I & Vision Research Centre

Virus Iris and Uveitis

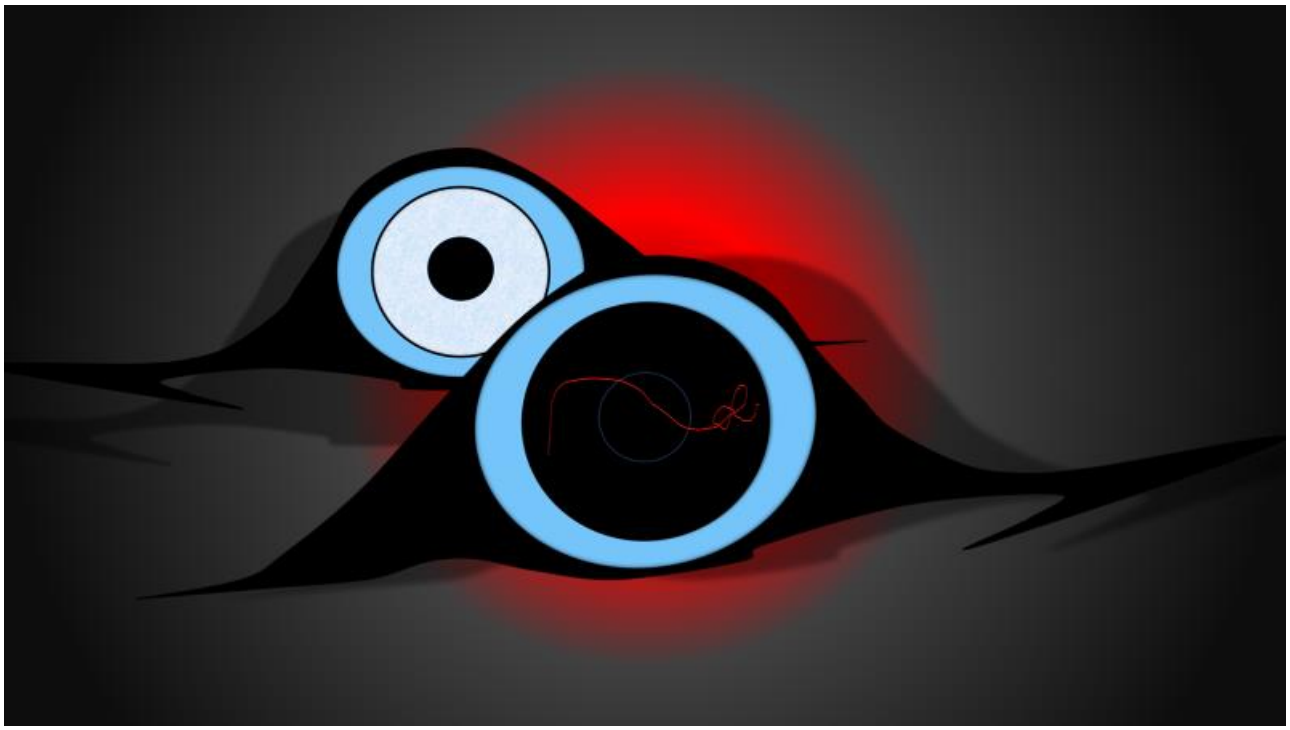

Image: Northern Gannet iris change from Avian Flu, a Filovirus, and considering Uveitis

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This month, a study on Highly Pathogenic Avian Influenza (HPAI) at Bass Rock, Scotland, revealed that the irises of surviving gannet turn black, and even mottled black, after infection. Black irises in gannets were first noticed shortly after the 2022 outbreak in Iceland, which spread to other avian species and regions and quickly became the worst outbreak in European history, with around 50 million domestic farmbirds culled. Seabirds were also impacted, but the full extent of damage to colonies will only be made clear during 2023s ongoing breeding season. Even in 2022, the Bass Rock colony was described by the BBC (2022) as 'decimated', with empty patches in place of nesting sites.

The scientists hope to use easily observable iris colour as a non-invasive diagnostic to understand how HPAI affects vision post-recovery, and what it means for immunity. As of yet, they don't know whether the iris colour change is seen in other birds, or why it occurs in Northern Gannets, or why it occurred once before in Northern Gannets in 1922. Ophthalmology exams are the next step, which are, incidentally, also recommended if you happen to notice any changes in your own eye colour. Reasons may be harmless, like eye freckles from sun exposure, or darkening after prescribed medication. However, injury and disease may be responsible with heightened risk of glaucoma from some of the implicated conditions (Rauch, 2023).

It would also be interesting to see the effects on mate selection and other behaviours if the birds are influenced by the new assortment of iris colours. Further consequences may result if they are adversely affected in terms of their eyesight or neurological function.

There's another infamous and highly pathogenic virus that collects in immune-privileged sites like the eye, sometimes changing iris colour and affecting ocular health: Ebola. In 2014s West African outbreak, an American doctor found out that Ebola Zaire viral replication was occurring at massive scale in his eye several weeks post-recovery. His left eye, quite famously, had changed colour from blue to green and lost a great deal of sight as this happened (Loftus, 2015).

