BIODIVERSITY AUDIT OF THE ALLOW RIVER CATCHMENT

- With Particular Focus On the European Otter, Kingfisher and Dipper

Action E4

IRD DUHALLOWLIFE+ PROJECT

JUNE, 2015

LIFE09 NAT/IE/000220 Blackwater SAMOK

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Executive Summary

Three on-the-ground conservation actions carried out by DuhallowLIFE were the installation of artificial nesting and resting units for three Annex listed species; otters, kingfisher and dipper found along the Allow, Dalua and Brogeen Rivers. In addition, native trees were planted along the Allow to protect the riverbanks from excessive erosion. The main goal was to create a wildlife corridor that connected stretches of the river and provided cover for a range of species, including otters. The range of native trees planted included: willow (*Salix spp*), alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*) and oak (*Quercus petraea* and *Q. robur*).

Otter activity recorded through the bridge surveys on the Allow, Dalua and Brogeen remained relatively constant throughout the duration of the DuhallowLIFE Project. The inclusion of artificial holts and log piles was not associated with an increase in the rate of detection of spraint and footprint under these bridges. However public engagement proved to be very successful with many of the farmers and landowners contacting the project with updates and queries on the holts and other signs of animal activity.

Incidents of kingfisher sightings increased once project works got underway. In 2010, Cummins, et al. found no evidence of kingfisher activity on the River Allow. Since the beginning of the project new nests, albeit no longer active, were discovered on the Allow and the Dalua and sightings have occurred each year. Bank erosion prevention works, fencing and planting have all improved the habitat for both kingfishers and their prey.

Sightings of dipper in the Allow catchment reached their peak in 2013. Two years (2013 and 2014) recorded higher temperatures and lower rates of rainfall than the previous two years (Met Éireann, 2015). The improved weather saw an increase in surveys and on-the-ground works for the project. As the project came to a close in 2015 sightings dropped significantly as did survey work. Nest box inspections were maintained and found no significant drop in positive recordings. It would appear positive recordings increased with survey effort. This would suggest that the number of dippers in the Allow catchment has been maintained throughout the duration of the project.

Riverine habitats are among the most important biodiversity hotspots in Europe. A four-and-a-half-year project to improve river habitat and water quality is a massive undertaking, however immediate results are limited as ecosystems take time to recover. The true improvement to the

otter, dipper and kingfisher habitat will not be known for some years but measures are in place, including public and landowner involvement, to ascertain such information in later years.

Background

Three on-the-ground conservation actions carried out by DuhallowLIFE were the installation of artificial nesting and resting units for three species found along the Allow, Dalua and Brogeen Rivers. Action C7 entailed building and installing ten artificial holts and 28 log piles for the European otter (*Lutra lutra*). Action C8 involved installing 12 artificial nesting tunnels for the European kingfisher (*Alcedo atthis*) at five locations in the River Allow Catchment and one at a site on the Owentaraglin River. Action C9 consisted of constructing and fixing two types of nesting units for Dippers (*Cinclus cinclus hibernicus*) under ten bridges on the Allow and Brogeen Rivers.

Surveys were conducted to assess the success of not only the installation of resting and nesting sites, but also to record activity within the Duhallow region of these three species.

The European otter (*Lutra lutra*) is listed under Annex II & IV of the EU Habitats directive (Joint Nature Conservation Committee, 2014). The otter is found throughout Ireland, particularly along rivers and coasts (Bailey & Rochford, 2006; Chapman & Chapman, 1982). While otter populations have fallen considerably in many European countries (National Parks and Wildlife Service, 2007), Ireland has bucked this trend and has one of Europe's most important populations (Poole, *et al.*, 2007). Ireland boasts the highest densities of otter in Europe (National Parks and Wildlife Service, 2007) and the otter's range covers 75% of the total area of Ireland (Marnell, *et al.*, 2011). However, Bailey & Rochford (2006) found that low densities of otters occur where there is habitat fragmentation. The Kingfisher is an amber-listed (O'Clery & Lusby, 2015) river bird that is listed in Annex I of the European Birds Directive (Crowe, 2010). They require steep, sandy banks with little vegetation to nest in (Crowe, et al., 2008). Kingfishers are vulnerable to changes in their habitat and, as piscivores, susceptible to changes in water quality (O'Clery & Lusby, 2015).

Recent years have seen a marked change in the morphology and hydrology of the River Allow (Anon., 2010). It is believed that a lot of the banks along the Allow are sub-optimal. A Birdwatch Ireland survey of the Allow River in 2010 found no evidence of kingfishers along the channel (Cummins, et al., 2010).

The *Cinclus cinclus hibernicus* is a sub-species of dipper found only in Ireland, the Outer Hebrides and the west coast of Scotland (Avibase, 2003). A common bird in Ireland (O'Halloran, et al., 1992), they are found to occur along clean, fast flowing rivers (Arizaga, et

al., 2009; Sorace, et al., 2002). Dippers feed on the aquatic macroinvertebrates that are found on and in the substrate of rivers and streams (Taylor & O'Halloran, 1997). They are capable of swimming and walking under water to reach their prey (Shaw, 1978). Because of their dependence on macroinvertebrates they are susceptible to changes in water quality and can even be describes as indicator species (Sorace, et al., 2002). Dippers commonly build nests on ledges, in crevices and even disused drainage pipes (D'Amico, 2010; Shaw, 1978). In fact, the most common nesting site for dippers in Ireland is under bridges (Smiddy, et al., 1995).

