



FALKLANDS CONSERVATION



Outbreak of Avian Pox Virus in Gentoo Penguins in the Falklands, February 2006.

Collated: Grant Munro

In early February 2006 (7th February) reports of symptoms corresponding to an outbreak of avian pox virus were reported from 2 gentoo colonies at Port Stephens (Indian Village and Ten Shilling Bay) and 1 colony at Port Albemarle, on the southern coastline of West Falkland. Subsequently reports were received of infected colonies on New Island and Beaver Island, with an additional unconfirmed report from Shallow Harbour, all to the south or southwest of West Falkland. In total infection was confirmed at 5 separate colonies.

Port Stephens (Indian Village & Ten Shilling Bay)
Albemarle (limited to 1 colony)
New Island (limited to 1 colony)
Beaver Island (limited to 1 colony)

Two infected birds were collected by Peter & Ann Robertson and picked up by Alex Jones to be flown into Stanley for diagnosis (8th February) Histology samples collected by Falklands Conservation and the Falkland Islands Government Veterinary Department (9th February) were sent to Veterinary Laboratories Agency - Lasswade, UK, for analyses. VLA-Lasswade confirmed that the infection was avian pox virus. A copy of the histology reports are attached in Appendix 1

Infection was only confirmed in gentoo penguins, no other species were recorded as showing symptoms. Magellanic penguins in the vicinity did not show signs of infection. Scavengers such as skuas, gulls and turkey vultures did not show signs of infection. Infection was limited to specific colonies with separate entry points from the water, with at times less than 1.5km between infected and uninfected colonies.

The clinical signs of infection were wart-like lesions predominantly on the un-feathered parts of the skin, notably the face, feet and flippers. Symptoms also include weakness, emaciation, difficulty in swallowing, breathing and vision problems (swollen and clouded eyes often closed with encrustation and warts).

Avian pox is extremely contagious and the impact upon the affected populations will depend upon that populations pre-exposure and hence resistance to the virus. It is probable that original infection was through an infected bird arriving from outside the area and was subsequently spread by direct contact between infected and susceptible birds and indirect contact through contamination of breeding sites through virus containing scabs shed from the lesions of an infected bird. Soil, water, feather debris, air-borne particles and clothing can all become contaminated and act as a vector for infection. Insects are not thought to be a major contributory factor to the spread of the disease in the Falklands.

The long-term impact of the virus on infected populations is not known.

There is no evidence that avian pox virus can infect humans and, therefore, it is not a public health concern. Given the sensitivity of many people, due to the increased awareness of avian influenza worldwide, it is important to stress that avian pox virus is not related to the avian

influenza virus. Whilst humans can act as a vector transmitting the infection on dirty footwear there is no risk of humans catching the virus.

Avian Pox Virus

Avian pox is a mild to severe, slow-developing disease of birds caused by an avi-pox virus. Three common strains have been identified. The 3 strains are fowl pox virus, pigeon pox virus and canary pox virus. The strains vary in their virulence and have the ability to infect other avian species. However, many of the strains are group specific. Approximately 60 species of birds from 20 families have been diagnosed with avian pox including at least two reported cases in penguins, one in Humboldt penguins in a Polish zoo and another in jackass penguins in South Africa. Avian pox virus has also previously been recorded in black-browed albatross in the Falklands. Ian Keymer found similar lesions on black browed albatrosses in 1987 and these were confirmed as being caused by an avian pox virus. Apparently, at that time, the disease was also suspected within the domestic fowl population in the Falklands. The isolate from the black-browed albatrosses was looked at by AHT in Compton and was typed as a member of the “fowl pox” group but was considered to have “diverged “from other viral species in the group.

Avian pox lesions (wart-like growths) occur on the unfeathered parts of the bird's body and, in some cases, the mouth, larynx, and/or trachea.

