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Department
for Environment
Food & Rural Affairs

Evidence summary

Review of fish eating birds policy

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1. Introduction

In June 2011, Defra published a paper, 'Impacts of Predation by Fish-Eating Birds on Inland Fisheries 2011 Review in England'[1]. This set out the terms of reference, scope and timeframes for an evidence-led review of Defra's policy in relation to controlling the impact of predation on inland fisheries and fish farms by fish-eating birds, and, specifically, in relation to the threat of serious damage[2] caused by cormorants, goosanders and red-breasted mergansers.

Defra officials from the Biodiversity Programme led the review with expert advice from its nature conservation advisors Natural England, and from Cefas and Fera. Defra set up a Review Group to work closely with organisations and individuals who have a strong interest in the outcomes of the review. The Review Group included the Angling Trust, a Fisheries Management Consultant, RSPB, Natural England, Cefas, Fera, Environment Agency and Defra.

The review invited evidence and expert opinion in order to ensure policy continues to be based upon the best available evidence and is robust and fit for purpose. Angling is estimated to be worth in excess of £3.5 billion to the economy of England and Wales and supports 37,000 jobs.[3] The UK also places a very high value on its native biodiversity and the role that birds play as part of the country's wildlife assemblage. In conducting this Review, the Group was therefore mindful of the need to balance the protection of fish stocks and fisheries with the conservation status of the different bird species.

The Review Group met seven times during the course of the review and has also visited inland fisheries to discuss with fishery managers the challenges they face in managing fish-eating birds where such birds are causing serious damage to inland fisheries. The Group commissioned additional analysis of population data for cormorants to better inform the modelling of the impacts of lethal control and has identified positive changes to the current licensing regime that have already been implemented.

This document provides a summary of the evidence considered by the Group. A full list of the original reference source material consulted and supporting evidence made available to the Group is provided at Annex 1. Background information relevant to particular sections is also listed at the start of each section. This document also provides a series of key messages for each of the topics considered. Based upon these, the Group has compiled a Final Report which makes a number of recommendations for delivering improvements to the way that fisheries and fish-eating birds are managed to minimise the risk of serious damage caused by these predators.

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[1] http://www.defra.gov.uk/publications/files/impacts-predation-fish-eating-birds.pdf
[2] See section 5.2.2. pg 46 for further information on "serious damage and the evidence thresholds for it
[3] Economic evaluation of inland fisheries: The economic impact of freshwater angling in England & Wales Science Report – SC050026/SR2 Environment Agency 2007

2. Aims of review

- To gather evidence on the current impact of fish-eating bird predation on inland fish stocks and fisheries by three species (cormorants, goosanders and red-breasted mergansers)

- To evaluate, through consideration of 'real world' examples, the effectiveness of management techniques (whether they require a licence or not) for the control of fish-eating birds as currently employed in England

- To assess the current licensing regime in light of current levels of serious damage to fisheries, customers' needs, and the conservation status of the three species of wild bird mentioned.

- To assess the current levels of lethal control of fish-eating birds available to prevent serious damage to fisheries and consider the merits of changes to this level

- To assess the effectiveness of the current model used by Natural England for setting the level of cormorant licensing

- To ensure the conservation status of cormorants, goosanders and red-breasted mergansers is not jeopardised

3. Goosanders and Red-Breasted Mergansers

The scope of the Review included consideration of three species known to predate on fish at inland fisheries: cormorants, goosanders and red-breasted mergansers. The Group acknowledge that the evidence presented in this document relates primarily to cormorants, though the Angling Trust's 'Cormorant Watch' website provided sightings data on all three species and evidence was gathered on the conservation status of all three species, as well as available information on case studies. The existing evidence base in relation to fish-eating birds is dominated by the impacts cormorants have on inland fisheries; such evidence is available from locations in many parts of the world involving a number of cormorant species. However, the Group considers that its recommendations will nevertheless also support better management of fisheries to minimise the impact of goosanders and red-breasted mergansers.

4. Other evidence gaps

It is also important to note that during the course of this Review the Group identified several evidence gaps which it recognises could be usefully addressed to inform any future review of policy and implementation in this area:

- Impact of licensed control on breeding populations of cormorants – the existing model and adaptive resource management approach for determining levels of lethal control relies on annual counts of over-wintering cormorants. It is not currently possible to assess what impact licensed control may be having on breeding populations.

- Collation of new evidence of the impacts of fish-eating birds on inland fisheries – the review has been constrained by a paucity of reliable current information on the impacts of fish-eating birds on inland fisheries, particularly in respect of goosanders and red-breasted mergansers. Further targeted scientific case studies would be beneficial. It would also be helpful to explore options for building possible impact indicators (e.g. levels of damaged fish) into existing routine monitoring programmes.

- Effectiveness and take up of control measures (fish refuges, shooting (to kill) to maximise scaring effect, etc) – it is generally accepted that shooting to kill enhances the scaring effect of shooting, however, evidence in respect of cormorants is equivocal. Earlier Defra-funded research found that both shooting to kill and shooting to scare were effective at reducing bird numbers at sites, but was unable to prove or disprove the hypothesis that killing enhances the scaring effect of shooting. It would be valuable to provide further clarification of this issue. In addition, further information is needed on the take-up of different management options, in relation to the efficacy of different management approaches at various

sites, and an examination of the factors that would encourage better take-up of different strategies.

- The extent of illegal killing of fish-eating birds – future model developments and enforcement activities would benefit from some indication of the extent and year-to-year variability in the level of unlawful shooting.

- Relative importance of – and interactions between – predation and other factors affecting fishery performance.

5. Evidence summary by theme

The following three broad themes and sub-categories are taken from the scoping paper published on the Defra website – 'Impacts of Predation by Fish-Eating Birds on Inland Fisheries 2011 Review in England'.

For each sub-category the Review Group has indicated what evidence/information has been considered, a summary of their considerations / findings and key messages to inform the recommendations to be made to Defra Ministers.

5.1. Control in practice / levels of damage

- New evidence on current levels of damage to fisheries
- Changes since last policy review
- Efficacy of tools employed to control birds (lethal and non-lethal)
- Current guidance on managing conflict – adequate?
- How effective is lethal control in preventing serious damage
- What level of unlawful lethal control takes place

5.1. The current licensing system as administered by NE

- Content of form and information requested
- Evidence thresholds (for serious damage)
- Number of site visits
- Licensing period
- Efficacy of process for assessing application for prevention of serious damage

5.2. Population Modelling and Conservation status:

- Current conservation status of the three species
- Population Modelling
- Review of current management baseline and efficacy of current model
- Review of UK population figures

5.1. Control in practice / levels of damage:

5.1.1. New evidence on current levels of damage to fisheries

5.1.1.1. Key evidence considered

- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and a summary of their licensing and management history, provided by Natural England
- NE response to the Angling Trust's case studies
- RSPB comments on the Angling Trust's case studies
- Natural England's 'Analysis of Customer Feedback Questionnaire completed by applicants for piscivorous bird licences 2011/2012'
- Angling Trust Web Survey ('Cormorant Watch') of bird sightings
- Site visits conducted by the Review team
- Licensing data for lethal control provided by Natural England
- Cefas review of UK case studies for all three species
- Cefas review of wider scientific literature on conflicts between fisheries and fish-eating birds

5.1.1.2. Summary

Case studies and scientific literature

The Cefas review of published UK case studies confirmed that the three fish-eating bird species covered by the Review – cormorants, goosanders and red-breasted mergansers – could all cause problems for inland fisheries. However, impacts were considered a problem for specific fisheries rather than a general problem, with depredation levels being high enough to cause fishery decline at some sites but not in others. Goosanders and red-breasted mergansers were primarily a concern for river fisheries, particularly those supporting salmon and trout, although conflicts were relatively localised in nature. Information on red-breasted merganser diet and impact was largely restricted to Scotland. Cormorants, in contrast, were more widespread and affected a broader range of fishery types. Earlier Defra-funded R&D indicated that the impact of cormorant predation at stillwaters was more variable than on rivers, suggesting rivers were better 'buffered'

against bird predation, at least in the short term. A key conclusion of these case studies was that it was not possible to define a single level of depredation, in terms of the proportion of the fish standing crop removed by birds, which could be used as a threshold for assessing whether losses were serious. It was thus considered necessary to evaluate conflicts on a case-by-case basis. Each fishery was expected to have its own threshold dependent on the complex interaction between bird depredation and fish population dynamics, between consumption and production,

Cefas also reviewed recent international scientific literature. Information mainly derived from Europe and N. America and largely focused on cormorants, and reflected the fact that cormorant/fishery conflicts are relatively widespread and widely perceived as a problem for fisheries. Key points to emerge from this review were:

- Cormorants are adaptable predators and prey switching occurs in response to changes in prey availability. This is in keeping with the birds' opportunism and with the diet typically being representative of the fish species present at particular sites/times of the year.

- Cormorants can also have sub-lethal effects on fish in addition to direct mortality (e.g. wounding, behavioural changes, fish condition).

- Cormorant/fishery conflicts are complex - a variety of factors can influence fish stocks and predator/prey interactions; it is important to try and understand the different ways in which variables influence fish abundance.

- Cormorant/fishery conflicts occur across a wide variety of aquatic habitats and fishery types and there may be substantial year-to-year variation in losses.

- It follows that impact assessments are difficult, and unequivocally demonstrating cause and effect can be problematic. This does not necessarily mean that no damage is occurring to fish stocks/fisheries, or that damage occurs wherever birds are present.

- In common with the UK, wider views, from Europe and elsewhere, on the seriousness of cormorant impact and the merits of management action vary markedly. Perspectives vary among individuals and different stakeholder groups.

- This literature review considered a number of studies which have examined long time series of fishery data, and which have explored various explanatory factors, have concluded that cormorants have been the likely cause of observed changes in fish populations (higher mortality rates, lower stock levels). In some cases, there is evidence that subsequent management action against cormorants at these sites has been successful in allowing some recovery of the fish populations.

- Few of these studies have attempted to quantify losses in financial terms. However, economic evaluations suggest losses can be substantial at some sites, e.g. including both loss of stock and the cost of implementing management actions.

- In other studies considered, impacts of cormorants on fish stocks have been found to be negligible, or no clear impact was demonstrated. For example, other factors have been reported as being more important in regulating fish stock sizes, or cormorants and fishermen have largely exploited different sizes or species of fish.

- It follows that conflicts need to be evaluated on a case-by-case basis. Further, management activities to safeguard particular fish species may also need to be site specific.

Angling Trust survey / case studies

The Angling Trust carried out site visits and interviews with eight fishery managers or fishery officials representing a range of fishery types and geographical locations. Sixteen questions relating to the impacts of fish-eating birds on their fisheries were asked, as agreed by the Review Group.

The questions were:

- Which birds are causing the problem?

- When do birds arrive (month & time of day)?

- How quickly do numbers build up?

- How many birds?

- How long do they stay (daily and longer-term patterns)?

- How variable are numbers (e.g. any feel for ‘turnover’ at the site)?

- Nature of fishery site – target fish species and size.

- What deterrents / management measures have been tried?

- What measures have helped?

- What measures have not worked and why?

- What problems have occurred (e.g. stock loss, wounding, catches, ticket sales, affect on membership)?

- What evidence to support this?

- Perceptions on relative impact of predators and other potential limiting factors.

- How long did it take to fill in the licence application form?

- What problem areas did you have with it?

- How long did it take for Natural England to respond?

The Review Group considered the results of these interviews and accompanying background case information. The general view of interviewees was that shooting to scare, reinforced by regular shooting to kill, is the most effective method. The Group also noted that the fishery managers consulted raised a number of issues with the licensing system, and there was a general perception that the process was unwieldy and slow. Natural England was perceived as being in opposition to fisheries interests, though relations with local NE officers were generally considered favourable.

Responses to Angling Trust survey / case studies

Natural England also submitted to the Group a separate analysis of the AT case study sites, and a summary is provided here:

- A number of these case studies refer to difficulties obtaining licences. In the majority of cases these comments refer to applications submitted before the last review of licensing policy when evidential requirements set by Defra were considerably more stringent. The policy was changed for the 2004-05 season onwards.

- There is a misconception regarding the existence of a quota system. Advisers set an appropriate number of birds for each case, which should be 10-20% of the number of birds present locally. This is in line with Government policy, the majority of licences are to reinforce scaring, not to cull or eliminate cormorant populations; totals greater than 10-20% would be inconsistent with that policy.

- Broad statements about a 'breakdown in trust' are unsupported, and the basis for this reported breakdown is unclear. Most licence applications are repeat applications, with the process for renewing licences designed to minimise the administrative burden on fisheries.

- The reported '*general reluctance to request more [birds on the licence] in case this jeopardised the granting of any birds*' is at odds with the fact that two of the seven case study fisheries made such a request and were issued increased numbers of birds on their licence.

- It is part of normal procedure to have a monthly limit to encourage people to spread the use of the licence (to reinforce scaring) over the whole vulnerable period. However this can be discussed with the local NE adviser, who can vary or not apply a monthly limit if it is appropriate to do so.

- The application form requests information on stewardship agreements and protected sites because the exact extent of the fishery in relation to such agreements / sites may not be evident. Failure to properly take account of agreements or sites could lead landowners or fisheries to breach legally-binding agreements or the law, so this is for their benefit.

- There is no definitive definition of 'serious damage' and this is judged on a case-by-case basis, taking into account factors such as size/type of fishery. Other factors affecting the fishery, and the use of non-lethal methods are also taken into account when determining a licence application.

- Under current Government policy the number of birds licensed is based on the number of birds visiting the fishery and those present in the local area, not the amount of damage caused.

In comparison with the conclusions drawn from the eight case studies, analysis of the voluntary feedback provided to Natural England with licence returns by 34% of all applicants for fish-eating bird licences shows that applicants are highly satisfied with the licensing system. Responses were received from 175 (37%) cormorant applicants (the biggest sample of fish-eating bird licence applicants, both in terms of number of applications received and number of customer feedback questionnaires returned). This is believed to be higher than the average return rate, e.g. postal returns are about 12-15%. Of the cormorant applicants responding 99% rated the overall service provided by Natural England as good or excellent; 80% found it easy or very easy to get in contact with the Wildlife Management and Licensing Team; and 95% reported that their issue/enquiry had been resolved by the advice provided by Natural England.