Site Description

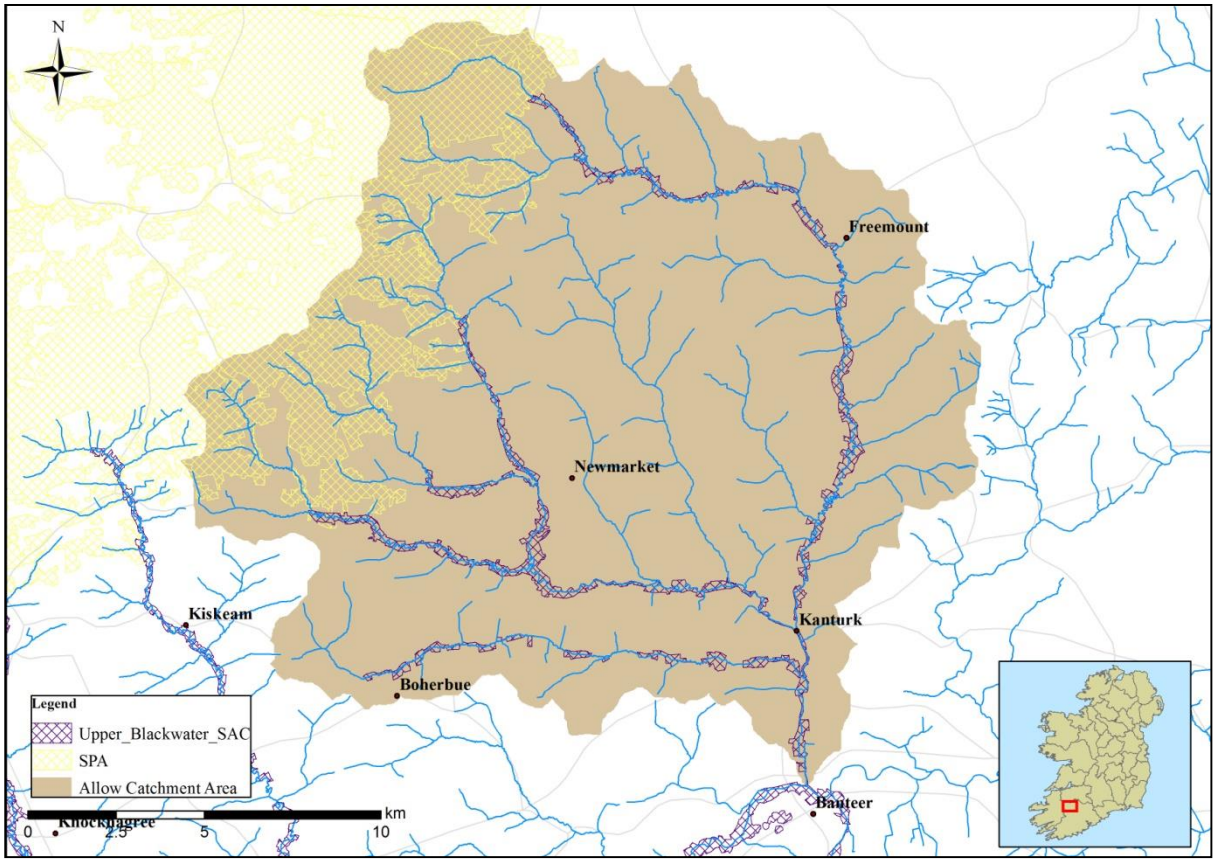

Figure 1 River Allow catchment area targeted by the DuhallowLIFE Project (LIFE09 NAT/IE/000220 Blackwater SAMOK)

The River Allow catchment is 310km^2 (*Figure 1*). The three major rivers that drain the catchment are the Allow, Dalua and Brogeen. The main agricultural land use in the catchment is pasture with dairying and sucklers forming the majority of farming practices.

The majority (70%) of the soils in the Allow catchment are deep, poorly drained mineral soils. Blanket peat covers approximately 5% of the catchment, mostly in upland reaches. Mineral alluvium is associated with the river channels, while shallow well drained mineral soils make up the remaining soil type in the catchment (EPA/Teagasc, 2006; Tedd, 2014).

The River Allow catchment rivers (Allow, Dalua, Brogeen, Glenlara and Owenkeale) form part of the Blackwater River (Cork/Waterford) Special Area of Conservation (Natura 2000 site code: 002170). These tributaries provide important habitat for Freshwater pearl mussel *Margaritifera margaritifera,* Atlantic salmon *Salmo salar* and European otter *Lutra lutra*, all of which are listed in the Annex II of EU Habitats Directive.

The upper reaches of the Allow catchment contain the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protection Area, which was designated as such for Hen Harrier *Circus cyaneus* (listed in Annex I of the EU Bird's Directive).

Methods

European Otter *Lutra lutra*

DuhallowLIFE, increased riparian vegetation through fencing and planting native broadleaves along the River Allow and its tributaries. Following a baseline survey to ascertain otter activity in the catchment and to assess suitable habitat the project built and installed 10 artificial holts and 28 log piles.

- The survey techniques employed followed those outlined by Chanin (2003).
- Sites were located on 1:50,000 (OS map 72) and all public bridge crossing locations noted.
- The river banks upstream and downstream of bridges were searched for otter activity for a distance of 50m.
- Prominent features that are attractive to otter as spraining points (i.e., boulders, logs etc.) were investigated.
- Ledges beneath bridges were also checked for otter activity (e.g. slide, spraint, footprint).
- Otter activity were recorded on data survey sheets reproduced from Chanin (2003) (*See* Appendix 1).

Kingfisher *Alcedo atthis*

A key project action of DuhallowLIFE was that suitable sites be identified for the installation of 12 nest boxes for the kingfisher. Pre and post instalment surveys were conducted to establish the presence of kingfisher in the Allow catchment. Each artificial nest box was inspected for activity annually after they were installed.

- A 30.5km stretch of the Allow River, from Ballynaguilla Bridge (ITM: 534396, 615581) to confluence with Blackwater (ITM: 538452, 598812) was surveyed in 2011 for possible signs of kingfisher activity (Murphy, 2011).
- The survey included an assessment of the suitability of its riverbanks and to determine suitable sites for artificial nesting tunnels.
- In 2012 the survey extended into the Dalua and Brogeen Rivers. In 2013, drawing from the baseline survey, six sites were installed with two nesting tunnels.
- Annual walkover surveys, along with nesting tunnel inspections, were conducted to find any subsequent kingfisher activity in the catchment.

Dipper Cinclus cinclus hibernicus

The 19 bridges that span the River Allow were inspected for dipper nests and nesting suitability by DuhallowLIFE in 2011 (Murphy, 2011). Ten bridges were selected for the installation of nesting boxes. Two designs, developed and tested by the project, were used under each bridge (*See* DuhallowLIFE, 2015). These bridges were inspected annually following their installation. Walkover surveys of the Allow were also conducted to locate more nests and to establish the presence of dippers in the channel.

- Walkover surveys were conducted to establish dipper activity along the Allow
- Each bridge spanning the Allow was surveyed for dipper nests and possible suitability for artificial nest boxes
- Bridge inspections were conducted each year from 2012 to 2015 to ascertain nest box take up

Results and Discussion European Otter *Lutra lutra*

In total, 45 bridges were selected for monitoring otter activity in the Allow catchment. The ten bridges on the Brogeen that were monitored for the study showed the highest average percentage frequency of otter activity (60%). The next highest rate of activity was recorded on the Allow with an average of 56.56% of the 19 bridges confirming otter activity. The lowest rate of recording was in 2012 with only 26.3% of bridges verifying the presence of otter. The best recorded year for positive occurrences was in 2014 with 11 out of the 16 bridges (57.89%) having either spraint or print recorded. Over the four surveys on the Dalua the mean percentage rate of spraint/print occurrence was 36.83%.