According to Walker (2015), his symptoms of pain, blurred vision, and photophobia were initially suspected to be due to ocular toxoplasmosis, from *toxoplamosis gondii*. Aside from changing eye colour via anterior uveitis (iritis), this is a parasite which makes infected wolves 46x more likely to leave the group and become a pack leader, and is known to raise appetites for risk-taking in several species (Meyer *et al.* 2022). Although fascinating, a cultural sensation and internet clickbait-y, the suspicion of toxoplasmosis by doctors Shantha and Yeh does not appear in any other documents or interviews (e.g. Roach, 2015). Further tests revealed acute panuveitis, and that fluid from his aqueous humour had a high concentration of viable Ebola virus, although blood and later fluid tests were negative. Even more testing revealed that tears were also absent virus.

Eyeballs are viral reservoirs and immunological blindspots for a variety of reasons – also making them excellent candidates for tissue transplants (Niederkorn, 2019). This is explained in a later study (Todd *et al.* 2022), where retinal pigment epithelial cells were found to be substantially more susceptible than ocular pigment (iris) cells to Ebola, partially due to their phogacytic nature. As they release virus at substantially higher titers, this has implications for retinal inflammation and disease.

For the thousands of survivors of Ebola in Africa, one of the common complications (range of 10-33%) is uveitis. Uveitis occurs when the middle layer of the eyeball becomes inflammed. This may occur after injury, while fighting an infection like shingles or Lyme disease, or in step with systemic inflammation like IBD and arthritis (Boyd, 2022; Prevent Blindness). It can be at the front of the eye (anterior), middle (intermediate), or back (posterior), or all over in the case of panuveitis. The latter three, where they become recurrent or chronic, are likelier to cause blindness.

Another viral haemorrhagic fever, Lassa, that infects hundreds of thousands and kills approximately 5,000 people annually, was recently evaluated in terms of impact on ocular disease and visual impairment in 31 survivors, x2 for eyes. In the preliminary investigation for Lassa, there was an absence of anterior uveitis, with manifestation of cataracts and conjunctivitis. Blindness – just 3 cases – were attributed to cataract and glaucoma (Li *et al.* 2020).

In post-Ebola syndrome, perhaps 40% of uveitis cases resulted in blindness, with anterior uveitis noted (Shantha, Crozier & Yeh, 2017). The reductions in visual clarity, presence of macular scars, and reduction in colour vision (Eghrari *et al.* 2021) negatively impacts quality of life, mental health, and economic opportunity for survivors (Yasmin, 2016).

The high lethality filovirus was first microscoped and photographed in October of 1976, after the first and frankly nightmarish outbreak in Zaire with 88% of cases fatal (Breman *et al.* 2016). The type and severity of haemorrhagic fever had not been seen before in humans, although incidence in lab monkeys in Marburg, Germany was flagged by the CDC in 1967. Yellow fever and malaria which were endemic to the region were the original suspects, and do have some overlap of symptoms.

We've been at war with viruses, other species, hominids, and of course ourselves, for a very long time. Many things have changed in our disease avoidance, detection, and survival strategies, such as our ability to adapt with tools, chemicals, medication, make-up, photo filters, and knowledge-based behaviour. The challenge we face now is one of compromised immunity, inflammation, animal farming, and density & proximity that increases risks from a global

cornucopia of mutating pathogens. Jumping across species, which Ebola is believed to have done from bats to humans, or from domesticated to wild birds in the case of 2022 HPAI, is an uncertainty. This unpredictability complicates our ability to prepare and properly evaluate the different tactics and targets worth investing in.

Moving forward: Methods to test for the continued presence of dangerous viruses in specific organs and tissues of survivors may involve ocular imaging and sampling technology – the less invasive and more precise the better. Detection is one aspect, but what this actually means for response policy, immunity, severity, treatment, tolerance, and transmission would be more meaningful contributions. Beyond that, refining and timing treatment scope and approach will hopefully mitigate post-infection syndromes including ocular disease and blindness. Lastly, delivering equipment, local medical and community training & education, and other resources to teams and territories on the frontline are crucial and could mitgate impact on human populations around the world (Shantha and Yeh, 2023).

Let's not forget the seabirds either. At least 50,000 wild birds are thought to have died from H5N1 since October 2021, and this is a count from the United Kingdom only. There is hope that mortality rates are declining and the virus has burned itself out, but nevertheless, the huge and likely underestimated figure includes a portion of 55% of the world's Northern Gannet population, which happens to live in the UK (Colley, 2023).

Gannets are known for monogamy, reuniting with their mates for each year's laying of a single egg. While the long-lived birds typically find another mate after one dies, a mass adult death incident, especially if sex ratios are affected, may substantially affect breeding and behaviour. You can peek at this year's Bass Rock birds through this livefeed: https://www.seabird.org/webcams/bassrock

If you are so moved, you could also adopt one – symbolically and with representative plush. The babies are called 'gugas'.

Disclaimer: *The material presented is for informational and entertainment purposes only, in summary of recent news and events. It neither reflects the views nor constitutes professional advice of the organisation. The major sources used are referenced below.*

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