RSPB also considered the AT case studies and submitted a paper for consideration by the Group. They indicated the focus of the AT case studies was on past (i.e. pre-2005) difficulties, and suggested that the case studies did little to inform the current assessment of the licensing policy and its administration. The RSPB considered more recent experiences described had been addressed under the current system. They also indentified a number of specific issues with each of the eight case studies, many of which echoed the responses made by NE in their response to the AT case studies summary.

Angling Trust web survey – 'Cormorant Watch'

The Angling Trust also launched a web based survey called 'Cormorant Watch[4]' on 14 June 2011, which allows users to report sightings of cormorants, goosanders and red breasted mergansers. The results of this survey indicate cormorants are found on many of England's river and still waters (especially on large still waters) with goosanders sighted mainly on rivers and relatively few sightings of red-breasted mergansers on any water body. The highest concentration of cormorant sightings from the web survey was in east and central England with relatively few observations in south west England and Wales. Most goosander sightings were in the north and west of England and Wales. These findings are in broad agreement with other sources of information on the distribution of the different bird species. The Review Group noted, however, that the presence of birds does not in itself mean that they are causing serious damage at the specific locations where they were sighted

[4] http://www.cormorantwatch.org/

It is acknowledged that 'Cormorant Watch' is essentially a people engagement exercise rather than a reliable source of information on piscivorous bird numbers. This is due to the lack of either a scientific survey methodology or a way of validating data submitted by unknown individuals, risking short-comings such as double-counting or mis-identifying birds. The fact that groups of birds flying over or loafing are identified as colonies (a term used to refer to breeding groups of cormorants) shows that the data should not be used to provide detailed information on the bird populations.

The Group recognised, however, that the large response to the exercise highlights the level of concern amongst the angling community regarding the impact of predation of fish stocks by fish-eating birds. The Group also noted the difference between the numbers of birds observed as part of the Angling Trust's 'Cormorant Watch' and the formal population data provided through the Wetland Bird survey (WeBs) and subsequent interpretation of this data (see Section 5.3.4).

The results of the survey (recognising the caveats about 'Cormorant Watch' described above) may be summarised as follows:

- Between June 14th 2011 and 1st October 2012 www.cormorantwatch.org resulted in 10,089 records from 3,380 unique users and the reporting of observations of 67,586 birds (this ignored records where users either mistakenly or mischievously entered large numbers, e.g. one user who reported 5,000 individual cormorants in one place). Inevitably, the figures include some level of repeat counting of the same birds.

- There were 7,702 records of cormorant sightings with 37,762 individual bird observations.

- There were 882 records of cormorant colonies with 20,744 individual bird observations.

- There were 1,084 records of goosander sightings with 5,254 individual bird observations.

- There were 199 records of red-breasted merganser sightings with 780 individual bird observations.

Review Group site visits

Members of the Review Group also visited four fisheries in the Midlands in November 2011 and met fishery managers to discuss their experiences of fish predation, management measures employed and experiences of using the licensing regime administered by Natural England. The sites were selected to provide a range of different fishery types within a localised area (further details below). The Review Group agreed that it would only be possible to visit a small number of typical sites in the time available; the suggested sites were agreed by the Group. During these visits the Group were able to

discuss the concerns of anglers and fishery managers on an informal face-to-face basis. The visits are summarised below.

The site visits covered a range of fishery types where fishery managers had reported fish-eating birds impacting the fish populations, and represented typical lowland fisheries:

- a major water-supply reservoir that was maintained as a stocked trout fishery;
- a number of coarse fisheries, from disused gravel pits to rivers, managed by a large angling club;
- an angling lake and section of river running through a town, both managed for coarse fishing by a small angling club;
- a pair of man-made, stillwater coarse fisheries created by a farmer specifically to provide additional income from angling.

The visits enabled the Group to better understand the practical challenges involved in protecting fisheries from fish-eating birds. These encompassed the financial costs of fishery-protection measures, the manpower required to deploy them, their effectiveness and public acceptability, and the inappropriateness of lethal measures in specific circumstances.

At the water-supply reservoir, the outputs of consultancy work were discussed. This work, though not formally published, had revealed that the decline in anglers' reported trout catches over several years correlated with the rise in the numbers of cormorants roosting in a nature reserve at the end of the fishery. Most protection measures were too impractical to install, and licensed shooting of some of birds was deemed to be unacceptable. Here, manipulation of the trout stocking policy proved successful, with the majority of fish introduced at weights in excess of 700g and the first annual fish introductions delayed until just before angling was permitted in early spring.

In the case of the large fishing club, considerable volunteer time was involved (a three-man team working three days per week) to co-ordinate bird-scaring tactics and exercise licensed control, with four-wheel drive vehicles and walkie-talkie radios employed to locate and co-ordinate the scaring of cormorants, as well as the use of trained dogs to recover shot birds. The team also advised and helped co-ordinate action by other neighbouring, smaller clubs which did not have the same resources available to them. The Review Group met the volunteers on the site of a disused quarry, fished by club members, which had suffered from significant cormorant predation eight years previously and was only now becoming viable again as a fishery. Issues raised included concerns about the flexibility of licences to be able to accommodate sudden increases in bird numbers as a consequence of changing winter weather patterns.

Members of the small angling club expressed some confusion regarding how many birds they were entitled to shoot on existing licences, flexibility of licensed bird numbers and the difficulties of using scaring tactics because the fishery was in an urban environment. The

core problem was with cormorants, but the numbers of goosanders had risen in recent winters. To date, no effective fishery protection measures had been discovered.

At the purpose-built coarse fisheries, the owners had purchased and installed a number of different audio-visual cormorant deterrent devices, and these had been deployed in combination. However, they were of modest effectiveness in deterring cormorants in the early stages of fisheries development because repeated feeding visits were made by birds which frequented other fisheries nearby, including a large river which is used as a daily flyway. Protection of the fisheries improved markedly after permission was granted for some lethal control and cormorant foraging success declined - the water became more coloured (by algal blooms and increased levels of suspended matter), marginal vegetation was allowed to encroach into the lake edges and afford fish refuge areas, and the stocked fish – notably the common carp - grew too large for the birds to consume. Thus a range of measures likely contributed to the improvements; it was not possible to assess the relative contributions of each. This would be typical of the approach that fishery managers normally take.

Cormorant licensing and population data

Natural England provided a summary of the number of licences granted, and the number of cormorants shot under licence and cormorant population estimates for the period 1996 – 2010, data for the most recent years are summarised in Table 1 below. This shows that, not all cormorants licensed to be shot are actually shot (based upon returns provided to NE); this percentage has fluctuated somewhat since 2003/4, but it averages 29% over the period.

Year	Licences issued	Birds licensed to be shot	Number reported shot	% cormorants not shot	Current Population estimates (England only)
2003/4	142	790	570	28	24522
2004/5	327	1,972	1,299	34	22659
2005/6	404	2,529	1,603	37	20457
2006/7	347	2,178	1,458	32	21024
2007/8	296	1,598	1,227	23	22423
2008/9	359	1,908	1,590	17	23231
2009/10	389	2,133	1,643	23	20796
2010/11	430	2,262	1,798	21	24758
2011/12	468	2,611	1,885	28	tbc

Table 1 - Cormorant licensing and population data (N.B. these cormorant population data are based on the latest revised estimates from BTO from annual WeBS data– see Section 5.3.4. for further details).

Summary

From responses to the Angling Trust interviews, and during the discussions with fishery managers during the site visits, it was apparent that there is a perception amongst some anglers that things have got steadily worse in terms of the serious damage fish-eating birds cause. The evidence concerning levels of serious damage to fisheries from predation provided to the Group has been largely anecdotal or observational in nature reflecting, in part, the difficulty of quantifying the impacts of predation on fish stocks by fish-eating birds, and the restrictions of timescale, budget and scope of the Review. While the Group has not discounted this evidence, it must conclude that there is no robust quantitative evidence to indicate that the impact of fish-eating birds has changed significantly since 2004/5 when the policy was last reviewed. The Group also recognised that views expressed in the media could influence perceptions. .

The Review Group noted it was not possible to draw any firm comparative conclusions about changes to the frequency and scale of serious damage caused to inland fisheries by fish-eating birds, since impacts have not been quantified either at the time of the last policy review (2004/5) or as part of the current review. It may be noted, however, that populations of fish-eating birds have not increased since the time of the last review (see next paragraph).

It is unclear whether there is any direct proportional or linear relationship between populations of fish-eating birds and levels of damage to inland fisheries. However, it is generally accepted that more birds will mean more (or bigger) conflicts with fisheries. Changes in the status of the populations of the fish-eating bird species concerned will, therefore, presumably provide an indication of the scale of damage. The latest available population data (see Sections 5.3.1. and 5.3.4.) for cormorants (England only) suggest that current wintering numbers (5-year mean 2005/06 to 2009/10 = 21,951) are slightly lower than in the period prior to the previous review (five-year mean 2000/01 to 2004/05 = 22,576).

The State of the UK's birds 2012[5] gives the most recent information on populations at a UK level.

	Long-term trend %	Ten-year trend %	UK Winter population estimate
Cormorant	n/a	5	41000
Goosander	-11	-31	12000
Red breasted merganser	-16	-32	9000

[5] http://www.rspb.org.uk/Images/SUKB_2012_tcm9-328339.pdf

Table 2. Goosander numbers increased to a peak in the late 1990s (5-year mean for years 1994-1999 was 16,100), but have fallen to a level of about 12,000 wintering birds more recently. Red breasted merganser have been decreasing with the UK population about 9000 birds with a 10-year trend showing a 32% decline.

5.1.1.3. Key messages

- There is no new scientific evidence to suggest that the frequency and/or scale of serious damage has changed since the last policy review in 2004/5.

- In the UK, populations of cormorants have been relatively stable over this time. Goosanders and red breasted mergansers are showing a decline.

- Available case studies and recent scientific literature support the view that cormorants (and other fish-eating birds) are not a general problem, but they can cause serious damage at some sites. This suggests there is an ongoing need for case-by-case evaluation/management at problem sites. While birds revisit some feeding sites regularly, their opportunistic foraging behaviour means that they also often switch feeding sites or species in response to changes in prey availability (as well as management activities).

- There was little evidence to suggest that red-breasted mergansers were a particular problem in England. Goosanders were more widespread and mainly affected upland rivers in the north and west of England. However, these rivers chiefly hold migratory salmonids, have relatively high economic values and are managed to sustainably maximise these. Cormorant conflicts were more widespread and affected a broad range of fishery types.

- Earlier Defra-funded R&D (Feltham *et al*., 1999) concluded that '*there is no single level of depredation in terms of the proportion of the standing stock removed by birds that can be a threshold above which loss is considered serious. Each fishery has its own threshold set by the complex interaction between bird depredation and fish population dynamics, between consumption and production*.' Available evidence indicates that this continues to be the case.

- It is recognised that demonstrating serious damage is difficult and, of necessity, commonly involves some degree of subjective assessment. It is also recognised that cormorants can deplete a fish stock quite rapidly and that it is unreasonable to require detailed studies before action is taken. The European Commission is in the process of providing further guidance on Article 9 of the Birds Directive (which relates to the use of derogations), and this is expected to include further guidance on the interpretation of serious damage. The previous Defra policy review concluded that the evidential requirements required of fishery owners before a licence might be issued had previously been too onerous. Thus, serious damage is currently accepted to occur where (a) significant numbers of cormorants are actively foraging at a site; (b) the population structure and combination of fish species present at the site indicate that the foraging birds are preying on fish stocks worth

protecting; and (c) other factors are not likely to be responsible for serious damage to the fish stocks. This is believed to be consistent with the emerging EC guidance.

- There is a belief amongst anglers and fishery managers, supported by expert opinion within the Review Group and the extensive observations of fish-eating birds at fisheries (Cormorant Watch survey), that fish-eating birds are continuing to be present at fisheries and in some cases cause serious damage.

5.1.2. Changes since last policy review in 2004/5 (i.e. what other factors have affected fish stocks and fisheries)

5.1.2.1. Key evidence considered

- Conservation status of bird species can be found in section 5.3.1. below
- New information on river ecology and fish populations through river basin planning process
- Site visits conducted by the Review team
- Cefas/EA summary paper on how inland fisheries have changed since 2004/05 – factors other than bird predation

5.1.2.2. Summary

There are many factors that influence the viability of inland fisheries, including economic, ecological and social factors. Cefas/EA provided the Group with a summary of factors (other than bird predation) that have affected fish stocks and fisheries since the last cormorant policy review in 2004/05. This brief overview aims to cover all inland fishery types, including rivers and stillwaters, and it highlighted, in no particular order, the following key issues:

Climate driven changes

Climate change has had (and is predicted to continue to have) a major effect on aquatic ecosystems. Higher temperatures, unpredictable weather events and increased climate variability are predicted to affect all components of freshwater ecosystems, and the risks of both floods and droughts are expected to increase. Higher temperatures and variations in run-off will also affect water quality. Climate-driven processes have also impacted oceans, with impacts on the survival and productivity of species such as salmon and eel. Climate-driven changes in the abundance or behaviour of fish may affect their availability to predators.

Proliferation of in-river hydropower schemes

There has been a sharp upturn in the number of hydropower schemes approved in England since 2009, and this is anticipated to increase further in the coming years. Poorly designed schemes can affect river connectivity and impact on fish populations and fisheries. There are particular concerns about the potential for cumulative effects where a number of schemes are developed within a single catchment.

The increase in the otter population

Otter numbers have increased steadily in recent years. Otters are now widespread in England, and this has resulted in conflicts and growing concerns among fishery groups. Otters are able to take much larger fish than fish-eating birds, and particular concerns have been expressed about the loss of 'specimen' fish from specialist stillwater fisheries, sometimes worth >£2,000 each.