In regard to year by year results (barring 2013 as no survey was conducted) the River Allow survey found a significant decline of recorded activity in 2012, compared to 2011 *($p = 0.015$, paired t-test*). An ANOVA test performed, with the results of the Allow surveys, showed significant difference in recorded otter activity ($p = 0.0066$). A Tukey-Kramer HSD test was performed and found that 2012 was significantly different to 2014.

On the Brogeen, the highest number of positive recordings was in 2014, with eight observations, but was not significantly higher than in previous years (*$p = 0.34$, paired t-test*) or the following year (*$p = 0.08$, paired t-test*). Overall, the Brogeen study found no significant fluctuations in recorded occurrences (*$p = 0.45$, ANOVA*).

With no significant fall in otter activity on the Dalua, 2014 saw a statistically significant increase, compared to the previous two years (*$p = 0.34$, paired t-test*). Overall, there were no statistically significant fluctuations over the four years during which the bridges of the River Dalua were surveyed for otter activity (*$p = 0.11$, ANOVA*).

Correlation coefficient tests were conducted to examine any relationship between otter activity and river width. This was performed only where otter activity was recorded more than once in the four surveys. There were no correlations found on the Allow (*$r^2 = 0.141$*), Brogeen (*$r^2 = 0.285$*) or Dalua (*$r^2 = 0.003$*).

Kingfisher Alcedo atthis

Walkover surveys alone were not enough to ascertain the presence of kingfishers in the Allow Catchment. All sightings of *A. atthis*, in the Allow were incidental sightings during the undertaking of other DuhallowLIFE actions (e.g. tree planting, snorkel surveying, Himalayan

balsam removal). Similarly, two of the four nests found were discovered while conducting snorkel surveys for Freshwater Pearl Mussels.

The three sightings on the Dalua occurred in three separate years but are clustered within 800m. An abandoned nest site was subsequently found in close proximity to the 2015 sighting. All other positive findings and discoveries occurred on the Allow main channel. None of the nests were in use, however, when investigated the Duhallow Birdwatch Group confirmed that the sites were typical for kingfishers.

None of the artificial nest tunnels were used. Birdwatch Ireland (O'Clery & Lusby, 2015) established that they were all installed correctly. The study by O'Clery and Lusby (2015) state that site selection and nest installation were to a high standard but that riverbank conditions deteriorated due to excess flooding and eventual erosion.

Although many of the riverbanks in the Allow catchment were suffering from excessive erosion (Blackwater SAMOK, 2011), walkover surveys of the rivers found many that were deemed suitable (*See* Appendix – Kingfisher Walkover Survey). Cummins *et al.* (2010) also deemed much of the Allow had suitable habitat for kingfishers.

The number of sightings and nest discoveries in the Allow catchment does not give enough data for any meaningful statistical analysis. Be that as it may, six distinct kingfisher territories were recorded that may be in use or once existed, in the Allow Catchment (*See* Appendix 2. Figure 7). This is based on nest location and grouping of sightings. Each territory, bar two, is in 4km in length. Typical kingfisher territory in Ireland is 1.5 to 4km (O'Clery & Lusby, 2015). The territories found on the Allow's confluence with the Blackwater and on the Dalua involve more than one river system. The territory ranges for these two sites were estimated by measuring 2km from the nest or group of sightings.

Dipper *Cinclus cinclus hibernicus*

Dippers were observed on the Allow and Dalua not only by walkover surveys but during many of the other surveys and works undertaken by DuhallowLIFE. The bird has been spotted flying and foraging at a number of sites throughout the duration of the project (2011 – 2015). While walkover surveys produced positive results, the more frequently visited stretches of river yielded the most recorded sightings. Casual observations were frequent at locations where tree growth was monitored, freshwater pearl mussels were surveyed and where fencing was being wired. As these activities increased throughout the catchment, more positive sighting were

recorded. On-the-ground works decreased in 2015 and as a result less dippers sightings were recorded.

Downstream of Freemount was one of the more visited sites on the Allow due to fencing, tree planting, bank erosion works and artificial nest box inspection. There were no dippers observed for over 2km downstream of the nest. This, in all probability, was due to poor water quality.

In 2014 it was discovered that aluminium flocculate was entering the Allow from the drinking water treatment plant in Freemount. This was only discovered during the low flow of water during a period of drought. While immediate steps were taken to remediate the situation, damage had already been done to the immediate vicinity. Kick samples taken from the Allow found very low numbers of macroinvertebrates downstream of the treatment plant (Igoe & Murphy, 2014). The lack of dipper observation along the stretch is therefore most likely due to an absence of prey (macroinvertebrates) availability along this stretch. This event supports the study by Sorace, et al. (2002) which maintains that the dipper is a good water quality bio-indicator.

Conclusions

Otter activity recorded through the bridge surveys on the Allow, Dalua and Brogeen remained relatively constant throughout the duration of the DuhallowLIFE Project. The inclusion of artificial holts and log piles was no associated with an increase in the rate of detection of spraint and footprint under these bridges. Chanin (pers. comm., 2013) stated that building artificial resting places for otters does not necessarily increase their numbers in the area as they usually have enough natural holts and couches. He maintained that awareness among landowners and the increased interest in wildlife among farmers is the greatest positive that could come from installing artificial holts and log piles. This has certainly proved to be the case as many of the farmers and landowners involved have contacted the project with updates and queries on the holts and other signs of animal activity.

One of the actions of DuhallowLIFE was to plant native trees along the Allow. The chief objective for this action was to protect the riverbanks from excessive erosion. The second goal was to create a wildlife corridor that connected stretches of the river and provided cover for a range of species, including otters. The range of native trees planted included: willow (*Salix spp*), alder (*Alnus glutinosa*), ash (*Fraxinus excelsior*) and oak (*Quercus petraea* and *Q. robur*) were planted along the Allow. While willow is a quick growing plant (Wickham, et al., 2010), the other tree species take longer grow and sufficient cover for otters and other species was not envisaged to be available by the end of the project.