Transmission of the avian pox virus can occur in a number of ways. The disease can be spread via mechanical vectors, primarily by species of mosquitoes. Transmission occurs when the mosquito feeds on an infected bird that has a viremia (pox virus circulating in the blood) or on virus-laden secretions from a pox lesion and then passes to feed on an uninfected bird. Mosquitoes can carry and transmit the virus for a month or longer after feeding on an infected bird. Experimentally, stable flies have shown the capability of being able to transmit the pox virus. In the Falklands the absence of mosquitoes should limit the transmission of the virus by mechanical means. In the Falklands situation it is not known if mites and fleas may be capable of transferring the virus amongst birds within the colony.

Avian pox can also be transmitted by direct contact between infected and susceptible birds. In this case the virus is transmitted through abraded or broken skin, the conjunctiva (mucous membrane covering the anterior surface of the eyeball) or other mucous membranes. Indirect transmission of the pox virus can also occur via ingestion, when food and water sources are contaminated with virus-containing scabs shed from the lesions of an infected bird. The pox virus is highly resistant to drying and may survive months to years in the dried scabs. Indirect transmission can also occur via inhalation of pox virus infected dander, feather debris and air-borne particles. It is thought that such transfer is most likely in the Falklands where colonies are often densely populated with birds in close proximity. Damp conditions and standing water in the colony can be additional sources of contamination and the strong winds are liable to transfer the virus through contaminated air-borne particles and shed scabs.

Generally mosquitoes are responsible for transmission within local areas (although in the Falklands direct and indirect contact between birds in a colony is the most probable), while wild birds are responsible for outbreaks over greater distances. Clinical signs observed with avian pox are weakness, emaciation, difficulty in swallowing and breathing, vision problems, a reduction in egg production, soiled facial feathers, conjunctivitis, edema of the eyelids and the presence of characteristic wart-like growths on the unfeathered portions of the skin and/or formation of a diphtheritic membrane on the upper portion of the digestive tract.

A presumptive diagnosis of avian pox can be made due to the gross lesions on the body. Confirmation of avian pox is accomplished by microscopic examination.

There is no known treatment for avian pox in wild birds. In captive situations, there are a variety of treatments that have been used along with supportive care to treat the pox lesions and to prevent secondary infections in various avian species. These treatments consist of removing skin lesions and utilizing sodium bicarbonate or Lugol's solution of iodine washes, removing the diphtheritic membrane from the mouth and throat and swabbing the area with Lugol's solution of iodine, bathing the eyes with a 1-2 percent saline solution, and raising the environmental temperature. In all cases, providing assistance for recovery may spread the infection to other parts of the skin or to other birds.

A vaccine against avian pox is commercially available for pigeons (nobivac pigeon pox) however wide scale vaccination is not feasible and it is unknown if there is cross immunity between species or strains.

Avian pox is a highly contagious disease, and 3 forms of control have been used when infected birds are present.

Eliminating standing water will control the primary vector, the mosquito, in areas where this is perceived as a problem.

In captive situations infected birds should be isolated or culled to remove the source of the virus. In wild situations this is not usually feasible and may only be appropriate if a single bird was identified and could be controlled prior to an outbreak occurring.

Again in captive situations feeders, waterers, birdbaths and cages should be decontaminated with a 10 percent bleach solution or a solution of Virkon-S.

Virkon-S is a commercial product that is a proven disinfectant against poxvirus and it is used in hatcheries. It can be used as a foot dip to wipe surfaces and clean water systems and even mist eggs. Virkon-S is made by Dupont and a limited supply is held at the Falkland Islands Government Veterinary Department.