The decline of eel stocks

Eel stocks are critically low throughout Europe. The number of juvenile eels returning to our rivers has collapsed to less than 5% of historic levels. A wide range of factors have been implicated in this decline, affecting the fish in both freshwater and marine environments. The fall in eel numbers has prompted the European Commission to produce an Eel Recovery Plan[6] which requires Member States to develop eel management plans and deliver improvements in stock status. In compiling these plans, it was estimated that cormorants consumed between 29 and 43 tonnes of eels across the whole of England and Wales during the birds' breeding season.

Atlantic salmon stocks

Many Atlantic salmon stocks in England are in a depleted state and are failing to meet designated conservation limits, despite the fact that many fisheries have been closed or heavily regulated. There are numerous reasons for this, again affecting the fish in both freshwater and marine environments.

Proliferation of highly-managed stillwater fisheries

The number of man-made, purpose-built stillwater fisheries has increased markedly in recent years and many of these are managed intensively to produce very large stock densities. This change is believed, in part at least, to reflect the Environment Agency's policy change of relaxing the close season; angling is now allowed throughout the year on these sites. Other socio-economic factors are changing, such that many anglers also prefer local, readily available fishing opportunities. Data show that about half of the anglers buying rod licences fish only on stillwaters such as these.

Management practices in some fisheries

Particularly high levels of stocking are felt to have contributed to the cormorant/fishery 'problem' by attracting cormorants to some areas (i.e. in effect acting as bird tables). Large stock densities have also given rise to some concerns on fish welfare grounds. Initially, large stock levels were largely a feature of commercially motivated fisheries. Subsequently, many angling clubs have responded with similar approaches in order to compete to retain memberships and viability.

[6] Council Regulation (EC) 1100/2007, establishing measures for the recovery of the stock of European eel

There has been a sharp increase in the number of consent applications to stock carp in stillwaters. Although carp are popular fish with anglers, the Group has heard evidence that this is also a response to predation on 'silver-fish' - carp are less susceptible due to their ability to grow quickly to sizes too large for cormorants to consume.

The Institute of Fisheries Management has worked with fisheries interests to produce a code of practice that many stillwater owners have adopted[7].

Altered angling practices

The principal shift in angling practices over recent years has been the increasing preference for fishing at stillwater fisheries rather than on rivers. Stillwaters can offer a more immediate experience and are often located close to population centres. Owners report that customers fish for much shorter periods – reflecting wider changes in society – hence more immediate success is attractive to them.

Water quality

In general, the chemical quality of river water is substantially improved and at the most favourable levels since monitoring began. There are, however, ongoing concerns about diffuse pollution and endocrine-disrupting chemicals, and new monitoring programmes under the Water Framework Directive are indicating wider problems with the general ecology of some river systems. However, many formerly heavily polluted urban rivers now support healthy fish stocks and offer new fishing opportunities close to where people live.

Habitat quality

Historically, many river catchments have been heavily modified for social and economic benefits such as drainage, industry, forestry, agriculture, power and other purposes. This has had an impact on fisheries and biodiversity. Efforts to address these issues are being made in line with Water Framework Directive requirements.

Invasive non-native species

A number of invasive non-native species have spread through UK waters in recent years. For example, topmouth gudgeon, signal crayfish, killer shrimp, and various plant species have all made significant adverse impacts upon aquatic habitats.

5.1.2.3. Key messages

- It is recognised that fishery performance, and the fish stocks on which fisheries depend, can be affected by a wide range of factors; the impact of fish-eating birds is just one of these factors. The relative importance of different factors in regulating particular fish stocks / fisheries varies widely.

[7] https://www.ifm.org.uk/shop/products/management-intensively-stocked-stillwater-coarse-fisheries

- It is very difficult to assess the precise impact of fish-eating bird predation among a range of other factors affecting inland fisheries, particularly on rivers and at larger sites. The data do not always exist – for either fish-eating birds or fish – at a level which would provide for robust analysis, and to routinely collect data at each site would not be possible because of the complexity and costs involved.

- Since the last review, the European Water Framework Directive has necessitated enhanced levels of monitoring and assessment of inland waters, and it is bringing greater focus to bear in resolving the complex pressures facing rivers, including: diffuse pollution, barriers to fish passage, non-native species, discharges from the water industry, etc.

- Fishery managers should be encouraged to adopt a holistic approach in managing their fisheries to ensure that limiting factors, other than bird predation, are considered alongside any management of fish-eating birds. Management strategies should be targeted appropriately to address key issues/constraints at particular sites while also ensuring management, where appropriate, is considered at the catchment level.

5.1.3.Efficacy of tools employed to control birds (lethal and non-lethal)

- **Is best practice consistently employed?**
- **What is being done in other countries?**
- **Are licences fully utilised?**

5.1.3.1. Key evidence considered

- NE questionnaire to 2011/12 licensees in respect of non-lethal methods and Fera analysis of the responses
- General NE feedback on efficacy of shooting at licensed sites
- Cefas review of UK research into conflicts between fish-eating birds and fisheries
- Cefas review of scientific literature on recent cormorant/fishery conflicts
- Cefas review of cormorant management approaches in other European countries
- Cefas summary paper on whether shooting is effective at resolving issues with cormorants
- Overview of contents of cormorant management 'toolbox' (from EU INTERCAFE project)
- Site visits conducted by Review team
- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and Natural England's summary of the licensing/management history of these
- Licensing data for lethal control provided by Natural England
- Existing advisory leaflets and information on reducing the impact of fish-eating birds (e.g. Moran Committee booklet).
- Results from earlier Defra-funded R&D on management measures (McKay *et al*., 1999; Parrott *et al*., 2003)
- Results from earlier Defra-funded R&D on fish refuges (Russell *et al*., 2008)

5.1.3.2. Summary

Overview of management options

Conflicts between fish-eating birds and fisheries are complex – they affect a range of fishery sectors across a broad spectrum of natural and man-made aquatic habitats. They are subject to change due to factors such as: the population dynamics of birds and fish; variations in external factors, particularly weather conditions; and stakeholder perceptions. Managing such conflicts is also complex and influenced by wide-ranging factors. However, there are numerous management tools available, and these have been shown to be effective, at least in some places at some times.

Before licences can be issued to allow lethal control, the law requires that all non-lethal anti-predation measures have either been tried and found to be ineffective or are impracticable at the site.

It is important to note that effective management of fish-eating birds will normally require a combination of management tools to be employed. The range of measures required will vary between fisheries – there is no single solution guaranteed to be effective in every situation.

Identifying the most appropriate deterrents or other mitigation techniques will likely require careful consideration on a site-by-site basis. Some techniques, such as fish refuges, seek to make predation more difficult, while others work by persuading fish-eating birds to leave a particular feeding site and move elsewhere (scaring). The birds' 'willingness' to move will depend on how effective mitigation measures are at reducing predation, or in persuading the birds to leave a site and, also, on the relative attractiveness of alternative feeding/breeding sites in the area.

As a general guide, it is likely that management programmes will need to be applied consistently and robustly to be successful. Management measures should be planned to start when birds first arrive, before they establish feeding habits at the water bodies to be protected. Thus, for example, on waters that typically experience cormorant depredation in winter, a scaring programme should be planned and start in the autumn when the first birds arrive. Evidence suggests that cormorants stop visiting some water bodies for a month or more after initial aggressive scaring efforts. As birds arriving later in the season often follow birds that are already present to feeding areas, conditioning the early birds to avoid certain waters should help to reduce damage by later arrivals. However, deterrent measures will likely have to be applied consistently throughout the season at many sites.

With many deterrents, their impact is likely to diminish with time as habituation tends to occur with any scaring technique that is not reinforced by a demonstration of real danger. Thus, to be effective over longer periods, it is advisable to constantly change the appearance and location of deterrent devices, and to use combinations of harassment techniques in a rigorously applied, integrated control strategy. Shooting, too, either to kill or to scare, is thought to be most effective where it is used in combination with other

deterrent measures. In short, management works best if it is adaptive and employs a variety of techniques.

The capacity to implement management actions will also be an important factor. Some angling clubs are run on a largely voluntary basis while other fisheries are large commercial concerns. The result is that there are considerable differences in the resources available to deliver management of fish-eating birds. It is not clear, therefore, whether all inland fisheries are well placed to implement a wide range of management techniques to address the predation impacts that can occur. It should also be noted that not all techniques are suitable for use at all sites. For example, fish refuges can be very effective for some fisheries, but may not be appropriate for others (e.g. they tend to be less effective on rivers and large reservoirs).

Key factors that need to be considered by fishery managers in implementing a management programme will include:

- The size of the site to be protected and whether actions are to be local and site-specific or co-ordinated over a wider area.
- The nature and size of the problem being addressed (including the type of fishery, time of year, number of birds/fish involved, trends in bird/fish numbers, etc.).
- The behaviour of the birds (e.g. breeding, roosting, resident, migrating) and the availability of alternative foraging sites.
- The time that can be devoted to addressing the problem (deploying deterrents, co-ordinating actions, etc.)
- The associated costs (manpower and equipment) that can be devoted to addressing the problem viewed against expected fish losses (i.e. some sort of simple cost-benefit analysis).
- Awareness and adherence to local, national and international legislation on the use (or otherwise) of particular techniques, and the need to operate safely.
- Possible constraints on deterrent use such as:
    - the proximity of human habitation;
    - the security of unattended static devices against possible theft and vandalism;
    - accessibility to the land or water areas where deterrents could be deployed; and
    - wider conservation concerns (e.g. any designated nature conservation status of a site and the potential impact upon other wildlife).

Previous research in England into the efficacy of shooting against cormorants (McKay *et al*., 1999; Parrott *et al*., 2003) has demonstrated that both shooting to kill and shooting to

scare are effective at reducing bird numbers at fishery sites. Short-term reductions in bird numbers of around 50% were recorded at a range of sites for a 'post-treatment' period, with numbers returning to pre-treatment levels after a few weeks. The results did not show a statistically significant difference between the effects of lethal and non-lethal shooting, and it was, therefore, not possible to prove or disprove the hypothesis that killing enhances the scaring effect of shooting. Shooting was, however, shown to be more effective at smaller sites. The gradual recovery of bird numbers once shooting ceased highlighted the need for repetition of shooting to reinforce and maintain the reduced numbers.

Previous Defra-funded research on the use of artificial fish refuges (Russell *et al*., 2008) has demonstrated that these structures have the potential to greatly reduce losses to cormorants where fish have little existing available cover and where birds have access to alternative foraging sites. Trials in paired ponds demonstrated a 67% fall in the estimated mass of fish consumed per cormorant visit in a 'refuge pond' compared with an adjacent control pond. On average, this also resulted in 77% fewer cormorant visits to the refuge pond over the duration of the trials. The study highlighted the importance that underwater habitat features play in regulating interactions between cormorants and their prey and provided proof of concept that artificial refuges can provide a useful additional management option for fishery managers in appropriate circumstances. Fish refuges are likely to be particularly well suited to smaller stillwater fishery sites and where fisheries are dominated by smaller coarse fish species (e.g. roach, rudd, perch, etc). Efforts to demonstrate clear benefits for fish stocks / fisheries in subsequent field investigations gave more equivocal results. However, there was clear evidence that fish rapidly found and utilised suitable refuge structures and there was a general perception among anglers and fishery managers that the refuges were of benefit.

The Review Group recognised that the presence of fish-eating birds at a particular site had the potential to generate conflict between stakeholder groups. A range of stakeholders may have legitimate interests, particularly where conflicts occur at large fisheries or over extensive areas. It was noted that the initiation and continuation of dialogue, and an appreciation and understanding among stakeholders of others' aspirations and concerns, were pre-requisites to resolving conflicts. A forum for effective dialogue was thus considered to be an important tool in ongoing management of this issue.

Is best practice consistently employed?

A number of documents have previously been produced, or will be available shortly (e.g. the INTERCAFE Cormorant Management 'Toolbox'[8] and the new EU cormorant webpage[9]), that aim to summarise management techniques and inform stakeholder groups about options for reducing the impact of fish-eating birds. Existing information includes an advisory booklet on protecting your fishery from cormorants and a number of advisory leaflets on specific management options (fish refuges and using nets and wires). This information is available on the Natural England and Environment Agency websites.

[8] http://www.intercafeproject.net/
[9] http://ec.europa.eu/environment/nature/cormorants/home_en.htm

The Review Group also considered an analysis, conducted by Fera, on the results of a questionnaire survey on the use of non-lethal methods. The data were collected by Natural England staff during interviews with licence applicants during the 2010-2011 season; the owners, managers or tenants of 368 fisheries who had applied for licences completed the questionnaire. This asked for details of the alternative methods used and, in particular, whether fish refuges had been deployed and whether these had been a success. The wide-ranging results included:

- Sites made use of many different management methods; 99% used non-lethal scaring, 78% used habitat improvement, 56% made changes to the stocking regime while 31% used fish refuges. [N.B. It was recognised that these data were from licensed sites and that the use of alternative non-lethal measures was a prerequisite for licences being issued. As such, take-up of such techniques at other sites might well be different.]

- The use of alternative methods was not associated with any reduction in the number of birds shot under licence on that site.

- Overall, 65% of those using fish refuges considered them to have been successful.

- For both stillwater and river fisheries the most commonly cited reasons for not using fish refuges were that they were unsuitable for the fishery (44%), that the would impede angling (17%) or that the fishery was unaware of the method (10%). Only 3% of interviewees had tried fish refuges and found them not to work. Stillwater fisheries made up 73% of responses, and in this category 40% had tried fish refuges, rising to 46% for stillwater coarse fisheries.

- Stillwater fisheries using fish refuges did not apply for fewer licences to shoot cormorants and appeared to make more frequent use of a range of alternative methods as well as fish refuges. This suggests fish refuges did not reduce reliance on alternative methods among respondents; rather it may be that those sites which used fish refuges were more willing to try other alternatives as well.

It should be noted that the majority of applicants interviewed were repeat applicants, i.e. had held a licence in previous years. Therefore, these applicants will have already had to (where practical) try non-lethal measures, and the majority will have been undertaking such measures as a condition of previous licences. Where non-lethal measures alone have been found to be ineffective, and a licence has been issued to reinforce these measures, it is not expected that the continuing use of non-lethal measures will reduce the numbers of cormorants shot or negate the need for the licence.