Incidents of kingfisher sightings increased once project works got underway. In 2010, Cummins, et al. found no evidence of kingfisher activity on the River Allow. Since the beginning of the project new nests, albeit no longer active, were discovered on the Allow and the Dalua and sightings have occurred each year. Bank erosion prevention works, fencing and planting have all improved the habitat for both kingfishers and their prey.

Sightings of dipper in the Allow catchment reached their peak in 2013. Two years (2013 and 2014) recorded higher temperatures and lower rates of rainfall than the previous two years (Met Éireann, 2015). The improved weather saw an increase in surveys and on-the-ground works for the project. As the project came to a close in 2015 sightings dropped significantly as did survey work. Nest box inspections were maintained and found no significant drop in positive recordings. It would appear positive recordings increased with survey effort. This would suggest that the number of dippers in the Allow catchment has been maintained throughout the

duration of the project. The introduction of nesting boxes to the bridges that span the rivers in the Allow catchment now serves another purpose: indictors of the rivers health. As already iterated, dippers depend on the abundance of macroinvertebrates (Taylor & O'Halloran, 1997). A loss or dramatic reduction in these prey items is indicative of poor water quality (Benetti, et al., 2012). Therefore a low number of dippers in a catchment can indicate poor water quality (Sorace, et al., 2002). If the nest boxes are maintained the presence or absence of dipper nests can be used as a proxy for water quality monitoring.

Riverine habitats are among the most important biodiversity hotspots in Europe. The degradation of these ecosystems can pose a devastating impact on nature throughout the country (Figarski & Kajtoch, 2015). A four-and-a-half-year project to improve river habitat and water quality is a massive undertaking. Immediate results are limited as ecosystems take time to recover (Ruiz-Jaen & Aide, 2005). Since surveys conducted in 2008 (Crowe, et al.) and 2010 (Cummins, et al.) increases in kingfisher sightings are encouraging. The true improvement to the otter, dipper and kingfisher habitat will not be known for some years but measures are in place, including public and landowner involvement, to ascertain such information in later years.

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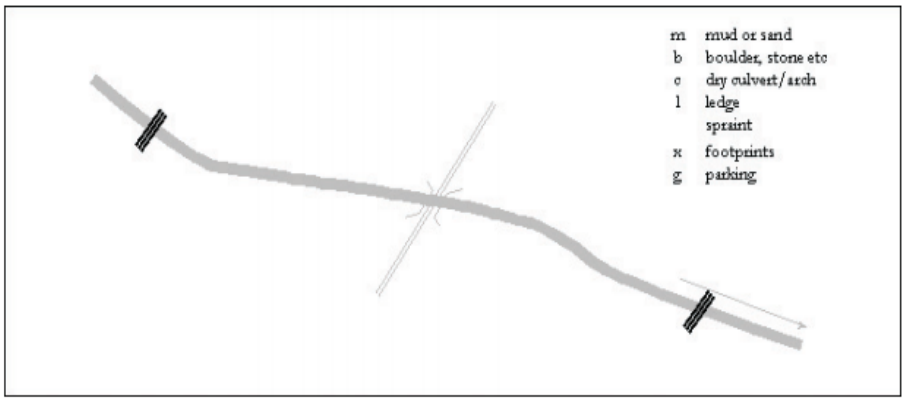
Appendix 1. Otter Surveys

Ref number	Sub catchment		
Grid Ref.	Stream name		
Suitable for use?	Yes/No/Possibly	Width of bridge	>15m / 5-15m / <5m
Needs Artif. site?	Yes/No/Possibly	Max depth under bridge	<25cm / 25-75cm / >75cm
Permission needed?	Yes/No		
Spraints recorded	Dried Fragmented:	Dried intact:	Not fully dry:
Footprints found?	Yes/No		

Mark: nature and position of potential spraint sites; location and type of signs found; parking place.



Notes on:

Suitability; need for artificial spraint site:

Potential spraint sites:

Parking/Access:

Hazards:

Post survey notes:

Figure 2 Recording form for preliminary survey of potential spraint monitoring sites (Chanin, 2003)

Year:				Date of Survey:	
		No. of spraints			
Site ref no.	I/0	Df	Di	Nd	Notes

Presence (1) or absence (0) of otters
For: Dry fragmented (Df) /Dry intact (Di) /Not dry (Nd)
Are water levels normal? Have there been changes since preliminary survey?
Record any need for maintenance of spraint site.