The best form of control in the wild is to prevent spread of a suspected infection. Once a colony is infected there is little that can be done so prevention is better than cure. Soil and vegetation around infected colonies will be contaminated by the virus through the shed scabs of infected birds. Dirt and dust is easily transferred to clothing and boots especially if visitors are close or crouched down. A pair of dirty boots can then transfer the virus from one area and colony to another. There is a real risk that a visitor travelling widely around the islands on a wildlife itinerary could inadvertently spread the virus - leading to a major outbreak island wide. It is important that visitors to a colony that is suspected of having infected birds clean their footwear and clothing after leaving the colony. A 10% bleach solution or Virkon-S are both effective for washing footwear or for use as a footbath on cruise ships. It would be advisable not to visit or move from 1 colony directly to another or if this was done extra attention should be paid to the cleaning of footwear, clothing and equipment such as camera tripod legs, etc. Vehicles if driven close to colonies or across penguin highways could also accidentally spread the virus and it would be best to park at a distance and again to wash vehicles or use a disinfectant spray.

Site Surveys of gentoo penguin colonies and estimates of mortality

The gentoo penguin colonies thought to be affected by avian pox at Albemarle and Port Stephens were visited between 2nd and 3rd of March 2006 by John Cromarty. All dead gentoo penguins were recorded as adults or chicks, although due to scavenging and decomposition this was not always practicable. The colony size was also noted and recorded as numbers of birds present. Due to the lateness of the survey in the breeding season the counting of

breeding pairs was not relevant. Early failed breeders, non-breeders and juveniles could have been present to start the moult and chicks were creching with some beginning to fledge. In addition at this time of year both adults are absent from the colony foraging at the same time to provision the chick. Due to this and the dispersed nature of the birds present accurate population counts were not possible. It is thus difficult to say what the overall effect may have been as it is not possible to relate infection rates to original breeding pairs. In addition it is impossible to quantify how many birds may have died at sea following incubation of the virus contracted ashore, or birds that may not have returned due to poor condition.

To gain a better estimate of the overall effect on breeding adults, counts in the following year should have been performed, although again this could be affected by changes in recruitment.

After leaving each affected area all personal equipment and clothing was decontaminated using a Virkon solution as directed by the Veterinary Department. All blood samples (and associated equipment) were handed over to the Veterinary Department on the 6th March 2006 and other non-medical disposable items used were burnt locally.

Albemarle colony

The Albemarle colony was visited on the 2nd March 2006. The gentoo penguins present at the site were dispersed between the colony area, the beach and in the water (424 adults and 45 young). 27 birds on and around the colony were dead, 6 were still affected (although mobile) whilst 1 was unable to run away. Due to the reported apparent recovery of some infected birds the intention was to collect blood samples from apparently healthy birds and to test for antibodies to show pre-exposure or recovery. Three apparently healthy birds were captured however on capture they showed signs of being infected with avian pox and on close inspection it appeared that most birds in the colony showed some sign of infection. This might suggest recovery in some birds or resistance so that only mild symptoms were manifest. Upon attempting to take blood it was not possible to extract a viable sample with only the single operative present and blood sampling was discontinued due to the risk of undue disturbance.

Albemarle	
Total Number on Site Alive + Dead (Individuals)	496
Number of Live Adult (Individuals)	424
Number of Live Chick (Individuals)	45
Total Number of Mortalities	27
Percentage Mortality of Numbers Present (Alive + Dead)	6 %
Original Breeding Pairs	
Albemarle Airstrip (pairs)	328
Albemarle Point (pairs)	435
Total	763

Port Stephens colonies

The Indian Village colony was visited on the 3rd March 2006. The 1084 gentoo penguins present at the site were dispersed between the colony area and the beach with >50 birds in the water. Some birds (23) were still affected although mobile. A total of 418 dead gentoo penguins were noted between the beach and the colony area. The bulk of these were on the colony breeding areas (282), of which a large proportion of these were chicks. Again 3 blood samples were taken from apparently healthy birds, but on capture they showed signs of being infected with avian pox.

Stephens Peak (Wood Cove) colony was also visited, where 279 gentoo penguins were still present with >500 on the beach and >50 in the water. Despite the close proximity to the

Indian Village colony (1.5km) no birds appeared to be infected. This may well be because they frequent the opposite coastline to the Indian Village colony and therefore the two colonies do not interact. Between the lower slopes and the beach area 20 carcasses were seen (in an advanced state of decomposition). No dead gentoo penguins were recorded on the colony.