Anecdotal information and feedback from site visits suggested (though not unequivocally demonstrable from the evidence presented) that non-lethal methods could be better employed, and that there may be scope for increased take-up of best practice for the management of fish-eating birds to protect inland fisheries in England. It is not known if lethal methods are being deployed as effectively as possible. There also appeared to be no effective mechanisms in place for sharing best practice management techniques across

fisheries (particularly fisheries of differing types and scale). The field visits attended by the Review Group also highlighted the practical difficulties of shooting birds using a shotgun (e.g. due to the size of water bodies, ability to get sufficiently close, wariness of birds, etc.). Although the majority of licences require shooting to be carried out using a shotgun (which provides a greater scaring effect), it was noted that licences could be issued, in particular circumstances, to allow birds to be shot using a rifle .. Such licences are issued rarely and require additional safety precautions.

What is being done in other countries?

The Group considered a paper summarising different management approaches to cormorant/fishery conflicts in other European countries provided by Cefas. It was noted that cormorant numbers across Europe are very much greater than they are in the UK (tentatively estimated at around 1.2 million in 2007 in the whole western Palaearctic region, although potentially well in excess of this figure). Cormorants in Europe also undergo wholesale migrations from predominantly northern breeding areas to southern wintering areas. These migrations tend to be driven by the cold winters in more northern and central parts of Europe and the freezing over of many water bodies. Many countries thus experience large, seasonal migrations of birds on top of any resident populations. The relatively small UK population experiences some immigration/emigration (including birds from the continent), but this is modest by comparison.

The fisheries affected by cormorants also vary widely across Europe. While the main focus of cormorant/fishery conflicts in the UK centres around recreational fisheries, often in relatively small, widely distributed water bodies, conflicts in other countries affect various other fishery sectors also. Thus, for example, large extensive fish farms for carp and other freshwater species are the sites of prominent conflicts in large parts of central Europe, while coastal commercial fisheries are often affected in Baltic states and coastal aquaculture lagoons in southern Europe, and recreational fisheries on alpine rivers (managed for grayling and trout) are a major concern in countries in central Europe. Cormorant management strategies in different countries have thus been devised to address the different conflict issues that pertain in these countries. These vary widely in terms of their timing (wintering birds, breeding birds, migrating birds, or some combination of these), the numbers of birds involved, the nature and extent of the ‘fishery’ interests affected, and the scale over which measures are applied. The following examples illustrate the large differences between European countries in the fishery sectors affected by cormorants and the alternative approaches to cormorant management:

Netherlands. The main conflicts are with commercial fisheries operating in freshwater (e.g. large water bodies such as the Ijsselmeer) and with recreational fisheries (for angling). It is recognised that cormorants have an economic impact, although it has proved difficult to evaluate actual levels of damage. However, there is no overall management of cormorants in the Netherlands and no measures to control new colonies or to limit numbers or breeding success in existing colonies. Further, no derogations are applied to allow lethal control measures. A large proportion of the cormorant populations in the Netherlands (90 %) breed in Natura 2000 sites; management plans are being established

for all these sites. If cormorants are one of the features for which the site has been designated, then conservation objectives are established for the birds.

Denmark. A high proportion of the conflicts in Denmark relate to commercial fisheries in coastal areas. The Danish Ministry of the Environment first established a cormorant management plan in 1992 in response to the marked increase in the breeding population of cormorants in the country. The latest plan was approved in 2010, with the main objective of ensuring that the size and distribution of the cormorant population did not cause unacceptable damage to fish populations and fisheries, while maintaining the cormorant's protection and survival as a Danish breeding bird.

A range of measures are permitted under the Danish national plan. Lethal shooting is permitted in the vicinity of fishing gear (within 1000m and precluding the breeding period from April to July) and at fish farms. Lethal control measures are also applied at breeding sites, and egg oiling is used to control unwanted population growth in certain defined regions. This effort is concentrated on sites in or close to important areas for fish or fisheries and is only used on ground-nesting colonies [N.B. ground nesting does not occur at inland sites in the UK]. Nests are also removed and birds harassed at certain breeding sites to prevent new colonies from becoming established. Part of the rationale for this is to confine birds in areas where they are already well established, such that the natural carrying capacity of an area helps to regulate numbers/breeding output (i.e. working with density-dependence rather than against it). In addition to lethal measures, various scaring techniques are employed, in particular to protect migrating salmonid smolts and fishing gear and to prevent the formation of new colonies. Shooting is the method most commonly used, sometimes in combination with other deterrents (e.g. gas cannons, fireworks, and other audible and visual scaring devices) to reinforce the effect of the scaring techniques.

The Danish management plan also includes requirements for the continued monitoring of the cormorant population with a view to ensuring that the conservation status of the species remains satisfactory.

France. France is now the largest cormorant wintering area in Europe. Conflicts affect mainly recreational angling and inland aquaculture. Shooting started in France in 1992, initially at only a few sites, but it has increased steadily since this time. In 2009/10, 41,800 birds were permitted to be shot, representing about 40% of the wintering population counted in mid-January (~105,000 birds), although many more birds than this migrate through the country over the winter period. In reality, not all the 'allocated' birds are killed, with numbers actually shot at around 33,000 in 2008-09 and 2009-10.

In spite of this large-scale shooting, some reports indicate that there has been no clear effect on the number of wintering cormorants in France (i.e. no correlation has been demonstrated between shooting intensity and trends in bird numbers at a regional (département) scale). There has, however, been progressive levelling-off of the national population in France since 1999, although it is suggested that this may be mainly due to natural, density-dependant factors.

In view of the fact that there has been no decline in wintering numbers (it seems shot birds are rapidly being replaced by new 'recruits' after the next breeding season), it is understood that the French authorities, and many fish-farmers and anglers, are increasingly of the view that the shooting is largely ineffective. However, they are reluctant to abandon existing lethal control measures pending some other satisfactory solution. A favoured proposal appears to be the implementation of a wider pan-European scheme that would limit the cormorant breeding population in northern European countries and hence reduce the number of winter migrants in France.

Are licences fully utilised?

Licences for lethal control have not been fully utilised in recent years. Over the past 6 years an average of 71% of the birds licensed have been shot, meaning that the number shot has remained below the threshold set by Defra policy of 2000 birds. (See Table 1 in Section 5.1.1.). Currently, the number of cormorants shot under licence is only reported at the end of each licence 'season', so it is not possible for the 'spare capacity' to be reallocated to licensees who have shot up to their limit within that season. The requirement for a 'mid-season' return has been removed in response to feedback (see section 5.2.1). However, when considering repeat applications, if a licence quota has regularly not been used in previous years then it is normally reduced. These 'unused' birds from that seasons limit can therefore be allocated to fisheries elsewhere, where the need may be greater.

The NE questionnaire survey of licensed sites indicated that:

- There were no significant differences in the number of licences to shoot cormorants issued to stillwater or river fisheries.
- Licence applications from put-and-take trout fisheries were, on average, for greater numbers of cormorants than for coarse fisheries.
- New licence applicants were, on average, issued permissions to shoot significantly fewer cormorants that repeat licence applicants.

5.1.3.3. Key messages

Is best practice consistently employed?

- Best practice is likely to require repetitive use of a range of techniques to minimise predictability and the risk of birds habituating to deterrents. It is recognised that such measures, both lethal and non-lethal, are likely to be costly and time consuming.
- The Natural England survey was conducted for sites that have applied for licences. The results indicate that there is widespread use of non-lethal techniques. However, it may be (though not demonstrable from the evidence presented) that non-lethal methods could be better employed. It is not known how effectively licensed sites are deploying lethal methods (i.e. if shooting is being deployed in such a way that will

maximise the scaring effect). Thus, there may be scope in England for increased take-up of best practice for the management of fish-eating birds to protect inland fisheries. Furthermore, it is not known to what extent sites that do not apply for licences employ non-lethal scaring.

- There appears to be some scope for increased take-up of fish refuge use, particularly on inland stillwaters.

- Resources for implementing best practice management varies widely in England among inland fishery managers and groups, and smaller fisheries may be less well placed to adopt best practice management of fish-eating birds. However, it is unclear whether failure to employ best practice reflects lack of awareness, costs or other constraints. Best practice can be resource-intensive, reducing the viability of some of the available techniques for small scale and/or volunteer-led fisheries.

- Other than existing guidance material and advice from NE, there appears to be no effective mechanism in place in England for sharing best practice management techniques across fisheries (particularly fisheries of differing types and scale).

What is being done in other countries?

- Given the wide variation in the numbers and behaviour (e.g. migration) of cormorants across Europe and in the fishery types affected, we should be cautious about making comparisons with management strategies overseas.

- The considerable variability in approaches taken by different countries suggests there is a reasonable level of flexibility in respect of the derogations allowed under Article 9 of the Birds Directive. The Commission guidance document, currently under development, should be helpful in providing further clarification in this context.

- The importance of stakeholder engagement in cormorant management processes is widely recognised and formal consultation mechanisms/fora exist in a number of countries.

- The nature of the conflicts in England (site-specific across varied, often small water bodies) merits a case-by-case approach to management of fish-eating birds, which means that more co-ordinated efforts to protect wider areas/fisheries (as employed in some other countries) would not always be appropriate. However, following discussion within the Group it was felt such an approach merits further consideration, particularly for river catchments.

- Some countries use compensation payments as a means of helping to manage conflicts. This is mainly, but not exclusively, restricted to aquaculture.

Are licenses fully utilised? i.e. are all the birds licensed actually shot?

Licences for lethal control of cormorants have not been fully utilised in England in recent years as not all birds that are licensed are actually shot (e.g. 71% in winter 2011/12). Under-utilisation of a licence does not result in an automatic reduction in the number of cormorants covered by future licences for that fishery.

Currently, the number of cormorants shot under licence is only reported at the end of each licence ‘season’, so it is not possible for the ‘spare capacity’ to be reallocated to licensees who have shot up to their limit within that season. The requirement for a ‘mid-season’ return has been removed in response to feedback (see section 5.2.1.).

However, when considering repeat applications, if a licence quota has regularly not been used in previous years then it is normally reduced. These ‘unused’ birds from that seasons limit can therefore be allocated to fisheries elsewhere, where the need may be greater.

5.1.4. Current guidance on managing conflicts – adequate?

5.1.4.1. Key evidence considered

- NE questionnaire for 2011/12 applications
- Existing advisory leaflets and Moran Committee booklet on '*Protecting your fishery from cormorants*'
- Overview of contents of INTERCAFE cormorant management toolbox[5]
- Cefas review of UK case studies
- Wider Cefas review of scientific literature on conflicts between fisheries and fish-eating birds
- Site visits conducted by Review team
- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and a summary of their licensing and management history, provided by Natural England

5.1.4.2. Summary

There is a large amount of information available on techniques for managing conflicts between fisheries and fish-eating birds, including written and web-based material. For example, the earlier Moran Committee Wildlife Group developed a comprehensive guidance booklet on protecting your fishery from cormorants, and Cefas has prepared advisory leaflets on the use of fish refuges and on protecting sites using nets and wires. All this information is available on the NE and other (e.g. Environment Agency) websites. The guidance in some cases (e.g. the Moran Committee booklet) is not fully up to date, however.

Site-specific guidance has also been routinely provided to fishery owners/managers by NE Wildlife Advisors. However, the level of contact between NE Advisors and fishery owners has been reduced somewhat in recent years following government better regulation initiatives in line with the Hampton principles[10].

The INTERCAFE cormorant management toolbox[5] has compiled information on cormorant management options from around the world and provides a comprehensive assessment of available techniques. In the report, each group of techniques is evaluated in terms of

[10] http://www.hm-treasury.gov.uk/d/hampton_compliance281106.pdf

practicality, efficacy, cost and acceptability. This report is expected to be published soon and to be made available via a new European Commission website.

Information derived from the NE questionnaire, site visits and AT case studies suggested more could be done to promote best practice and improve take-up of the available non-lethal techniques. It is not entirely clear whether the apparent reluctance to try alternative measures reflects lack of awareness, costs, or general scepticism about the efficacy of non-lethal techniques. It is likely to be some combination of these factors, although the Review Group also noted that the angling press commonly focused on culling as the only realistic solution.

The Review Group noted that effective use of deterrents was time-consuming and potentially costly and that this could pose a particular challenge for smaller concerns. However, fishery managers needed to recognise that a site supporting large densities of fish was likely to remain an attractive feeding site for opportunistic predators such as cormorants (even if bird numbers were smaller). As such, management measures need to be applied consistently and robustly to be successful, and varied combinations of harassment techniques are likely to work best in combating the danger of habituation. An important part of guidance and support for fishery managers thus needed to include best practice for application of different deterrent techniques, not just raising awareness of the techniques themselves.

Earlier experience in England and Wales, and from other countries, has demonstrated the importance of stakeholder engagement in cormorant management processes. It needs to be recognised that the issues around conflicts between fish-eating birds and fish concern people with different interests and views. Appropriate consultation mechanisms can thus provide a valuable input in building consensus on issues and in developing guidance material to inform different stakeholder groups. The Moran Committee Wildlife Group has previously functioned very well in this capacity, although has not met in recent years. Other similar groups have been set up in other countries.

5.1.4.3. Key messages

- EC and national guidance regarding best management practice could be made more widely available (most fishery managers rely on NE for information regarding best practice as opposed to primary sources)

- Currently there are a number of sources for best practice and other guidance (from NE, Defra, EA and at an EC level) that could be usefully collated in order to provide a ‘one stop shop’. It was recognised, however, that this information needs to be promoted through appropriate routes (Defra, NE, EA, Angling Trust, etc.).

- The INTERCAFE cormorant toolbox[5] will be a useful source of information on management options. It will be particularly useful once this becomes available in a readily accessible format on the new EU cormorant website.