Figure 3 Recording form for monitoring surveys

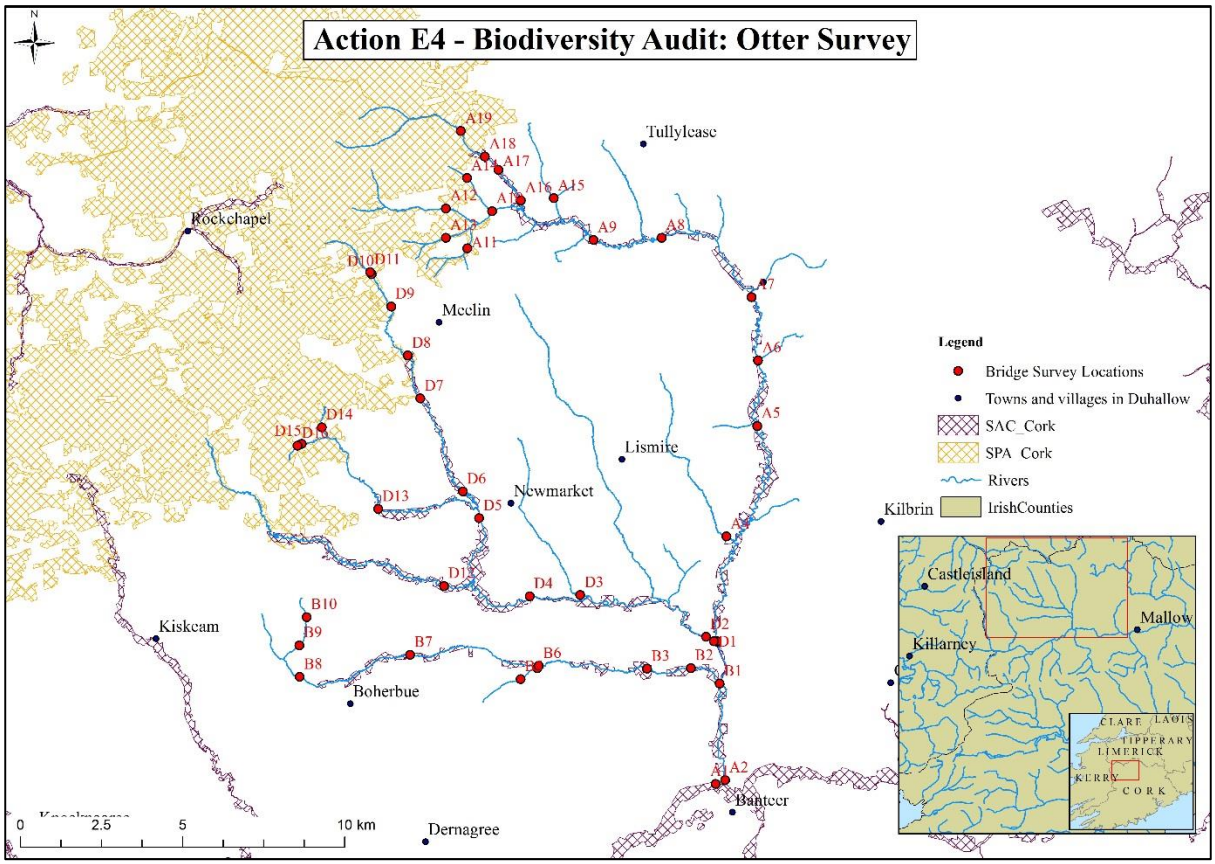


Figure 4 Locations of otter surveys

Table 1 Occurrence of otter spraints and prints recorded during the 2011 bridge survey (1 = present; 0 = absent)

2011								
Allow			Brogeen			Dalua		
Bridge	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**
A1	1	0	B1	0	1	D1	1	0
A2	1	1	B2	0	1	D2	0	0
A3	1	0	B3	0	1	D3	0	0
A4	0	0	B4	0	0	D4	0	0
A5	1	0	B5	1	1	D5	1	0
A6	0	0	B6	0	0	D6	1	0
A7	1	0	B7	0	1	D7	0	0
A8	1	0	B8	0	0	D8	0	0
A9	1	0	B9	0	0	D9	1	0
A10	1	1	B10	0	0	D10	0	0
A11	0	0				D11	0	0
A12	0	0				D12	1	1
A13	0	0				D13	1	0

A14	0	0				D14	0	0
A15	1	0				D15	0	0
A16	1	0				D16	0	0
A17	0	0						
A18	1	0						
A19	1	0						
Total (%)	**12 (63.1)**	**2 (10.5)**		**1 (10)**	**5 (50)**		**6 (37.5)**	**1 (6.25)**

Table 2 Occurrence of otter spraints and prints recorded during the 2012 bridge survey (1 = present; 0 = absent)

2012								
Allow			Brogeen			Dalua		
Bridge	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**
A1	0	0	B1	0	0	D1	0	0
A2	1	0	B2	0	1	D2	0	0
A3	0	0	B3	1	1	D3	0	0
A4	1	0	B4	0	0	D4	0	0
A5	0	0	B5	1	0	D5	1	1
A6	0	0	B6	0	0	D6	1	1
A7	0	0	B7	0	1	D7	1	0
A8	0	0	B8	0	0	D8	1	0
A9	0	0	B9	1	0	D9	0	0
A10	1	0	B10	1	0	D10	0	0
A11	0	0				D11	0	0
A12	0	0				D12	1	1
A13	0	0				D13	1	1
A14	0	0				D14	0	0
A15	0	0				D15	0	0
A16	0	0				D16	0	0
A17	0	0						
A18	1	0						
A19	1	0						
Total (%)	**5 (26.3)**	**0 (0)**		**4 (40)**	**3 (30)**		**6 (37.5)**	**4 (25)**

Table 3 Occurrence of otter spraints and prints recorded during the 2014 bridge survey (1 = present; 0 = absent)

2014								
Allow			Brogeen			Dalua		
Bridge	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**
A1	1	1	B1	1	0	D1	1	0
A2	1	0	B2	1	1	D2	0	0
A3	1	1	B3	1	1	D3	1	0

A4	0	0	B4	0	0	D4	1	1
A5	1	0	B5	1	0	D5	1	0
A6	1	0	B6	1	1	D6	1	0
A7	0	1	B7	1	0	D7	1	0
A8	1	1	B8	0	1	D8	0	0
A9	1	1	B9	0	0	D9	1	0
A10	1	0	B10	1	0	D10	0	0
A11	1	0				D11	0	0
A12	0	0				D12	1	0
A13	1	0				D13	1	1
A14	1	0				D14	1	1
A15	0	0				D15	0	1
A16	1	0				D16	0	0
A17	0	0						
A18	1	0						
A19	1	0						
Total (%)	**14 (73.7)**	**5 (26.3)**		**7 (70)**	**4 (40)**		**10 (62.5)**	**4 (25)**

Table 4 Occurrence of otter spraints and prints recorded during the 2015 bridge survey (1 = present; 0 = absent)

2015								
Allow			Brogeen			Dalua		
Bridge	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**	**Bridge**	**Spraint**	**Print**
A1	1	0	B1	0	0	D1	0	0
A2	1	1	B2	0	1	D2	0	0
A3	0	0	B3	0	0	D3	1	0
A4	0	0	B4	0	0	D4	1	0
A5	0	0	B5	1	0	D5	0	0
A6	1	0	B6	1	0	D6	0	0
A7	0	1	B7	0	0	D7	1	0
A8	0	1	B8	0	1	D8	0	0
A9	1	0	B9	0	0	D9	0	0
A10	1	0	B10	1	0	D10	0	0
A11	1	0				D11	0	0
A12	1	0				D12	1	0
A13	0	0				D13	1	1
A14	1	0				D14	0	0
A15	0	0				D15	0	0
A16	0	0				D16	0	0
A17	0	0						
A18	1	0						
A19	0	0						

Total (%)	**9 (47.3)**	**3 (15.8)**		**3 (30)**	**2 (20)**		**5 (31.3)**	**1 (6.3)**

Table 5 Summary results of otter bridge surveys conducted on the Allow River (1 = evidence of activity; 0 = no evidence)

Bridge	2011	2012	2014	2015
A1	1	0	1	1
A2	1	1	1	1
A3	1	0	1	0
A4	0	1	0	0
A5	1	0	1	0
A6	0	0	1	1
A7	1	0	1	1
A8	1	0	1	1
A9	1	0	1	1
A10	1	1	1	1
A11	0	0	1	1
A12	0	0	0	1
A13	0	0	1	0
A14	0	0	1	1
A15	1	0	0	0
A16	1	0	1	0
A17	0	0	0	0
A18	1	1	1	1
A19	1	1	1	0
Total (%)	**12 (63.15)**	**5 (26.3)**	**15 (78.9)**	**11 (57.89)**

