Gone fishing

Above the surface, the diving cormorant seems hawk-like in its ability to locate and strike its prey. Below water is a different story, says **Graham Martin**.

When a cormorant dives and grabs its prey it is a moving blur of twists, turns and rapid lunges. But are cormorants bludgeoning and indiscriminate predators or wily hunters? Our recent research suggests the latter: the cormorant is a supreme fisher with a particular technique that is governed by what it can, and cannot, see.

More than 100 species of birds dive for fish. But surprisingly little is known about how they detect and catch their prey. While we could have chosen any of these species, we chose to work on great cormorants since they are known to forage in all kinds of water – from murky rivers, lakes and estuaries to crystal clear coastal waters. Great cormorants also have a worldwide distribution with populations found from equatorial waters to within the Arctic Circle.

Cormorants are victims of their own success. Populations on inland waters across Europe have increased significantly recently. But many UK anglers want them dead. Or at least they see cormorants as unwelcome competition and want the right to shoot them.

The UK government now issues permits to cull the bird. But in other parts of the world their efficiency has been put to good use. In China and Japan cormorants are cherished as pets and trained to catch fish for the pot.

At the start of our investigation we saw cormorants as the underwater equivalent of hawks, seeing prey at a distance and hunting it down at high speed through the water column. This analogy with hawks requires the cormorants to have excellent vision.

Our research now shows that the cormorant's underwater vision is poor – it is no better than a diver without a face mask. It can detect prey only at close quarters. So, in murky waters do cormorants rely on their vision or another sense?

So just what makes cormorants such good predators?

Great cormorant in breeding plumage.

Cormorant about to enter the purpose-built tank.

GREAT CORMORANTS

Breeding pairs in the UK: **8355**

Wintering in the UK: **23,000**

Source: British Trust for Ornithology
www.bto.org/birdfacts/index.htm

Cormorant colony

We hand-raised a colony of cormorants from three weeks old. With training, our birds could soon work on various tasks in a large purpose-built tank housed adjacent to their aviary.

Our main findings hinge upon an extensive series of experiments – 20,000 trials – where we investigated the visual acuity of cormorants under water. To do this the birds learnt to swim through an underwater T-maze and chose between pairs of vertically and horizontally striped grids. By making the correct choice the birds received the reward of a fish; the incorrect choice led to disappointment.

The birds readily mastered the task and by changing the width of the stripes and doing many trials, we were able to work out the narrowest stripe widths that the birds could reliably see at a particular viewing distance. We then used this to characterise their visual acuity which could be compared with similar data for other species, including ourselves.

We'd reckoned that these birds' vision would be well adapted to moving between air and water, and they would see well under water. But the trials, where we varied light levels, viewing distances and the contrast of the striped patterns presented to the birds, painted a different picture: the under water vision of cormorants is poor and markedly inferior to that of aerial predatory birds.

Bird's-eye view

We created a 'cormorant's-eye view'. Through this we showed that cormorants can see only large fish if there is a big contrast with the background. And they can see these only at close range. Smaller or cryptically coloured fish of the kind often eaten by cormorants are virtually undetectable under many natural viewing conditions.

In short, cormorants under water can see little detail, even when the water is crystal clear.

So just what makes cormorants such good predators? They can feed successfully in the cloudy waters of estuaries and lakes and even at night.

We conclude that cormorants detect prey only at close quarters probably flushing it from hiding places among reefs, tree roots or from the bottom, and then grab the prey at short range as it tries to escape. In effect we believe that for much of the time cormorants are lunging at an escaping blur, and our observations suggest that to do this they extend their S-shaped neck very rapidly, much in the same way that herons do when grabbing prey.

This also raises the question of how they might know where to forage in the first place? It seems likely that they may have to sample many sites to see if prey is easily disturbed or they may rely upon the sight of other foraging cormorants as a cue to likely concentrations of prey. But overall it seems that it could be very much trial and error; dive down, see if anything is disturbed, if this doesn't happen in a short time move on to somewhere else. Of course, if they hit a rich site, the birds will return for further foraging bouts.

An additional twist is that this poor visual resolution suggests that cormorants may frequently have no idea what they are grabbing. There is, of course, a good chance that anything that tries to make a rapid escape when disturbed is likely to be edible. But, we know that cormorants bring prey to the surface before swallowing. This may in part help to identify it. We investigated the visual fields and eye movements of great cormorants to test this idea. It seems that their eyes have important features to help capture escaping prey and identify it at the surface.

A roving eye

Unlike many birds, cormorants have highly mobile eyes: each eye can swivel independently. These allow two things; first, the eyes can move to rapidly scan the area around the head with each eye looking in a different direction. Second, these eye movements allow a bird to bring both eyes forward and see between its bill – they can inspect what they've caught.

Such eye movements and the ability to see between the open bill are rare. So far, they've been reported only in birds such as herons and hornbills which also feed by grabbing escaping prey at short range.

So it looks as though cormorant vision may share some features with quite unrelated species and that these features could have evolved to overcome problems that are common to their foraging techniques, albeit that herons operate in air while cormorants do it under water.

We are full of admiration for great cormorants. Natural selection has compensated for their poor underwater vision with an artful fishing technique. Our overall conclusion is that cormorant foraging is far more complex than previously thought. The next stage is to find out just how good cormorants are at using vision to detect movement since this is likely to provide the ultimate limit on their foraging efficiency. ❖

MORE INFORMATION

Vision and foraging in cormorants: more like herons than hawks? PLoS 2007 ONE 2(7):e639. doi:10.1371/journal.pone.0000639

Vision and the foraging technique of great cormorants *Phalacrocorax carbo*: pursuit or flush-foraging? 2008 Ibis 150: 485-494

Behavioural strategies of predation in cormorants Phalacrocoracidae. *Ibis*, 2008, *in press.*

Professor Graham Martin is a researcher at the Centre for Ornithology, School of Biosciences, University of Birmingham.
Email: g.r.martin@bham.ac.uk