- Not all fisheries appear to make good use of available guidance, and support at grass roots level would be particularly helpful in implementing appropriate techniques and co-ordinating activities/best practice at a local scale (e.g. across a catchment). A key part of available guidance should be about the actual application of different approaches and not just the techniques themselves.

- Anecdotal evidence supports a face-to-face approach to providing advice and guidance to fisheries managers.

- Future efforts to consolidate/update guidance material would benefit from the re-establishment of an appropriate consultation/liaison mechanism in which all relevant stakeholders could participate.

5.1.5. How effective is lethal control in preventing serious damage?

5.1.5.1. Key evidence considered

- NE questionnaire for 2011/12 applications
- Cefas review of UK case studies
- Wider Cefas review of scientific literature on conflicts between fisheries and fish-eating birds
- Cefas summary paper on whether shooting is effective at resolving issues with cormorants
- Earlier Defra-funded R&D on management techniques for reducing impacts of fish-eating birds (McKay *et al*. 1999; Parrott *et al*. 2003)
- Site visits conducted by Review team
- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and a summary of their licensing and management history, provided by Natural England
- NE response to the Angling Trust's case studies
- RSPB comments on the Angling Trust's case studies

5.1.5.2. Summary

- It is generally accepted in bird management that lethal shooting enhances the effect of scaring, and feedback from NE licensees typically supports this view in relation to cormorants. However, scientific evidence on the relative effectiveness of lethal and non-lethal shooting against cormorants is equivocal. Prior to Defra-funded research carried out by Central Science Laboratories (CSL, now Fera) in the late 1990s (McKay *et al*. 1999, Parrott *et al*. 2003), it is understood there had been no detailed field studies to test this experimentally.
- The CSL study involved a large-scale field experiment at 13 sites across England and Wales to assess if shooting could be used to reduce numbers of cormorants present at sites and, in particular, if shooting to kill enhanced the scaring effect of shooting with blanks. The study demonstrated that both shooting to scare and shooting to kill (as an aid to scaring) could reduce the number of birds visiting a fishery for a 'post-treatment' period. A mean reduction in bird numbers of 50% was

observed. The reduction was more pronounced at smaller sites. The results did not, however, show a statistically significant difference between the effects of lethal and non-lethal shooting. It was therefore not possible to prove or disprove the hypothesis that killing enhances the scaring effect of shooting.

- The CSL study only looked at the impact of shooting over a relatively short (two week) treatment period, and bird numbers recovered to pre-treatment levels after a few weeks once shooting ceased. In practice, shooting (and other deterrents) are likely to need to be repeated over longer time periods to provide fisheries with adequate protection.

- As part of the earlier Defra-funded R&D on management measures (McKay *et al.*, 1999) a separate questionnaire survey was also conducted with relevant experts in a number of European countries. This confirmed that efforts to control cormorant predation at fisheries by shooting had been attempted in most countries. However, the effectiveness of shooting in reducing the number of fish-eating birds was reported to be equivocal for a range of fishery types. In some countries using a shotgun to scare cormorants was believed to be ineffective without killing some birds, while in others no difference between lethal and non-lethal shooting was reportedly apparent. The questionnaire responses also indicated that human disturbance appeared to be the most consistently effective deterrent.

- The Cefas review of scientific literature provided a number of examples of sites where management actions (control programmes) had been successful in reducing cormorant impact. Many of these examples incorporated other control measures (e.g. egg oiling), thereby extending beyond any evaluation of the effect of shooting alone. Nonetheless, the cormorant control measures in these studies had achieved the desired objective and were considered a management success. In some examples, cost/benefit analysis had also demonstrated that the programmes were cost effective. However, in other studies the results were equivocal or had unpredictable outcomes (e.g. moving the conflict to an adjacent site) and did not provide a clear indication of the efficacy of control measures.

5.1.5.3. Key messages

- It is generally accepted in bird management that killing birds enhances the scaring effect of shooting. However, the scientific evidence, for cormorants at least, is equivocal. This remains an evidence gap and an area where further research would be helpful. However, the practicalities of objectively testing this in the field should not be under-estimated.

- The cost-effectiveness of controls could usefully be evaluated further.

5.1.6. What level of unlawful lethal control takes place?

5.1.6.1. Key evidence considered

- Anecdotal evidence

5.1.6.2. Summary

- The Group discussed the issue of unlawful lethal control and concluded it was likely that such unlawful control does take place. There are, however, no official figures or research to assess the scale or scope of unlawful lethal control.
- The Review Group is not aware of any prosecutions for unlawful killing of cormorants in the past seven years.
- On average 9-10 licensees each year are found to have shot in excess of their licensed quota from the reports they themselves submit to Natural England (data from 2009 – 2011). Birds shot in excess of the licensed number (or otherwise in contravention of the licence terms and conditions) are unlawfully killed. Instances where licensees have shot more than their allocation will be considered under NE's enforcement procedures.
- The winter WeBS count data, on which the cormorant population model is based, will reflect the overall level of mortality on the population from one year to the next. Thus, although the scope of unlicensed control is unknown, it is, in effect, allowed for in the modelling process and in assessing the permissible level of licensed control.

5.1.6.3. Key messages

The Review Group agreed that unlawful killing is unacceptable and that actions should be considered to reduce it, although it noted that enforcement of such offences was difficult.

Current modelling of the population does not explicitly incorporate estimates of unlawfully killed birds, but provided that this activity remains at a relatively constant level year on year, it should not affect model projections.

By its very nature, the scale and scope of unlawful lethal control is unknown, and very difficult to quantify. This remains an evidence gap.

The Group recognised that the licensing system needed to reflect obligations under the Birds Directive and comply with the law. The Group also acknowledged that there were clear benefits in making the licensing system as simple and end-user friendly as possible.

5.2. The current licensing process as administered by NE including:

- **content of form and information requested**
- **evidence thresholds (for serious damage)**
- **number of site visits (the need for all new applicants to be visited)**
- **licensing period (consequences of further control in breeding season)**
- **efficacy of process for assessing application for prevention of serious damage**

5.2.1. Content of form and information requested

5.2.1.1. Key evidence considered

- Existing policy guidance documentation
- Site visits conducted by Review team
- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and a summary of their licensing and management history, provided by Natural England
- Response to the Angling Trust's case studies
- Natural England's 'Analysis of Customer Feedback Questionnaire completed by applicants for piscivorous bird licences 2011/2012'
- Current Natural England application form (following changes described below)

5.2.1.2. Summary

The Group identified and discussed a number of issues pertaining to the current Natural England application form. Two 'quick wins' were requested with the current application form and process, namely:

- That the complaints procedure should make it clearer that applicants can challenge a rejection decision.
- That Natural England could consider a different approach to requiring written evidence of landowner consent at the start of the application process.

In response, Natural England has revised the application form and procedures (following discussion with the Group) in a number of ways:

Landowner permission requirements have been simplified (a declaration by the applicant, rather than written permission from the landowner, is now sufficient)

- Clarification of the appeals/complaints process is now provided with all responses to licence applications.
- Additionally clarification has been provided to Advisers on the application of a monthly limit to licences issued.
- The requirement for a mid-season return to be submitted has now been removed (this was changed in response to feedback from the Angling Trust at the start of this Review).

The application process was rated by applicants for cormorant licences in 2011/2012 (according to Customer Feedback Questionnaires returned to Natural England – see further details of survey at Section 5.2.5.) in response to the question: 'How would you rate the service provided by Natural England in respect of …..?'

Poor	Fair	Good	Excellent
1.2%	7.2%	46.7%	44.9%

Table 3. Ease of completion of application

Poor	Fair	Good	Excellent
1.2%	4.1%	36.6%	58.1%

Table 4. Ease of completion of licence renewal form

5.2.1.3. Key messages

- The licensing process needs to continue to comply with legislative requirements. This includes providing evidence of serious damage and of other deterrents being tried.
- NE evidence (licensing history of case study sites) showed that the majority of concerns raised with the Review Group referred to applications submitted before the current, less stringent licensing system was introduced in 2004/05.
- Following feedback, changes have been made to the application form, which aims to be as user-friendly as possible, while continuing to ensure the requirements of the legislation are fulfilled.

- Customer feedback shows that more than 90% of responding applicants rate the application process as good or excellent. This feedback was received prior to the above changes being made.
- Non-completion or incorrect/minimal completion of application forms is a barrier to Natural England providing an efficient licensing process.
- Natural England routinely works with anglers where possible to provide advice on non-lethal methods of control and to improve the quality of original applications in terms of data provision, etc.

5.2.2. Evidence thresholds (for serious damage)

5.2.2.1. Key evidence considered

- Existing Defra policy guidance documentation
- Earlier Defra-funded R&D (Feltham *et al*., 1999)
- Draft EU Commission guidance document on Article 9
- AT case studies and NE response
- NE's licence application assessments
- Natural England Technical Information Note TIN041 "Fisheries and the presence of cormorants"
- Natural England Technical Information Note TIN040 "Fisheries and the presence of goosanders and herons"
- Natural England's Licence Application Form to kill or take fish-eating birds causing serious damage to a fishery.

5.2.2.2. Summary

It remains a requirement under the existing legislation that fisheries have to demonstrate that serious damage is occurring (or there is a reasonable expectation that this will occur) before a licence can be issued to kill protected birds.

A key outcome of the previous Defra policy review was a recognition that the evidential requirements on fishery owners/managers in respect of demonstrating serious damage had been too onerous. The burden of proof was, therefore, reduced at this time to make it easier for fisheries to demonstrate serious damage and obtain a licence. The majority of people who currently apply for a licence are successful in obtaining one.

The European Commission is in the process of drafting a guidance document on Article 9 of the Birds Directive, which relates to the use of derogations. The latest draft of the document[11] (which is currently out for consultation) indicates that:

11

https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp?FormPrincipal:_idcl=FormPrincipal:_id3&FormPrincipal_SUBMIT=1&id=adb9185b-c22c-4642-a12a-8b92dbe2dac8&javax.faces.ViewState=rO0ABXVyABNbTGphdmEubGFuZy5PYmplY3Q7kM5YnxBzKWwCAAB4cAAAAAN0AAEzcHQAKy9qc3AvZXh0ZW5zaW9uL3dhaS9uYXZpZ2F0aW9uL2NvbnRhaW5lci5qc3A=

- The general concept of serious damage (by cormorants) is relative and, as such, should be evaluated for each circumstance where and when a conflict occurs.

- It indicates that serious damage goes beyond mere nuisance and normal business risk, but it recognises that serious damage occurs where: (a) significant numbers of cormorants are actively foraging at a site; (b) the population structure and combination of fish species present at the site indicate that the foraging birds are preying on fish stocks worth protecting; and (c) other factors are not likely to be responsible for serious damage to the fish stocks.

- The EC accepts that cormorants can deplete fish stocks rapidly and that this precludes the need for detailed studies before action is taken.

A key conclusion from earlier Defra-funded R&D (Feltham *et al*., 1999) was that there is no single level of depredation (in terms of proportion of standing stock removed by birds) that can be set as a threshold above which serious damage occurs.

In order for a licence to be granted, the applicant must satisfy three fundamental tests:

- Serious damage is being, or is likely to be, caused by cormorants at the site.

- All other non-lethal anti-predation measures have either been tried and found to be ineffective or are impracticable at the site.

- It is reasonable to consider that shooting cormorants will reduce, or prevent from increasing, the level of damage (whether through scaring or direct reduction of numbers).

According to current Defra policy, in order to meet the serious damage test for cormorant applications, a fishery must be potentially vulnerable to predation by cormorants and it must be worth protecting. In practice, this will require evidence that significant numbers of cormorants are likely to be present and feeding on valued fish stocks, and that the ‘other measures’ test has been satisfied.

In order to meet the serious damage test for applications for other piscivorous bird species, a greater level of evidence is required to demonstrate that the fishery is being, or is likely to be, adversely affected by predation. This policy reflects, in part, the larger evidence base relating to the impacts that cormorants can have on inland fisheries.

Natural England’s Technical Information Notes and application form gives further guidance on the information required to provide evidence of serious damage.

5.2.2.3. Key messages

- It is unrealistic to set firm thresholds for determining serious damage. Such assessments are, of necessity, often subjective, and they need to be evaluated on a case-by-case basis. Therefore Natural England does not set thresholds for

evidence of damage as the significance of different levels of damage will vary between fisheries.

- The Group considered the existing working guidelines for evaluating serious damage to be flexible, pragmatic, and consistent with emerging guidance from the Commission.

- The level of evidence required to meet the serious damage licensing test is lower for cormorants than for other piscivorous birds, reflecting, in part, the larger evidence base relating to cormorant/fishery conflicts.

5.2.3. Number of site visits (the need for all first-time applicants to be visited)

5.2.3.1. Key evidence considered

- Concerns raised by Angling Trust and subsequent discussion by the Review team
- Site visits
- NE licence application assessments
- Natural England's 'Analysis of Customer Feedback Questionnaire completed by applicants for piscivorous bird licences 2011/2012'

5.2.3.2. Summary

One of the concerns that has emerged during the course of the Review is the lack of local support for fishery owners/managers in implementing management strategies against fish-eating birds.

The Review Group recognised the need for the licensing system to be as simple and user-friendly as possible, and that unnecessary site visits should be avoided. However, the Group also noted that visits by NE Wildlife Advisors represented a key opportunity for Advisors to provide site-specific guidance on available management options, as well as administer the licensing process. The reduction in face-to-face contact, as a result of the simplified licensing procedures (i.e. no requirement to visit sites prior to renewing licences), may have had a detrimental impact on the general awareness of potential management tools.

Applicants for cormorant licences in 2011/2012 rated the Natural England site visits as follows (according to Customer Feedback Questionnaires returned to Natural England):

Poor	Fair	Good	Excellent
0.0%	0.0%	28.5%	71.5%

Table 5. Competence of staff and advice provided during site visit

It seems that not all fisheries are aware of existing guidance material.

5.2.3.3. Key messages

First-time visits to sites are very useful to both applicant and licensing authority for a variety of reasons (relationship building, information gathering, providing advice, etc.). The Review Group felt that some form of face-to-face contact was necessary as part of future policy.