Table 6 Summary results of otter bridge surveys conducted on the Brogeen (1 = evidence of activity; 0 = no evidence)

Bridge	2011	2012	2014	2015
B1	1	0	1	0
B2	1	1	1	1
B3	1	1	1	0
B4	0	0	0	0
B5	1	1	1	1
B6	0	0	1	1
B7	1	1	1	0
B8	0	0	1	1
B9	0	1	0	0
B10	0	1	1	1
Total (%)	**5 (50)**	**6 (60)**	**8 (80)**	**5 (50)**

Table 7 Summary results of otter bridge surveys conducted on the Dalua (1 = evidence of activity; 0 = no evidence)

Bridge	2011	2012	2014	2015
D1	1	0	1	0

D2	0	0	0	0
D3	0	0	1	1
D4	0	0	1	1
D5	1	1	1	0
D6	1	1	1	0
D7	0	1	1	1
D8	0	1	0	0
D9	1	0	1	0
D10	0	0	0	0
D11	0	0	0	0
D12	1	1	1	1
D13	1	1	1	1
D14	0	0	1	0
D15	0	0	1	0
D16	0	0	0	0
Total (%)	**6 (31.57)**	**6 (31.57)**	**11 (57.89)**	**5 (26.3)**

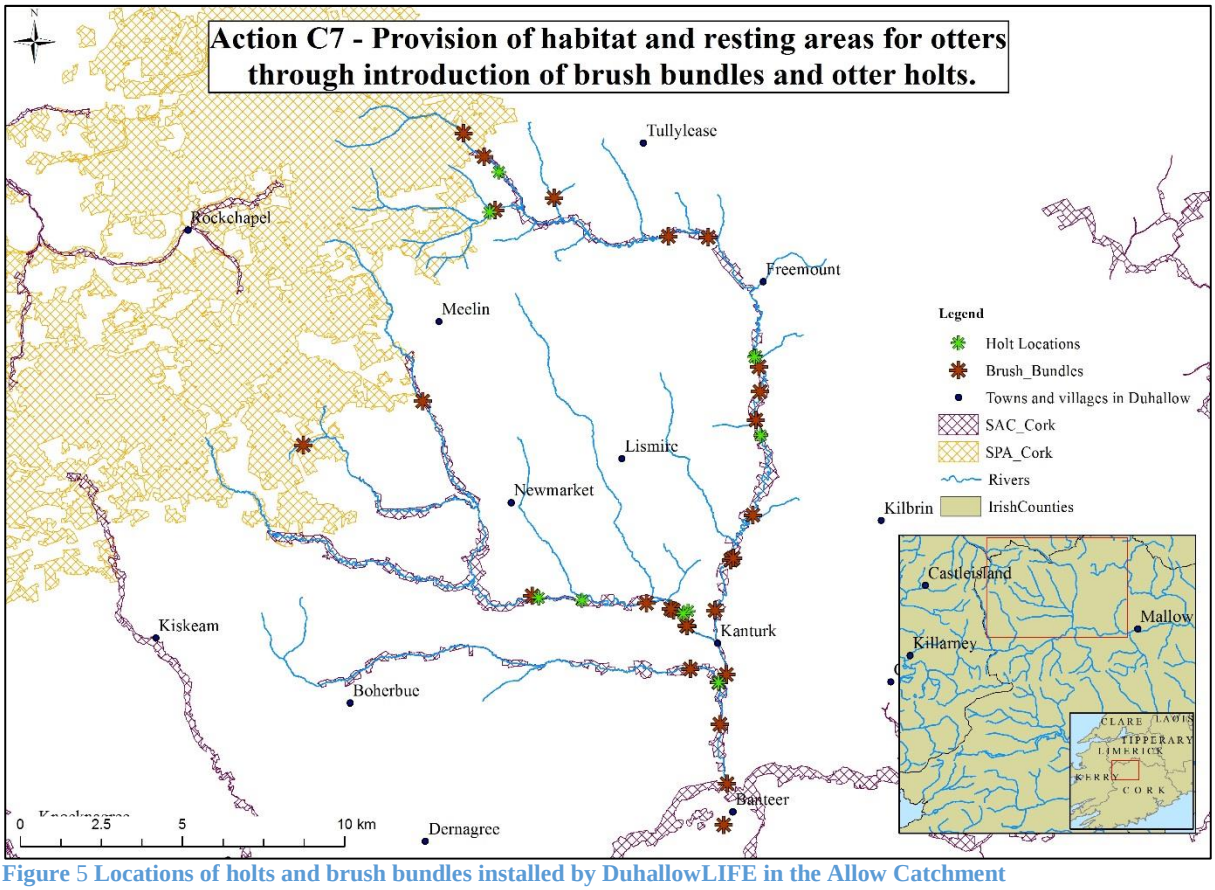


Figure 5 Locations of holts and brush bundles installed by DuhallowLIFE in the Allow Catchment

