

RECORDED NATURAL PREDATION OF FRESHWATER PEARL MUSSELS *MARGARITIFERA MARGARITIFERA* (L.) IN SCOTLAND

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Abstract The endangered freshwater pearl mussel *M. margaritifera* (L.) has been the subject of much research and the causes for its decline are well known. However, in contrast to other unionids, little or nothing has been published about the natural predators of *M. margaritifera*. This paper draws together observations of natural predation events from over 300 detailed licensed river surveys in Scotland between 1996 and 2007. *M. margaritifera* has few known natural predators and the evidence presented suggests that that natural predation does not cause significant mortalities in any of the Scottish rivers surveyed.

Key words Predators, mortality, mussel populations

INTRODUCTION

The endangered freshwater pearl mussel, *Margaritifera margaritifera* (L.), is a rare and threatened species that inhabits clean rivers and streams which have healthy native salmonid populations (Young and Williams 1983). It was once common across much of northern Europe, Russia and north-eastern USA/Canada and has now declined throughout most of its range. Scotland is considered to be a stronghold of *M. margaritifera*, containing approximately half of the world's known remaining viable populations (Young, Cosgrove & Hastie 2001). As a result of this decline and its conservation listing under national and international legislation it has recently been the subject of much research. The factors implicated in this decline have included pollution, decline in host fish populations, climate change, river engineering and pearl fishing. Reports of natural predation on *M. margaritifera* populations are rare and consequently the effects of these have not been properly investigated.

This paper describes the evidence of natural predation on Scottish *M. margaritifera* populations from over 300 detailed licensed river surveys between 1996 and 2007.

EVIDENCE OF NATURAL PREDATION ON MUSSEL POPULATIONS

Despite numerous studies into *M. margaritifera* populations, little has been written about the natural predators of freshwater pearl mussel populations. Derrow (1991) describes opportunistic predation on *M. margaritifera* by hooded crows *Corvus corone cornix* in a river in County Cork, Ireland when water levels were unusually low. The crows flew up into the air and dropped the shells smashing at least one valve. Aside from this account, little else appears in the published literature. This is in complete contrast to the USA, where the role of predation on endangered unionids, particularly by muskrats, has been well documented (e.g. Tyrrell and Hornbach 1998; Zahner-Meike and Hanson 2001) and often provides researchers with important records of endangered species.

In 1996-98, Scottish Natural Heritage (SNH) commissioned a national survey of all known *M. margaritifera* populations in Scotland (Cosgrove, Young, Hastie, Gaywood & Boon 2001). During this survey, natural predation was not recorded at all by researchers. Subsequent to the national survey, a handful of observations have been made during additional surveys and reports have been received relating to natural predation in Scotland. Only four species were observed/ reported preying on *M. margaritifera* (Table 1): oystercatcher (*Haematopus ostralegus*), Hooded crow, American mink (*Mustela vison*) and European otter (*Lutra lutra*).

Table 1 Recorded incidents of natural predation on freshwater pearl mussels in Scotland between 1996-2006.

Location	Year recorded	Remarks	Reference source
River A	1996	Otter regularly seen by anglers and estate staff eating pearl mussels at one river pool.	Various <i>pers comm.</i>
River B	1998	Mink seen carrying one live mussel shell to holt site where 2 eaten shells were found.	Cosgrove <i>pers obs.</i>
River C	2002	Small groups of oystercatchers seen feeding on shallow mussels beds during a particularly dry summer with low water levels. Small piles of dead shells left on the bank.	Main <i>pers comm.</i>
River D	2002	Several pearl mussel shells found to be punctuated by a row of small holes. River workers reported seeing otters breaking open mussel shells and leaving shells with a row of small holes	Young Associates (2003)
River E	2004-2005	Male otter regularly seen to take individual pearl mussels out of a deep pool and eat them on the river bank	Raitt <i>pers comm.</i>
River C	2005	Small groups of oystercatchers seen feeding on shallow mussels beds during dry summer. Piles of dead shells left on the bank (totaling ca. 100 individuals).	Main <i>pers comm.</i> and Cosgrove <i>pers obs.</i>
River F	2007	Hooded crow seen landing in river twice, plucking live mussels from the water and then dropping them from 10m height on to adjacent road smashing the shells and eating the mussel. Examination of the adjacent 100m road section found 6 similar smashed shells.	Cosgrove <i>pers. obs.</i>

Note: All rivers in Table 1 have been coded with a letter to prevent the identification of specific sites due to the continued threat posed by illegal pearl fishing.