Fisheries managers have highlighted good relations with their local NE Advisor as a key element of the licensing process.

It seems that more needs to be done to provide help and support at the grass roots level and that fisheries would benefit from more active guidance and/or consultation at a fishery specific level about how best to safeguard their site. Ideally, this should be at the earliest stage before problems develop and licences are needed.

A dedicated fisheries advisor (who would need to be fully familiar with the full range of available techniques) could be very useful in addressing this need.

5.2.4. Licensing period (consequences of further control in breeding season)

5.2.4.1. Key evidence considered

- Verbal advice provided by NE
- Cefas diet analysis of birds shot late in the season to protect the smolt run.
- Cefas review of scientific literature
- Earlier Cefas carcase analysis of birds shot under licence

5.2.4.2. Summary

The Group discussed the benefits of extending the period for which licences to control cormorants could be issued. There is provision under the current system for a licence to be granted until 1 May where this is necessary to protect smolts[12] and spawning fish. Smolt runs on some rivers extend well into May, or even early June, although licence extensions usually run until 15 April.

Cefas reported that diet data from the River Wye indicated that birds shot in the extended licensing period in April had contained a substantially higher proportion of smolts in the diet. So, the existing extension of the licensing season on this river appeared to be justified.

The scientific literature provides extensive evidence of dietary shifts in fish-eating birds in response to changes in prey availability (e.g. seasonal shoaling and migration of smolts, aggregations of spawning fish, etc.). This is consistent with the birds being opportunist predators. There are thus reasonable grounds for targeting management actions against fish-eating birds during potential predation 'pinch points'.

An extension beyond mid April for licensed lethal control of cormorants would overlap to a greater extent with the birds' breeding season. The Group concluded that extending control further into the breeding season could raise welfare issues that would need to be considered.

Although localised shooting in the breeding season would be unlikely to have a significant impact on conservation status, the Group recognised (see Section 5.3.2.) that the current adaptive management system does not allow any assessment of the impact of licensed

[12] 'Smolt' is the term used to describe the life stage of salmon and sea trout when juvenile fish undergo a physiological and physical transformation, form shoals and migrate from freshwater to the sea; this occurs in spring.

shooting on the cormorant breeding population. It would therefore be advisable to take a precautionary approach to any increase in licensed shooting in the breeding season. .

Cormorants breed early in the year so it is possible that small numbers of birds shot up to 15 April could already have dependent young. However, recent analysis of birds shot under licence by Cefas indicated that a high proportion of these birds were juveniles.

The Group also noted that the current modelling upon which the annual level of lethal control is set, is based upon over-wintering population figures for cormorants. The current model, therefore, would not be able to predict the impacts of any lethal control of breeding cormorants on the breeding population as a whole.

RSPB have requested an assessment of the cormorant licensing policy in England on breeding populations, both in England and also in Scotland and Wales (birds from breeding colonies in these countries are known to overwinter in England).

5.2.4.3. Key messages

Existing provisions permitting extension of licences further into April to help protect smolt runs and/or spawning fish are justified on the basis of the available evidence and should be retained.

Extending the lethal control of breeding birds later into the spring could raise welfare issues.

The current adaptive management system does not allow any assessment of the impact of licensed shooting on the cormorant breeding population.

5.2.5. Efficacy of process for assessing application for prevention of serious damage

5.2.5.1. Key evidence considered

- Natural England's 'Analysis of Customer Feedback Questionnaire completed by applicants for piscivorous bird licences 2011/2012'
- NE questionnaire for 2011/12 applications
- NE licence application assessments
- Site visits conducted by Review team
- Eight case studies submitted by the Angling Trust ('Review of Impacts of Predation by Fish-Eating Birds on Inland Fisheries in England') and the Natural England summary of those sites' licensing and management history.
- RSPB response to AT case studies.
- Natural England Technical Information Note TIN041 "Fisheries and the presence of cormorants"
- Natural England Technical Information Note TIN040 "Fisheries and the presence of goosanders and herons"
- Natural England's Licence Application Form to kill or take fish-eating birds causing serious damage to a fishery.

5.2.5.2. Summary

Current policy

In accordance with section 16(1)(k) of the Wildlife and Countryside Act 1981, Natural England issues licences for the purpose of "... *preventing serious damage to ... fisheries or inland waters* ...".

In order for a licence to be issued, the serious damage test has to be met (see section 5.2.2. above). Meeting this test involves showing that significant numbers of cormorants are likely to be feeding on valuable fish stocks (or that other piscivorous birds are impacting on the fishery), and that other management options are either ineffective or impractical. This would normally require some birds to be present before a licence can be issued. However if, for example, a new fishery was established in an area known to have problems with cormorant predation - demonstrated by the presence of surrounding licensees - then consideration could be given to issuing a licence for a small number of birds.

Natural England questionnaire survey of licensees

Natural England's Customer Feedback Questionnaire asks licence applicants to rate various aspects of the licensing process. Responses supplied by 175 applicants for cormorant licences in 2011/12 show a positive view of the licensing process:

- More than 92% of responses rating the speed of the process as good or excellent.
- More than 98% of responses rating the overall service as good or excellent.
- The majority of respondents (63%) reported that the issue was fully resolved, with a further 31% reporting partial resolution.
- More than 79% of respondents found it easy or very easy to contact Natural England's Wildlife Management and Licensing Team.
- 100% of responses rated Natural England's advice provided by telephone as good or excellent, and the website was considered good or excellent by more than 94%.
- Ratings of good or excellent were given by 100% of respondents for the competence of staff and advice given during site visits, and a rating of more than 97% was given for the competence, helpfulness and politeness of staff in the licensing unit.

Concerns raised by Angling Trust survey

The key issue seemed to be the speed with which fisheries could attain approval for a licence. The eight case studies submitted to the Group by the Angling Trust included responses to three questions relating to the 'efficacy of the process for assessing application for prevention of serious damage'. They were:

- Question 14. How long did it take to fill in the licence application form?
- Question 15. What problem areas did you have with it?
- Question 16. How long did it take to respond?

In addition to the impacts noted by the owners of the eight case study fisheries, one site (used for WeBS counts) illustrated the rapidly fluctuating numbers of cormorants that can be found at a single site. This is not reflected when looking at national data as a whole.

The other seven sites show a range of issues and were selected to represent a geographical range and different types of fisheries both in terms of size and fish species. Most are still waters with one combined still water and river fishery.

Selection of case studies was based on those that appeared to show a responsible approach to fishery management. Of those selected, one had not applied for a licence to shoot to kill to enhance scaring tactics, two had applied but had been declined within the

last six months and the other four had been granted licences either immediately prior to or after the change in Defra Policy in 2004/05.

For the two applications which had been declined, one had been declined on the basis that shooting to scare had not been tried and there was a lack of evidence of serious damage occurring. The other application had been declined due to lack of evidence of bird numbers and other factors impacting on fish stocks.

Common themes identified in the responses to the Angling Trust survey

- **Perceptions of a difficult, inflexible licensing system**

All fishery owners granted a licence felt that the numbers of cormorants allowed to be shot were inadequate; there was a general reluctance to request more in case this jeopardised the granting of any birds, given a perceived 'quota' system and the number of birds was suggested by the NE officer rather than by the fishery owners. There is a general lack of trust between fishery owners and the licensing authority. In the majority of cases this was not with the NE field officer but with the perceived 'system' and having to deal with 'Government', as it was felt that the 'quota' system does not sufficiently take into account socio-economic needs nor is it flexible enough to meet needs, weighing the interest of birds above fish. These reasons were behind one case study where the fishery had decided not to apply for a licence.

There was a general view that having a number of birds allocated per month did not give flexibility in management over the season, particularly when a large number of birds suddenly appeared and there was no time to apply for changes to licence conditions.

There was a general view that the licence should have greater flexibility or reserve built in to deal with circumstances as described in point 2, particularly with those fishery owners that had demonstrated responsibility in the past.

Whilst some owners had the knowledge to complete the forms correctly, others left sections blank that they did not understand. The sections not completed were those relating to stewardship schemes and protected areas, which applicants then assumed were completed by Natural England.

Actual completion of the forms took between half a day to a full day depending on the knowledge of the applicant (see point 4 above). However, considerably more time was spent in providing supporting data (e.g. rod catch data) and in going to the fishery to count the birds present.

Response times from NE were generally described as 'good', particularly in the last few years.

The question of 'serious damage' as decided by NE officers appears vague. It was unclear why two of the case studies had been declined licences.

- **Practical concerns not considered by the process**

Effective cormorant management is resource-intensive. In these cases the fishery owners were able to achieve this through volunteer commitment, but it should be recognised that this will not be always the case for other fisheries. The site visit by the Review Group to waters in the Midlands illustrates the amount of commitment required to professionally meet licence requirements: the quarry pit visited was taking a number of years to restore to fishing viability.

Interviewees maintain that licensed bird numbers do not reflect the damage done to the fishery. The four fisheries that have had licences granted have reportedly still not recovered to a stable financial situation despite these being granted prior to 2006. It has taken them to the brink of financial collapse and six years later the matter is still precarious with financial reserves depleted to meet extra stocking and reductions in membership adversely affecting cash flow. Although there may also be other reasons for declining membership, there is felt to be a compelling theme. For example, membership of the stillwater trout fishery has fallen by half, with members citing predation and wounded fish as the reason for leaving. Those questioned felt that once predation has started a much larger number of cormorants should be allowed on the licence (after all scaring tactics are used) with the numbers then decreasing as the fishery improves. It is not practical to undertake a full economic analysis given the variables involved, but the figures given in the case studies for loss, in particular re-stocking, are very apparent.

- **Efficacy of measures**

In all cases where licences had been granted it was felt shooting to kill to aid scaring was the most effective deterrent measure for birds not directly targeted and kept them away for longer periods than other scaring tactics. Exactly how long varied between waters

Natural England response to Angling Trust concerns and case studies

<u>Perceptions of a difficult, inflexible licensing system</u>

Perceptions: Cormorant numbers considered inadequate and inflexible. Concern that requesting an increase in numbers would jeopardise licence. Monthly allocation inflexible. Suggestion that a much larger number should be allowed initially, with numbers decreasing as the fishery improves.

Natural England position:

- The number of cormorants licensed will be a proportion of the local population (based on NE officer local knowledge informed by numbers reported by the applicant, county bird reports, etc.). The aim of the majority of licences is to reinforce scaring rather than to reduce the local population. Numbers licensed each year will vary where this is appropriate, in response to changes in the bird population, level of damage, effectiveness of non-lethal measures in conjunction with the licensed shooting, etc.

- Requests to make changes to licences, in particular the number of birds covered, can be made by telephoning the wildlife adviser. Where the change is justified an amended licence can be issued quickly and without additional paperwork from the licensee.

- Requesting an increase in bird numbers will not jeopardise a licence being granted. Licences are issued where justified, and for an appropriate number of birds. Applicants and licensees will not be 'punished' for requesting an increase in numbers.

- Monthly limits are placed onto licences to ensure that control is spread throughout the season, rather than to further restrict the number of birds that may be shot. Monthly limits should be applied in a way that allows effective control of cormorants. In some instances monthly limits may need to allow the bulk of the licensed numbers to be shot early in the season. The limits are flexible, and new internal NE guidance makes this clearer, ensuring that the licensee is aware of the presence of the limit, the reason for it, and that this can be changed during the season if there is an need to do so, e.g. because of a sudden influx of birds feeding on the fishery. An increase in monthly limit can be confirmed via email and a revised licence is not necessary.

Perception: Lack of trust between fishery owners and licensing authority.

Natural England position: Feedback provided to us by applicants does not suggest a lack of trust. (See above details on Natural England's Customer Feedback Questionnaire.)

Perception: Uncertainty over stewardship scheme and protected area questions on the application form.

Natural England position: NE normally expects people applying for a licence (or the landowners, whose permission the applicant will need to secure)to know of any stewardship agreements or designations on the land to be covered by the licence. However, where this is not the case, information can be found on websites such as MAGIC (http://magic.defra.gov.uk/default.htm). These questions are designed to both ensure that any licensed action does not result in the licensee acting unlawfully, and to ensure that licensed action does not conflict with stewardship agreements and designations.

Perception: Considerable time spent providing supporting data.

Natural England position: A certain level of supporting data is required to justify a licence, as required by current Government policy. For cormorant licences only evidence of bird numbers, value of the fish stocks and other measures tried is required.

Perception: NE response times generally good, particularly in the last few years.

Practical concerns not considered by the process

Perception: Effective cormorant management is resource-intensive.

Natural England position: NE appreciate this, but cormorants will exploit an opportunity to feed undisturbed. Therefore, the implementation of a variety of non-lethal scaring measures (reinforced by lethal control) is essential to try to deter cormorants while the fishery is unoccupied. This applies to all wildlife management, not only cormorants. Required levels of deterrent measures will be assessed on case-by-case basis. However, protecting fisheries adequately is always likely to require considerable effort, whether this is through shooting to scare or other measures. A licence is not intended to remove all or most of the cormorants from a site, and it does not provide an instant 'fix' to a cormorant predation problem.

Efficacy of measures

Perception: In all cases where licences had been granted it was felt shooting to kill to aid scaring was the most effective deterrent measure for other birds and kept them away for longer periods than other scaring tactics. Exactly how long varied between waters

Natural England position: The aim of the majority of licences is to reinforce scaring, and, hence, to provide part of a suite of measures that will effectively deter cormorants. There will be variations in the effectiveness depending upon site specifics, and the other measures that are being used in conjunction with licensed shooting.

5.2.5.3. Key messages

- Natural England's Customer Feedback Questionnaire responses from 175 applicants for cormorant licences in 2011/12 show a positive view of the licensing process, including the ease of contacting Natural England and completing the application form.

- The eight Angling Trust case studies surveyed highlighted a number of concerns about the current licensing system. These included: perceptions at grass roots level that 'the system/government' were difficult to engage with; that parts of the application form were unclear/inappropriate; that licences allowed too few birds to be shot and were insufficiently flexible (e.g. in terms of birds allowed per month); that it was unclear (on serious damage grounds) why a small number of licence applications had been rejected; and that there were substantial practical difficulties in implementing scaring regimes.