Appendix 2. Kingfisher Surveys

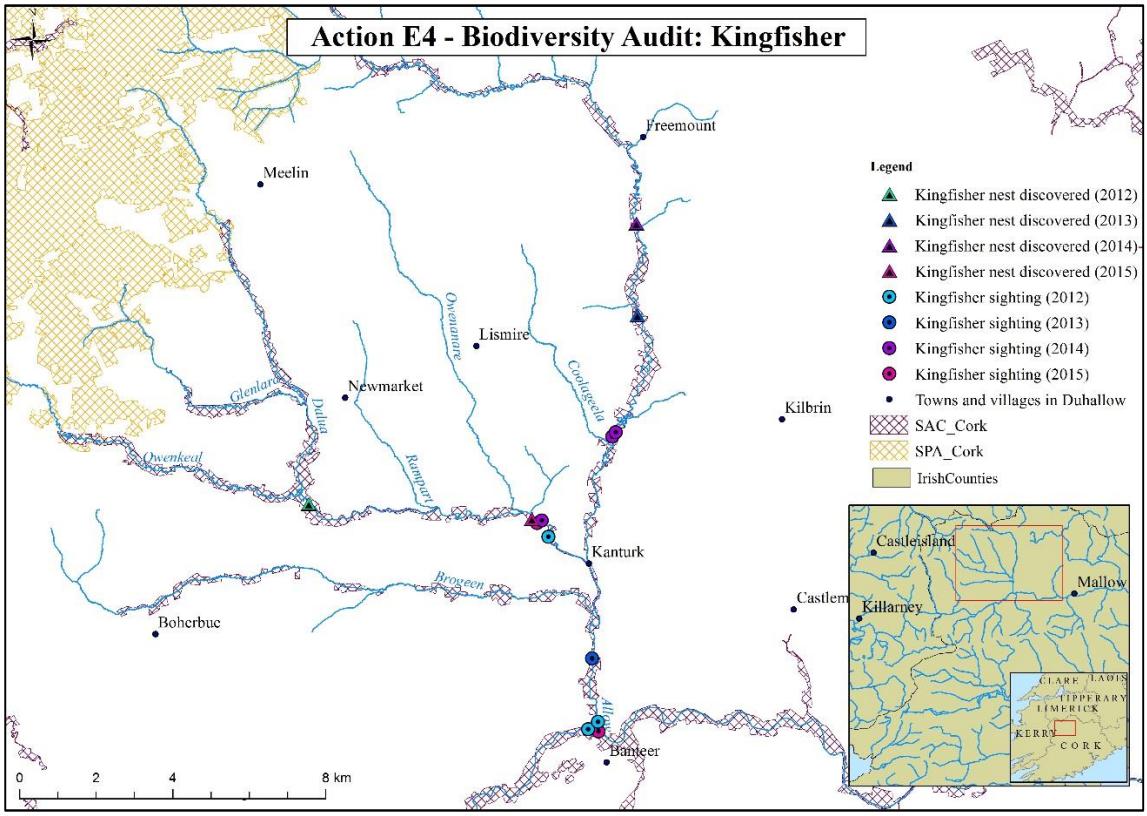


Figure 6 Locations of where kingfishers or kingfisher nest-tunnels were sighted in the Allow Catchment from 2012 to 2015

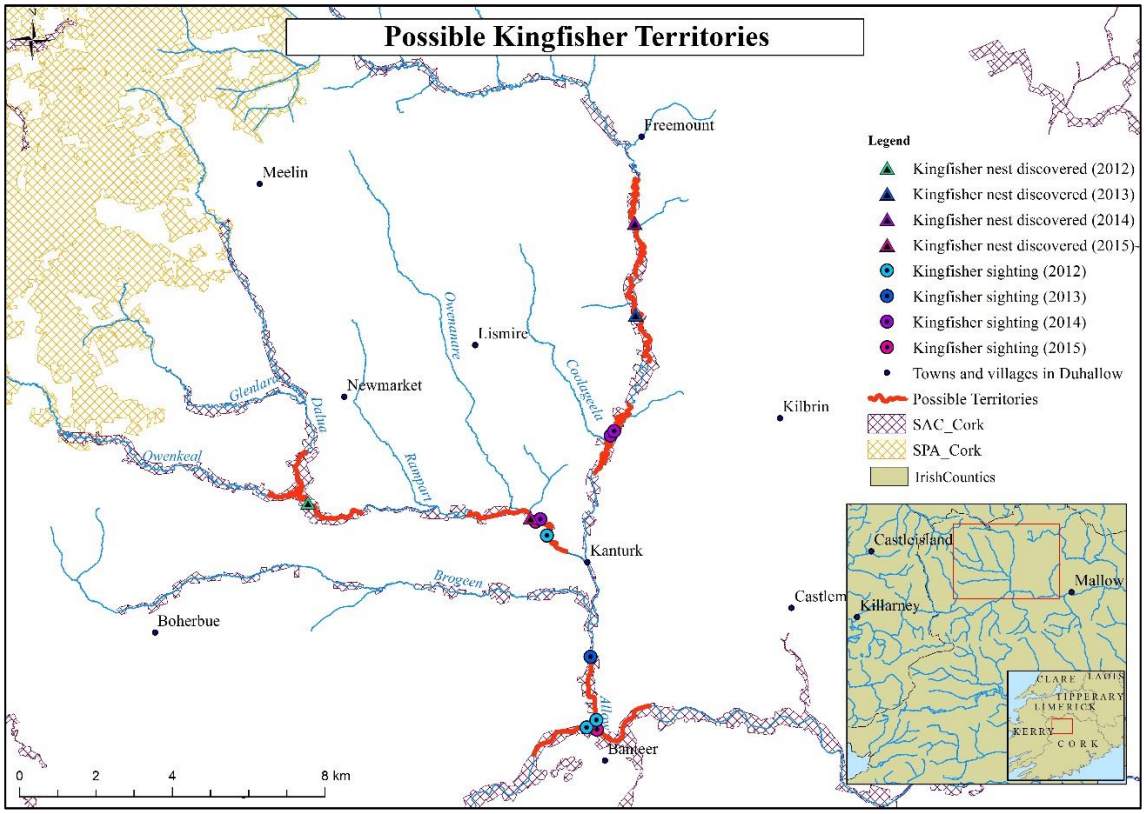


Figure 7 Potential kingfisher territories based on nests found and groupings of sightings. Territories can reach up to 4km in length (O'Clery & Lusby, 2015)

