Dispersal of the invasive topmouth gudgeon, Pseudorasbora parva in the UK: a vector for an emergent infectious disease

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Topmouth gudgeon, Pseudorasbora parva (Temminck and Schlegel), is a small cyprinid (maximum recorded: 110 mm fork length; Cakic, Lenhardt, Kolarevic, Mikovic & Hegedis 2004) native to Japan, China, Korea and the River Amur basin. Its life history traits, including early maturity (sexually mature at 1 year), batch spawning, nest guarding and broad environmental tolerance limits, favour its ability to succeed in invading new water bodies (Ricardi & Rasmussen 1998) and have undoubtedly assisted the rapid invasion of P. parva in European water bodies (Gozlan, St-Hilaire, Feist, Martin & Kent 2005). Consequently, P. parva has been classified as an international pest species (Welcomme 1992).

Until recently, the hypothesised risks that this Asiatic invader poses to European freshwater biodiversity, such as out-competing other fishes for food resources and preying on the eggs and larvae of other species (Stein & Herl 1986; Xie, Cui & Li 2001), have remained unquantified (Pinder 2005). However, the recent discovery that P. parva is a healthy host to an emergent infectious disease (Rosette-like Agent, closely related to Sphaerothecum destruens), which threatens European fish diversity (Gozlan et al. 2005), is the first real evidence that P. parva is capable of causing real ecological damage to freshwater ecosystems outside its native range.

This note reports on the rapid colonisation of new water bodies by P. parva in England and Wales and provides its current known distribution. Given the severe impacts that P. parva could have on native populations, this provides an important basis for those agencies responsible for protecting aquatic ecosystems in the UK, as it highlights previously unidentified P. parva populations. It also identifies those sites from which there is an imminent risk of downstream dispersal of P. parva into river networks, an occurrence that would greatly reduce options for controlling the future spread and subsequent impact of this alien species.

Following the rapid invasion of mainland Europe (Arnold 1985, 1990; Bianco 1988; Wildekamp, Van Neer, Kucuk & Unlusayin 1997; Caiola & Sostoa 2002; Gozlan, Pinder & Shelley 2002; Pinder & Gozlan 2003), it was no surprise when P. parva was recorded in England in 1996, following its discovery in a pond in Southern England (Domaniewski & Wheeler 1996). Although the source of this population is not known, Gozlan et al. (2002) indicated that the earliest and only known introduction to the UK occurred more than a decade earlier, when an ornamental aquaculture facil-
ity in Hampshire received a contaminated stocking believed to have originated from Germany. It was also reported that *P. parva* dispersed from there, and established in Tadburn Lake, a tributary of the River Test. A further recording was in a still water, approximately 300 km north, in Shropshire. Following the publication of popular media articles during 2004 to increase public awareness of *P. parva* presence and identification, there was a rapid increase in the number of recordings. These have since been confirmed by examination of both photographic evidence and live specimens. To date, 25 sites have been reported as hosting *P. parva* in England and Wales, with these comprising online and offline still waters, river systems and aquaculture facilities (Fig. 1).

Of the 25 sites, seven are fully enclosed still waters and pose no immediate threat of furthering the natural dispersal of *P. parva*. However, there are 10 sites, comprising both aquaculture and stillwater fisheries that do pose an imminent and direct threat of dispersing *P. parva* widely, as they are connected to river systems. The river length at risk to *P. parva* invasion is approximately 900 km, including sections of the Trent, Yorkshire Ouse and Severn catchments. These rivers consist of highly valued recreational fisheries that also provide multiple access points to the extensive canal network of England and Wales.

The role that still water sites connected to river systems can provide as an invasion route for *P. parva* was demonstrated by their presence in Tadburn Lake and the River Test. Drift sampling was able to confirm these populations originated from individuals dispersing from the aquaculture facility that received the original importation of *P. parva* (K. Beyer, personal communication). Their presence in these rivers and the neighbouring River Itchen is of concern, because they are internationally renowned for the quality of their

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**Figure 1.** Distribution of *Pseudorasbora parva* in England and Wales, November 2005 (●, river; ▲, fully enclosed lake; ■, sites connected to river network; — — — — — —, river length at risk from *P. parva* dispersal; - river network). Numbers 1–9 indicate river catchment and length of river at risk from invasion (Km): 1, Kent (23); 2, Yorkshire Ouse (160); 3, Trent (330); 4, Thames (157); 5, Medway (72); 6, Itchen (27); 7, Test (31); 8, Otter (4); 9, Severn (96).
salmonid fisheries. Although *P. parva* has also been recorded in the River Lee, Rothley Brook and Colaton Raleigh Stream, the source of these fish is presently unknown.

With the exception of the River Test system, there are no reports of escapes from any of the other online still waters. However, *P. parva* dispersal is considered inevitable, as the security of all these sites relies purely on mechanical screening devices that can only prevent the escape of larger fishes. They offer no obstruction to the egress of eggs, larvae and juveniles, and in many cases, the adult life-stage of *P. parva*. Unintentional anthropogenic translocation of *P. parva* has already been highlighted as a major concern in England and Wales (Pinder & Gozlan 2003; Pinder 2005) and this is highlighted by the present spatial distribution between populations (Fig. 1). It is highly probable that the primary cause of such translocations is connected to the increased development of commercial recreational fisheries in England and Wales. These rely heavily on artificial stocking practices and thus support an extensive industry for the movement of fishes nationally (Hickley & Chare 2004). This industry consists of businesses reliant on both inter-fishery fish movements and the culture and subsequent supply of fish. Of the 25 current *P. parva* sites in England and Wales, four are contaminated business sites related to the fish movement industry from which there is a very high risk of dispersal.

Despite current legislation preventing the keeping and movement of alien fishes without a licence in England and Wales (Hickley & Chare 2004), the number of sites colonised by topmouth gudgeon continues to escalate. To date, the primary mode of dispersal is the fish movement trade, through which *P. parva* is being translocated unintentionally from donor fisheries or farms, along with other species, to recipient recreational stillwater fisheries. The secondary, and perhaps the most threatening phase of dispersal, is natural radiation from these fisheries, using connectivity of waterways to access natural fluvial water courses that host wild fish populations.

At present, assuming that the major river networks have not yet been invaded, there is still some scope to control the dispersal of *P. parva*. This is demonstrated by an attempt to eradicate a population that is currently underway at one site in the English Lake District, an area of high conservation value in which *P. parva* dispersal could have a major impact on populations of rare and threatened fish species (Winfield & Durie 2004). However, unless attempts to eradicate other existing *P. parva* populations continue and further efforts are made to halt the spread of this alien species, then many of the risks that have been highlighted to the aquatic biodiversity of England and Wales may soon be realised and become irreversible. Urgent research is now needed to ascertain whether the Rosette-like Agent prevails in European stocks of *P. parva* and how this may impact on fish populations. Although, there is currently no legislation in place restricting the distribution of other species from contaminated sites, it is strongly recommended that where *P. parva* is identified as being present, fish movements off the site should be prohibited to minimise the opportunity for inadvertent dispersal. Where appropriate, addition control measures at infected sites should include increased site security, for example, fine mesh screens on all outlets to minimise escapes contaminating connected water bodies and, where feasible, eradication, using appropriate methods.

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**References**