- A number of these perceptions are inaccurate, for example: Requests for a change in the number of birds licensed can be made without jeopardising the licence, and can be done so by telephone; Monthly limits are flexible, and revised internal NE guidance makes this clearer.

- The Review Group highlighted that licences should not be seen as an instant ‘fix’ to a particular problem nor the absence of a licence as an impediment to non-lethal action, assuming there was a short delay between a problem arising and a licence being issued. Fishery owners had a range of deterrent options open to them (including shooting to scare) which could commonly be employed at the outset of any problem emerging. Indeed, it was recommended good practice to address emerging problems robustly and at the earliest possible time to reduce the danger of birds habituating to a particular site as a feeding area. Fishery owners also needed to recognise that protecting fisheries adequately is always likely to require considerable effort, whether this is through licensed shooting, shooting to scare or other management measures.

5.3. Population modelling and conservation status:

- **Current conservation status for three species**
- **Population modelling :**
    - **Modelling for population impacts of control throughout the year**
    - **Modelling for population impacts of control during breeding season**
    - **Modelling for increased and decreased levels of lethal control – e.g. 8%, 12%, 15% and 20% of UK over-wintering population**
- **Review of current management baseline and efficacy of current model**
- **Review of UK population figures (are these accurate?)**

5.3.1. Current conservation status of the three species

5.3.1.1. Key evidence considered

- Data from breeding and wintering counts (including WeBS data used in modelling exercise) / formal assessments of population size provided by BTO.
- BTO report on spatial analysis of effects of licensed control on winter cormorant population changes (Chamberlain *et al*., 2012b).
- Natural England assessment of the proposal of listing cormorants and goosanders on a General or Class licence.
- Information from BTO website[13].
- 'The State of the UK's Birds' (2011 and 2012).

5.3.1.2. Summary

Summary of population data and conservation status of fish-eating bird species

Species/population	GB winter population estimate	UK winter population estimate	Conservation status
Cormorant	35,000 (estimate prior to revised BTO assessment) 24,758 (latest BTO assessment for England only)	41,000	Green
Red-breasted merganser	8,400	9,000	Green
Goosander	12,000	12,000	Green

Table 6 – population data and conservation status of fish-eating bird species (ref. The State of the UK's Birds, 2011).

Cormorants

Cormorants were almost exclusively coastal breeders in the UK until 1981, but they have since established colonies in many inland areas. Inland breeding in England is thought to

[13] http://www.bto.org/

have been initiated by birds of the continental race *P. carbo.sinensis* from Europe, although many nominate *P. carbo. carbo* from coastal colonies in Wales and England have contributed to this development. By 2005, breeding had been recorded at 58 inland sites, and the inland population had risen to about 2,130 pairs. Breeding numbers and productivity at sample colonies have been monitored annually since 1986 by JNCC's Seabird Monitoring Programme. This annual monitoring, which includes inland and coastal breeders, indicates population increase to 1995 and then a shallow decrease, with a temporary increase in the early 2000s. These changes are accompanied by a long-term decrease in breeding productivity. JNCC report[14] an approximate 11% reduction in breeding population of cormorants during the period between 2000 and 2011.

The winter trend in Britain, comprising British and Irish breeding birds and continental visitors, has shown a strong increase since the late 1980s but may now be stable. The latest available population data (for England only) suggest that current wintering numbers (five-year mean2006/07 to 2010/11 = 22,446) are very slightly higher than in the period prior to the previous policy review (five-year mean 2000/01 to 2004/05 =22194). The cormorant is assessed as having favourable conservation status in Europe. In the *State of the UK's Birds 2012* the cormorant is confirmed as green listed. It is ranked as 'green' in the UK under the *Birds of Conservation Concern3 (BoCC3*) categorisation scheme at the species level *P.carbo.* The two races of cormorant occurring in the UK are individually amber listed; for *P.carbo.carbo* this is because the UK holds 20% of the EU breeding population and for *P.carbo.sinensis* this is because the UK holds at least 50% of its breeding population in 10 or fewer sites.

A BTO spatial analysis found no evidence of any difference in site-level population growth between sites that had experienced control measures compared with those where control had never been carried out over the period considered. This analysis also found no evidence that control intensity (level of licensed shooting) affected cormorant numbers in SPAs, However, the study was based mainly on population changes on larger well-monitored wetlands, and less is known about the population, and potential effects of control measures, outwith these sites. Furthermore, the power to detect effects at larger scales was limited in the analysis due to an incomplete control database. Due to the potential for increased movements of cormorants as a result of control activities, both at larger scales and to/from unmonitored sites, these findings do not provide any conclusive evidence as to whether increased control/culling since 2004 has impacted the national population trend. Effects on the population as a whole would be best understood through more detailed survey work at the national-level.

'The State of the UK's Birds 2011' states that: "*The population index for cormorant increased from the mid 1980s to the mid 1990s, boosted by increases at inland colonies (largely of the race sinensis, originating from continental Europe). Numbers have declined since 1995 (with a temporary increase in the mid 2000s). Shooting – licensed and unlicensed – is a probable contributory factor in their recent decline, as well as possible changes in food availability*."

[14] http://jncc.defra.gov.uk/page-3201

Whilst the BTO's analysis found no evidence of effects of cormorant control on site-level population growth, for the reasons outlined above it could not be concluded from these findings whether or not increased control since 2004 has impacted the national population trend. However, it should be noted that the increase in licensed killing of cormorants since 2004 is sufficient to account for the observed decrease in growth rate of the England winter population since that time.

Goosanders

Goosanders first colonised the UK in 1871, spreading from Scotland into northern England in the 1940s and subsequently expanding their range in northern England and colonising Wales and SW England. The species' winter trend in Britain, comprising British breeding birds and continental visitors, rose steeply from the late 1960s to the mid 1990s, but has since fallen back to 1980s levels (~12,000 birds). The State of the UK's Birds 2012 gives the 10-year trend for the UK population as a 31% decline. Breeding numbers are currently estimated between 2,900 and 3,600 pairs and the distribution of this breeding population is concentrated in the north west and west of England, from Cumbria to the West Midlands, with records as far south as Devon. This species breeds on faster flowing rivers. Reasons for the colonisation of the UK, and the subsequent range expansion and population increase, are unknown. The species is assessed as having favourable conservation status in Europe and is ranked as green in the UK under the Birds of Conservation Concern (BoCC) categorisation scheme. Globally it is a species of least concern.

Red-breasted mergansers

The latest estimates of red-breasted merganser numbers in Britain are 2,200 breeding pairs and 9,000 wintering birds. The State of the UK's Birds 2012 gives the 10-year trend for the UK population as a 32% decline. The species is not of concern in Europe and is ranked as green in the UK under the Birds of Conservation Concern (BoCC) categorisation scheme. Globally it is a species of least concern.

5.3.1.3. Key messages

All three species are green listed and are not nationally or globally threatened, they are assessed as having a favourable conservation status in Europe.

There are a number of Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs) in England where cormorants and goosanders are listed as qualifying species.

An analysis by BTO found no evidence that control intensity (level of licensed shooting) affected cormorant numbers in SPAs.

Nevertheless, the study was based mainly on population changes on larger well-monitored wetlands, and less is known about the population, and potential effects of control measures, outwith these sites. Due to the potential for increased movements of cormorants as a result of control activities, both at larger scales and to/from unmonitored

sites, these findings do not provide any conclusive evidence as to whether increased control since 2004 has impacted the national population trend.

Effects on the population as a whole would be best understood through more detailed survey work at the national-level.

5.3.2. Population modelling:

- **Modelling for population impacts of control throughout the year and**
- **Modelling for population impacts of control during breeding season and**
- **Modelling for increased and decreased levels of lethal control – e.g. 8%, 12%, 15% and 20% of UK over-wintering population**

5.3.2.1. Key evidence considered

- Initial Fera paper (Smith *et al*., 2008) on modelling the English cormorant population
- Comments on original Fera model (Green, 2008) and further comments from Professor Rhys Green (RSPB/ University of Cambridge)
- BTO R&D proposals for improving validity of data used in models
- BTO Research Report No.612 - Cormorant population trends with confidence limits (Chamberlain *et al*., 2012a).
- Revised Fera report (Dr Graham Smith) on modelling the English cormorant population
- Fera report (Dr Graham Smith) on modelling licensed culling of the English cormorant population (scenario testing)
- BTO report on spatial analysis of effects of licensed control on winter cormorant population changes (Chamberlain *et al*., 2012b).
- Natural England assessment of the pros and cons of listing cormorants and goosanders on a general or class licence

5.3.2.2. Summary

Background

The previous review of cormorant licensing policy in 2004 increased the number of cormorants that could be shot under licence from about 500 to around 2,000 birds per year (<10% of the estimated wintering population), with up to 3,000 in the first few years. In support of this policy change, Fera (then CSL) were asked to produce a model to assess the consequences of different levels of licensed culling on the cormorant population (Smith *et al*., 2008). The model was based on annual wintering counts of cormorants, from the

WeBS dataset, and information on the numbers of birds shot under licence each year. This model has subsequently been applied each year in late summer/early autumn, once the latest counts and shooting data become available, to inform decisions on the number of cormorants it is permissible to shoot in the forthcoming winter 'season'. This adaptive resource management approach allows the level of licensing to be adjusted in response to any changes in the population, should this be necessary.

The original model attracted some criticism (Green 2008), and it was also noted that there were substantial uncertainties surrounding the reliability of the raising factors used to estimate the wintering cormorant population from the WeBS counts (these counts are only conducted at a proportion of wetland sites and need to be extrapolated to the country as a whole). In the course of the current review, the original model was reviewed and updated, and new, more reliable, approaches were developed for estimating cormorant numbers with levels of uncertainty.

Model developments and adaptive resource management

The reappraisal of the WeBS data by BTO resulted in new time series of estimates of the wintering cormorant population, together with confidence intervals, based on a new methodology for adjusting for the unrepresentative coverage of inland wetlands by WeBS. Data sets were derived separately for England, Wales and various regions and were also computed separately for both inland and coastal sites. The revised estimates proved to be substantially lower than previously published estimates (Jackson *et al*., 2006; Musgrove *et al*., 2011). For example, the revised estimate of the English wintering population in 2002/03 is 21,005 birds compared with estimates from these other sources of about 23,000 and 30,000, respectively, for the same year. The revised estimate of the English wintering population (for 2010/11) is 24,758 birds, with 14,700 of these birds estimated to occur inland. The updated data (the wintering population of birds in England, coastal and inland combined) were used in the revised model to test a range of scenarios. (N.B. it is important to note that the figures shown on page 16 of this evidence summary became available after the modelling scenarios had been run.)

The revised model developed by Fera is a density independent model (the previous model was density dependent). The model makes a number of assumptions: (1) that the proportion of the wintering population (as assessed by WeBS) that arrives from elsewhere (i.e. elsewhere in UK and the continent) is relatively constant each year; (2) that there is no compensatory survival (i.e. killing some birds does not increase the survival of the remaining birds); and (3) no density dependence acts on the population. [If it did occur the population would recover more quickly than the model predicts after a decline]. Two of these assumptions act conservatively, in that the model would predict a greater decline and a slower recovery than reality if the assumptions are wrong. This potential conservative bias is appropriate since it provides an additional, but unknown, level of protection against making poor decisions.

In addition, it should be noted that there is a lag in the model due to the population data taking time to compile (the WeBS-based population estimates are a year behind). Thus, the model does not allow us to respond to the impact of the previous year's lethal control.

In effect, at any given point, the model is ‘seeing the picture’ in terms of the impact of lethal control from two years previously.

Using this model, a range of scenarios – different levels of licensed killing – were simulated over a ten-year period, starting in 2011, to assess the impact on the cormorant population size. These projections of the population include confidence intervals (certainty bands), which increase in size over time, reflecting the growing uncertainty as one projects further forward. The Review Group discussed and agreed a range of appropriate test scenarios during the course of their discussions; these did not adhere strictly to the example percentage reductions specified at the outset (see C (iv) header above).

Projections are made on historical data only and rely on the assumption that nothing will change into the future. It was considered unrealistic to provide predictions (projections that try to account for future change - e.g. how requests for licences respond to population size) due to insufficient information about various underlying factors and the likely extent of any future change. Thus, while the modelled projections provide the best possible assessment, these should be interpreted with some caution and be considered in relation to our best understanding of how things might change.

In brief, the projections indicate:

- With no licensed killing, the population is projected to grow, slowly reaching a size of 29,300 birds by 2020.

- For a stable population to occur (i.e. the mean population size in 2020/21 to be the same as it is in 2011/12), the number of birds killed each year should equal about 870 (fewer than half of the number permitted to be shot under the existing policy).

- Shooting 1,000, 1,500 or 2,000 birds annually all indicate a decline in the mean population size, the decline being faster the more birds are shot. With 2,000 birds shot per year (the number permitted under the existing policy), the projections indicate a small chance that the population could decline to zero.

As projections at and above 2,000 birds shot per annum indicated a chance of extinction, two alternative projections were derived. The first assumed no change in shooting level and the second assumed a complete cessation of killing once the population fell below a certain threshold level. For this purpose, an arbitrary threshold was set at the winter population size in 1988 (15,230 birds). However, due to the time lag in actually detecting the point the threshold was reached, the cessation in killing would not come into effect until two years later.

- At 2,000 birds killed per year, the population is projected to fall below the threshold in 2015. A complete cessation of killing in 2017 leads to an immediate increase in population growth, although the population remains below the threshold until 2020 (the end of the projection).

- With 3,000 birds killed per year there is about a 75% chance of the simulated population being eradicated by 2020. A complete cessation of killing in 2015 leads to a slow increase in population growth.

- With 4,000 birds killed per year there is about a 95% chance of the simulated population being eradicated by 2020. By the time the threshold level is detected and killing discontinued, there is still about a 25% chance that the modelled population would be eradicated.