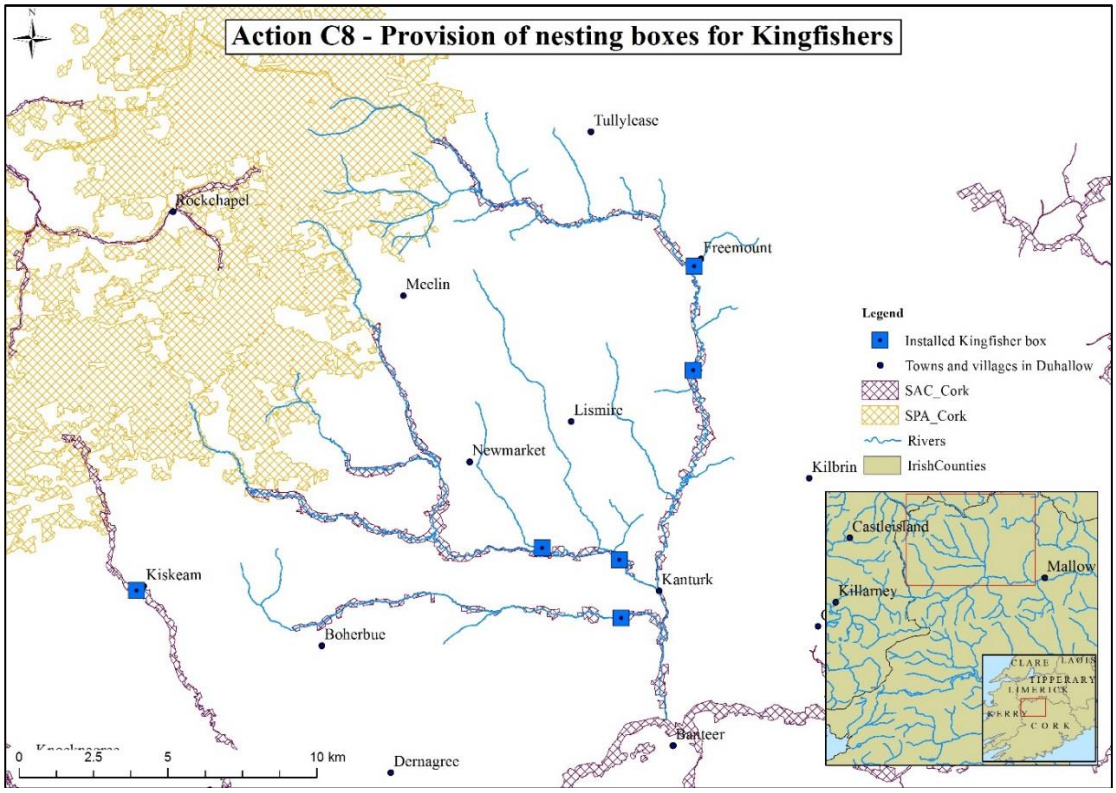


Figure 8 Locations of kingfisher nesting tunnels installed by DuhallowLIFE. Each site had two units inserted into the riverbank, 1m apart, as kingfishers will normally build a second nest if they have a second brood in the same season. (Note: one site was located outside the Allow Catchment, on the River Owentaraglin. This was to increase public awareness in the public park in the village of Kiskeam.

Figure 9 Riverbank suitable for kingfisher nesting - Upstream of Ballymaquirk

Figure 10 Sand martin nest holes upstream of Freemount - indicating suitability of bank for kingfisher

Figure 11 Suitable kingfisher bank - Upstream of Kanturk

Figure 12 Kingfisher nest hole on the banks of the Allow, near Johnsbridge

Appendix 3. Dipper Surveys

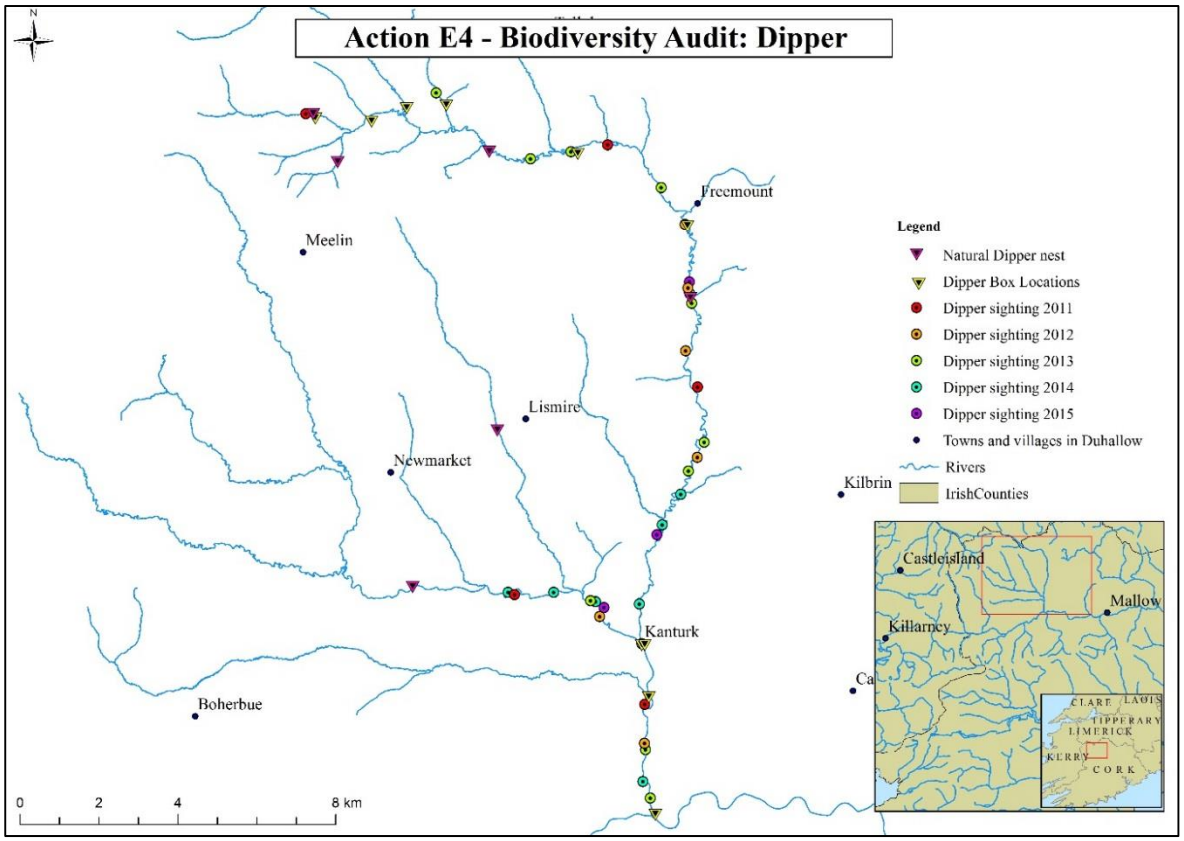


Figure 2 Locations of positive dipper sightings along the Allow and Dalua Rivers

Table 8 number of recorded dipper sightings each year of DuhallowLIFE, based on walkover surveys and incidental sightings

Year	2011	2012	2013	2014	2015
No. of sightings	**5**	**6**	**10**	**8**	**3**

Figure 3 One of two dippers observed on the Allow, downstream of Kanturk

Figure 4 Dipper on the River Dalua, upstream of Kanturk

Figure 5 Dipper spotted near nest in the upper reaches of the Allow in Knocktoosh

Figure 6 Dipper nest built into Ballinguilla Bridge

Figure 8 Dipper nest built into one of the two types of artificial nesting unit installed by DuhallowLIFE