The hooded crow in River F was seen to catch and predate on pearl mussels in the same way as reported by Derrow (1991) in Ireland. European otter and American mink are opportunistic predators and appear to take mussels occasionally from some regularly visited sites. Clearly, reported incidents of otter and mink taking mussels will be an under-estimate of true numbers taken, but piles of dead shells or 'middens' have not been recorded from areas where these species are known to occasionally predate upon pearl mussels. Therefore, it seems that, in

Scotland, overall numbers of mussels killed by mustelids are relatively small.

Oystercatchers specialise in feeding on molluscs in the marine/estuarine environment, where they have two main strategies for opening bivalves: (1) Hammering: one valve broken by a series of short thrusting blows, bill inserted and adductor muscles cut; (2) Stabbing: bill inserted between gaping valves and adductor muscles severed. Individual birds specialise in one of these two techniques, which they learn from their parents (Snow and Perrins 1998). The spe-



Figure 1 Oystercatcher *M. margaritifera* mortalities, River C, 2005. Note the minor damage to the top of the shells, where the oystercatcher's bill was used to stab in between the gaping valves. This method of opening bivalves is known as 'stabbing' (Snow and Perrins 1998). © Peter Cosgrove



Figure 2 Oystercatcher *M. margaritifera* mortalities, River C, 2005. Note the irregular and major damage to the shell, where the oystercatcher's bill was used to smash the shell. This method of opening bivalves is known as 'hammering' (Snow and Perrins 1998). © Peter Cosgrove

cies typically moves inland during the breeding season and becomes much more generalist in its feeding habits. Preferred inland nesting habitats in Scotland are arable and pasture fields and dry shingle river beds (Thom 1986), which can bring them into close proximity with freshwater pearl mussel rivers. Oystercatchers are then able to take advantage of low water levels to feed on mussels when the opportunity arises.

River C, where oystercatchers have been recorded twice preying on *M. margaritifera*, is a large river of mixed depth, with most pearl mussel beds in water too deep for oystercatchers to forage. It is therefore unlikely that oystercatchers impact upon pearl mussels in any significant way and possibly only feed on mussels that may become stranded and die during prolonged periods of low water levels. During floods, variable numbers of mussels are often removed from their parent beds and transported downstream to more exposed localities (Hastie, Boon, Young & Way 2001). However, most floods occur in the autumn/winter, when oystercatchers are found back in the marine/estuarine environment, so mussels temporarily stranded in exposed localities because of floods are unlikely to be predated by oystercatchers.

IDENTIFICATION OF NATURAL PREDATION EVENTS

During 2005, oystercatchers on River C were seen to retrieve pearl mussels from the river and fly to shingle banks, where they proceeded to consume the mussels (Table 1). As a result of such feeding, several small shell piles formed dominated by small-medium sized shells that had been attacked in the same manner as marine molluscs were described by Snow and Perrins (1998), via stabbing and minor damage at the top of the shell (Figure 1) and by hammering, breaking one side of a shell (Figure 2).

CONCLUSION

There is no direct evidence to suggest that natural predation causes significant *M. margaritifera* mortalities in any of the Scottish rivers surveyed. It appears that otter, mink, oystercatcher and hooded crow predation is rather rare and opportunistic in nature. The conventional wisdom relating to the impact of natural predation would therefore appear to be supported by observations from studies on over 300 Scottish rivers between 1996 and 2007.

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