508 | 501-601 | Field margin | Tree buffer | Anglian Region | Base-rich till landscapes |
| 520 | 501-601 | Farm complex | Resevoir | Midlands Region | Pre-Quaternary Clay landscapes |
| 524 | 501-601 | Farm complex | Tree and hedge buffer | Midlands Region | Base-rich till landscapes |
| 532 | 501-601 | Field margin | Tree buffer | EA Wales | Sandlands |
| 543 | 501-601 | Farm complex | Resevoir | Anglian Region | Pre-Quaternary 'Loam' landscapes |
| 611 | 601-701 | Farm complex | Tree buffer | Anglian Region | Base-rich till landscapes |
| 615 | 601-701 | Field margin | Tree and hedge buffer | Anglian Region | Sandlands |
| 637 | 601-701 | Field margin | Tree buffer | Anglian Region | Base-rich till landscapes |
| 680 | 601-701 | Farm complex | Tree buffer | Anglian Region | Sandlands |
| 859 | >701 | Field margin | Tree and hedge buffer | Anglian Region | Sandlands |
| 918 | >701 | Field margin | Woodland buffer | Anglian Region | Chalk and Limestone plateaux and coombe valleys |
| 1444 | >701 | Farm complex | Tree and hedge buffer | Anglian Region | Chalk and Limestone plateaux and coombe valleys |
| 1780 | >701 | Field margin | Limited buffer | North East Region | Chalk and Limestone plateaux and coombe valleys |

* The different colour shades are primarily used above as an illustrative guide to aid the reader in identifying the different categories within each row without having to read the text. For the "Buffer type between pond and field" row the colour coding can also be used as a scale indicating the level of buffering likely to be provided by each type of buffer from green (most) to red (least).

## Conclusion

- Highly isolated ponds (i.e. <301 m from other water bodies) are uncommon within highly agricultural landscapes. 90% of ponds are within <301 m of another water body. Highly isolated ponds do not generally occur in local landscape settings likely to result in high exposure to pesticides.

**References**

[1]Lake polygon geometry in Great Britain is based on Ordnance Survey data and contains public sector information licensed under the Open Government Licence v3.0 (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/).

[2]Defra Project PN0931 - Aquatic ecosystems in the UK agricultural landscape.
http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=9595