- If 7,000 birds are killed for three years (2011-2013) or 5,000 or more birds are killed each year for four years (2011-2014), then the median (most likely) population outcome by 2020 is eradication, even if no further killing occurs. If 7,000 birds were killed per year, there is a 61% chance that the modelled population would be eradicated by the time the threshold level was detected and killing was discontinued.

In reality, where the model projects population eradication, this is likely a worst case scenario. A number of factors are likely to act to reduce the likelihood of this occurring in practice: (1) the demand for killing birds around inland fisheries will decline in some manner with the decreasing population; (2) it will get progressively harder to shoot the remaining birds requiring more effort, which is unlikely to be forthcoming; and (3) no account has been taken of immigration, which might increase as the English population declines. However, it is not known to what extent these factors will apply, or at what level of reduction they might come into effect.

Estimates of breeding bird numbers are more difficult since many birds return to coastal areas and offshore islands, thereby making them difficult to count. Estimates of breeding birds are thus only derived on an intermittent basis, roughly every five years. The Review Group noted that it was therefore not possible to model the population impacts of control during the breeding season.

Natural England appraisal of alternative licensing approaches

Independent from the modelling, Natural England completed an assessment of the arguments for and against regulating the control of cormorants and goosanders under a General or Class Licence (as opposed to individual, site specific licences as at present). In general terms, regulatory controls are greatest for individual licences and least for general licences, with class licences intermediate.

The NE assessment concluded that the addition of cormorants and goosanders to the general licence would likely result in a substantial increase in the numbers of both species killed in England compared with current control levels, and that higher levels of control had the potential to reduce the national populations of both species by an amount that it was difficult to predict.

On the basis of their assessment, NE recommended that the use of a general licence would be unsuitable for regulating the control of either cormorants or goosanders, and that

a class licence would be unsuitable for goosanders. NE further recommended that a class licence had some potential as a means of regulating cormorants, but that the terms and conditions, and the level of associated compliance checking, required would be complex, potentially onerous and not without risk. On balance, NE considered that a class licence would offer little advantage over the current approach of assessing individual applications for cormorants.

BTO analyses of cormorant population data and licensed shooting

BTO completed an analysis of the effects of licensed control on wintering cormorant populations. Specifically, they looked at changes over a finer spatial scale (measured as site-level population growth) to determine: (i) the extent to which licensed shooting affected site-level population changes and whether any such effects varied at different levels of shooting intensity, and (ii) whether effects of licensed shooting were evident on populations of cormorants at Special Protection Areas (SPAs).

The results of the BTO analysis found no evidence of any difference in site-level population growth between sites that had experienced control measures compared with those where control had never been carried out over the period considered. There was also no evidence that control intensity affected cormorant numbers in SPAs.

5.3.2.3. Key messages

- The results of the BTO analysis found no evidence of any difference in site-level population growth between sites that had experienced control measures compared with those where control had never been carried out over the period considered. There was also no evidence that control intensity affected cormorant numbers in SPAs.

- Nevertheless, the study was based mainly on population changes on larger well-monitored wetlands, and less is known about the population, and potential effects of control measures, out with these sites. Due to the potential for increased movements of cormorants as a result of control activities, both at larger scales and to/from unmonitored sites, these findings do not provide any conclusive evidence as to whether increased Control since 2004 has impacted the national population trend.

- Effects on the population as a whole would be best understood through more detailed survey work at the national-level.

- The model is regarded as a particularly valuable tool for helping to establish appropriate levels for licensed shooting. It is recognised that the model produces comparatively precautionary assessments.

- Available data do not allow modelling of the impacts of control during the breeding season on the cormorant breeding population; this remains an evidence gap.

- The development of improved WeBS methodology has led to revised estimates of the wintering cormorant population in England. These values are around 20% lower than previous published estimates (see Section 5.3.4.). The latest estimate of the English wintering population (2009/10) is a little over 21,000 birds, with c.13,000 occurring inland.

- Model projections of shooting during the autumn/winter indicate increasing risks of long-term detriment to the wintering population as more birds are killed. If 3,000 or more birds are killed each year the model predicts there is a high probability of population eradication by 2020. Such a level of control is unlikely to be compatible with the requirement to maintain the conservation status of the cormorant population.

- There is a clear need for ongoing short term evaluation of the impact of licensed shooting, as dictated by the principals of adaptive resource management. This will enable licensing decisions to be informed by changes in the size of the wintering population.

- It remains vital that a reasonable balance is struck between protecting fisheries without posing a serious risk to the conservation status of the cormorant population. Based on recent experience, a level of licensed shooting at around existing levels (~2,000 birds per year) is unlikely to result in a significant decline in the cormorant population but will continue to offer protection for inland fisheries. While noting the projections undertaken for this review suggests that a significant decline could occur within 5 years if this existing level of control is maintained, it is important to note such a decline would only occur without any intervention based upon the annual modelling undertaken. With the adaptive resource management in place any significant decline would result in a revision to the level of lethal control to address the decline and allow populations to recover. Certainly there is no evidence based upon historical data that the existing level of control is causing a significant decline. A more precautionary approach based upon the projections alone, if the objective was to maintain the cormorant population at current levels, would be to allow on average ~870 birds per year to be controlled. It seems likely however that this would result in increased levels of serious damage to inland fisheries unless effective alternatives to lethal control could be developed.

- Licensing levels should continue to incorporate local considerations, for example, the numbers of birds already licensed to be shot in a particular area, information on regional bird numbers and the proximity of sensitive areas such as SPAs. Natural England do not consider that a general licence would be suitable for regulating the control of either cormorants or goosanders, or that a class licence would be suitable for goosanders. NE further consider that a class licence would offer little advantage over the current approach of assessing individual applications for cormorants. The principal short-coming of these approaches is that they could not easily deliver the level of control over the scale of shooting that the analysis (see above) suggests is required.

5.3.3. Review of current management baseline and efficacy of current model

5.3.3.1. Key evidence considered

- Initial Fera paper (Smith *et al*., 2008) on modelling the English cormorant population
- Comments on original Fera model (Green, 2008) and further comments from Professor Rhys Green (RSPB/University of Cambridge)
- BTO Research Report No.612 - Cormorant population trends with confidence limits (Chamberlain *et al*., 2012a).
- Revised Fera report (Dr Graham Smith) on modelling the English cormorant population
- Fera report (Dr Graham Smith) on modelling licensed culling of the English cormorant population (scenario testing)
- BTO report on spatial analysis of effects of licensed control on winter cormorant population changes (Chamberlain *et al*., 2012b).
- Natural England assessment of the pros and cons of listing cormorants and goosanders on a general or class licence

5.3.3.2. Summary

Each year, Natural England currently set a maximum upper limit on the number of birds that may be killed under licence. A modelling approach is used to predict the impact of different licensed shooting levels and this (along with other factors) informs Natural England's decision. Part of the decision-making process has involved setting a baseline reference level for the cormorant population around which NE aim to manage the population. For this purpose, NE currently use a national reference level set at the average English winter cormorant population size over the period 1996 – 2000 (about 24,000 birds, based on the previous winter population counts). They then aim to adjust the level of annual licensing so that the population maintains a five-year average equal to or greater than this reference level.

In addition to the national reference level, NE also take account of local sources of information on bird populations (e.g. at a catchment or county level) in reaching licensing decisions. In this way, NE can guard against the risk of particularly high levels of shooting in particular regions.

The national population baseline reference level adopted by NE for management purposes is an arbitrary figure. In effect, this has been adopted as a level considered being be

broadly consistent with maintaining the conservation status of the birds. In practice, there is no recognised population level at which the species conservation status can be considered 'favourable', and the reference level could be set to any agreed value. It should be recognised, however, that the lower the reference level is set, the greater the risk to the population associated with licensed control. A substantially lower reference level would increase the risk of long-term detriment to the population and also increase management uncertainty (likely requiring large adjustments or complete cessation of licensed shooting). While noting its arbitrary nature, the Review Group recognised that the current methodology for setting the baseline and assessing the level of permissible lethal control seemed to have provided a reasonable balance between protecting fisheries and ensuring the conservation status of cormorants remains favourable since it had been introduced.

The rationale for setting the licensing thresholds is set out in the 'Reasoning behind the upper limit set for the numbers of cormorants that may be shot under licence' document on the Natural England website (http://www.naturalengland.org.uk/ourwork/regulation/wildlife/species/fisheatingbirds.aspx).

The threshold is set to satisfy two key policy objectives established by Defra, i.e. 1) licensed killing should not irreversibly affect the conservation status, and 2) the upper limit should only deviate from 2,000 birds p.a. if there is clear evidence justifying a change.

Annual licensing levels are adjusted so that the population maintains a five-year average equal or greater to the reference threshold level (over-winter average for the period 1996-2000). If the population increases to a level similar to or greater than the peak observed in 2003, then the higher (3,000 birds per year) threshold may be permitted.

The modelling exercise reported in Sections 5.3.2. was designed to test a range of scenarios and was not intended to operate around any specific baseline reference level or to evaluate the risks associated with managing around different baseline levels. However, as noted above, the scenario testing did utilise a threshold level at which all licensed shooting was stopped, and to allow projections to determine if the population was able to recover. This threshold was also set arbitrarily and, for this purpose, the winter population figure for 1988 (~15,000 birds) was used.

5.3.3.3. Key messages

The Review Group recognised that the current population baseline used for management purposes and for setting levels of licensed shooting was arbitrary. The Group further recognised that this figure could be changed, but that reducing the level would increase uncertainty and levels of risk. This, in turn, could make management more difficult (e.g. requiring large adjustments or complete cessation of licensed shooting) in response to the annual assessment cycle.

On balance, the Group felt that the current baseline population used in NE's annual assessment of lethal control was reasonable, and it noted this would now be lower than previous (as a consequence of the changes to the population estimates) at around 20,150 birds. The Group also considered that the existing flexibility to adapt licensing levels in

response to changing population levels should be retained (as noted in paragraph 6 above).

5.3.4. Review of UK population figures

5.3.4.1. Key evidence considered

- BTO Research Report No. 612 - Production of Representative Cormorant Population Trends with Confidence Limits (Chamberlain *et al*., 2012a)
- JNCC cormorant breeding data[15]

5.3.4.2. Summary

The Wetland Bird Survey (WeBS) produces annual estimates and population trends for around 70 species of waterbird, including cormorants. These data are used in the Fera model and to inform the annual NE licensing decisions. Two improvements were identified that would enhance the robustness and value of these critical data: (1) revising the methodology for scaling up available counts to the population as a whole (i.e. adjusting for the current unrepresentative coverage of wetland sites where counting occurs) to provide an authoritative time series of estimates of the wintering cormorant population together with confidence limits, and (2) to provide a separate time series from inland sites only. These issues were addressed in a report from BTO.

New statistical approaches were developed by BTO to derive more representative annual population estimates of both coastal and inland cormorants from available WeBS count data, and these were used to provide revised time series of wintering cormorant numbers for England and Wales. The English data were further sub-divided into seven regions: NE, NW, Midlands, East Anglia, London, SE and SW. It is understood that the revised methodology is to be written up for publication in a peer-reviewed scientific journal and will likely be applicable to a range of waterbird species.

The Review Group welcomed the revised estimates, and noted that these were substantially lower than the figures previously available. For example, the revised estimate for 2009/10 indicates the English population (inland and coastal combined) was around 21k birds - approximately 20% less than the previous estimate (about 25k birds). It was agreed, however, that the modelling and scenario testing (and future licensing decisions) should be based on the best available time series, and that the revised data set should now be regarded as the best data to use. The scenario testing was therefore run using the revised time series for England only (inland and coastal combined) from 1988/89.

The revised BTO estimates indicated that a higher proportion of the English wintering population were recorded at inland sites (range 9,754 to 15,726 over the available time period) than at coastal sites (range 5,476 to 9,457). The overall pattern (inland and coastal combined) showed an increase from 1988/89 to 2003/04 with a levelling off thereafter.

[15] http://jncc.defra.gov.uk/page-3201

English regional trends were broadly similar, although there appeared to have been a marked decline in birds in the London area since 2005.

Further details on the current status of cormorants, goosanders and red-breasted mergansers are provided in Section 5.3.1.

5.3.4.3. Key messages

- Revised time series of wintering cormorant numbers were derived by the BTO using improved methodology. This has resulted in a lower estimate – i.e. there are fewer cormorants in England than previously thought. These data were accepted by the Review Group as the best available and were utilised in the Fera modelling/scenario testing (see Sections 5.3.2.).

- The Review Group also recognised that the revised data should be used as the basis for future modelling to underpin annual licensing decisions. Assuming a similar baseline reference level is used, as outlined in Section 5.3.3., i.e. an average of the English wintering population for the five-year period 1996 to 2000, then this will currently equate to 20,134 birds. If similar protocols are adopted for future policy, then the aim will be to adjust annual licensing levels so that the population maintains a five-year average equal to or greater than this level.

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In addition to the above published references, the Review Group considered:

- Case studies submitted by the Angling Trust
- NE's response to the Angling Trust case studies
- RSPB response to the Angling Trust case studies
- Licensing data for lethal control provided by NE
- Natural England assessment of the proposal for listing cormorants and goosanders on a General or Class licence.
- NE's Analysis of customer feedback questionnaires
- Angling Trust's "Cormorant Watch"
- Information gathered during site visits
- INTERCAFE Cormorant management Toolbox
- Defra Policy Guidance
- EU Commission Guidance on Article 9 at: https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp?FormPrincipal:_idcl=FormPrincipal:_id3&FormPrincipal_SUBMIT=1&id=adb9185b-c22c-4642-a12a-8b92dbe2dac8&javax.faces.ViewState=rO0ABXVyABNbTGphdmEubGFuZy5PYmplY3Q7kM5YnxBzKWwCAAB4cAAAAAN0AAE0cHQAKy9qc3AvZXh0ZW5zaW9uL3dhaS9uYXZpZ2F0aW9uL2NvbnRhaW5lci5qc3A=
- Data derived from CEFAS carcass analysis of birds shot under licence, including diet analysis of birds shot late in the season
- Cefas review of cormorant management approaches in other European countries
- BTO R&D proposals for improving validity of data used in models