Port Stephens – Indian Village	
Total Number on Site Alive & Dead (Individuals)	1552
Number of Live Birds on Land (Individuals)	1084
Number of Live Birds in Water (Individuals)	50
Total Number of Mortalities	418
Percentage Mortality of Numbers Present (Alive + Dead)	27%
Original Breeding Pairs	
Indian Village (Pairs)	1,066

Port Stephens – Wood Cove	
Total Number on Site Alive & Dead (Individuals)	829
Number of Live Birds in Colony (Individuals)	279
Number of Live Birds on Beach (Individuals)	500
Number of Live Birds in Water (Individuals)	50
Total Number of Mortalities	0
Percentage Mortality of Numbers Present (Alive + Dead)	0
Original Breeding Pairs	
Wood Cove (Pairs)	819

Beaver Island

Figures were provided by Sally Poncet. Of approximately 150-200 birds in the colony approx. 50% were infected by the virus but only approx. 10 birds were dead. Birds returning from sea were approx. 60 -70 % infected.

Pre-exposure of birds to Avian Pox in the Falklands

Within resistant populations, mortality associated with avian pox may be only 1-2 %. In susceptible populations mortality may be as high as 50%. It is thus important in determining the potential risk and impact of avian pox in the Falklands to know whether there has been previous exposure of birds to the virus and hence a level of immunity has been acquired.

Generally bird populations in mainland areas have, overtime been exposed to a wide variety of avian diseases and resistance antibodies are present within the population, however on remoter islands such as the Falklands the introduction of exotic diseases can have catastrophic effects. In 2002 veterinarians from the Wildlife Conservation Society (WCS) of New York, took blood samples from black-browed albatross and gentoo penguins and tested for a wide range of avian diseases. It was found that unlike seabird populations on the coasts of South America the Falklands populations had no antibodies and thus no resistance to the majority of the diseases tested for. This means that birds may suffer heavily if or when diseases are introduced. Serious outbreaks have occurred in other sub-Antarctic islands notably avian cholera on Amsterdam Island and South Georgia last year and avian diphtheria in New Zealand.

Our knowledge of pre-exposure to avian pox is limited. In 2002 WCS vets tested for paramyxovirus (Newcastles, Type 2 and Type 3), avian adenovirus, avian reovirus, avian influenza virus, avian laryngotracheitis virus, infectious bronchitis virus, infectious bursal

disease, avian encephalomyelitis, Salmonella pullorum, Chlamydomydia psittaci and Marek's disease. Results for all except avian adenovirus were negative however the test used for avian adenovirus had not been validated for the tested species (gentoo and black-browed albatross) and should be treated with caution. Avian pox virus was not tested for. These tests covered only a small sample and are not be definitive at a population level.

In 1987, following the death of many penguins during the post-breeding moult some samples were taken from a variety of species by Ian Keymer and sent to AHT Compton. A pox-virus was isolated from a black-browed albatross specimen. The lesions were confined to the bird's feet and it was thought by Ian that the infections were acquired because the birds were crowded in one particular rocky area. Apparently at that time it was reported that domestic chickens on the islands also had poxvirus infections. The isolate has been included in a collaborative project with Mike Skinner and Susan Jarman, who until recently worked at the AHT Compton investigating avipoxvirus phylogenetics. It is understood that a paper has been submitted for publication but has not been sighted. The study concluded that the albatross virus belonged to the "Fowlpox" group but was considered to have "diverged" from other viral species in the group. Although penguin isolates have been reported AHT Compton did not include any in the study.

Another outbreak of suspected avian pox occurred on West Point Island in 1962 and was recorded by Robin Woods. It is almost certain from the description that the disease was avian pox and Robin Woods has photographs of at least one infected bird. The following extract is taken from an unpublished report by Robin Woods on the banding activities on West Point Island that was sent to the US Antarctic Research Program, Bird-banding Program in Baltimore.

"Young with diseased legs

When banding on Mt. Misery on 22.2.62 a most disturbing discovery was made. Many young in the ditch and on ledges either side were found to have feet affected by pimple- and wart-like growths. The growths varied in size from a pink pimple about the size of a match-head to a 3/4" wide, 1/2" high blackish wart, split on top and oozing a little blood when touched. The degree of infection varied from birds with only one or two large warts or a sprinkling of pimples, to birds dead on the nest with both legs and feet thickly sprinkled with varying sizes of growths.

A total of c250 birds were found with growths, and of these about 30 were dead on their nests. Infected birds were found in four of the five ditches on Mt. Misery, and in all cases, only those near or below Rockhopper Penguin rookeries were affected. The clean rookery had no Rockhoppers nesting in it. Not all birds in a group near Rockies were affected, for example, a group of c8 isolated from the rest, had c6 affected and 2 quite clean. Most birds affected appeared in perfect health otherwise, although some seemed rather under weight for their size.

A few young birds were seen with large growths similar to the leg growths, on the bill (at gape and halfway along) and one had a large lump at the side of one eye, making it almost blind in that eye.

The cause of this disease, or sign of disease, is of course unknown, but there seems to be some correlation with the presence of running water in ditches, where the worst specimens were consistently found. But the main factor is definitely the proximity or otherwise of Rockhopper Penguin rookeries. This is not as simple as it might appear, because both the West End Hill and Devil's Nose rookeries also have large Rocky colonies, but not a single 'warty' Molly was found at either place. Although West End Hill has the largest Rocky colony on West Point,

neither here nor at Devil's Nose are there streams approaching anywhere near the size of those on Mt. Misery.

It is not known yet how many of the slightly affected birds will die before they are old enough to leave the nests, but R.B. Napier will be checking on them this month and next.

It is to be hoped that the disease does not recur next year or spread to other areas, but the prospect does not appear very good, as dead infected birds will be on the rookery throughout the winter."

It is understood that Roddy Napier managed to send sample material away to the USA but unfortunately it is not possible to find any record of any definitive diagnosis. Certainly the description of the disease and photographs is very convincing and is supported by the positive tests conducted in 1987. The correlation to areas with surface water also fits with possible transmission of the disease by contaminated water that has been reported elsewhere. There is also the suggestion that rockhopper penguins may be connected.

Steve Pointing the chief veterinary officer at the time of the outbreak also reported that avian pox viruses have been present in the Falklands before. During his tenure in the Falklands he observed a few domestic chickens that appeared to have pox like lesions, however the symptoms have been so mild that it has not caused any major problems. Steve suspected that the virus could have been present in the Falklands for quite a period of time and the reason that the outbreak was so bad was that the birds in the affected colonies had not been exposed to the virus previously.

Specific information on the strain of infection and the ability of strains to cross-infect species is not available however it is not unusual. Occurrence in domestic fowl could be transferred to a variety of wild species including penguins and black-browed albatross. Such transfer could occur through gulls or turkey vultures, which might have transferred the virus without themselves being infected (though the death of non-colonial birds or a single bird would be more difficult to detect). Equally an infected penguin from elsewhere, or a scavenging bird could have introduced the disease from further afield. Subsequent to the first colony being infected the spread of the disease to only gentoo colonies suggests infected gentoos spread the disease. Tracking of gentoos, which are predominantly coastal feeders, has shown that they do visit other colonies and this may be especially true if they were to feel weakened at sea by the virus, when they may return to the nearest colony on land. There is no evidence to support the introduction or spread by man once the outbreak commenced and it seems unlikely that the original outbreak was introduced by anthropogenic means. There is no evidence of carrion eaters and scavengers having been infected. It is possible for such scavengers to spread the disease however due to the outbreak only being limited to gentoo penguins and the fact that adjacent colonies remained clear it would seem that on this occasion this did not occur.

The virus may remain viable in dried scabs and soil for a number of years and it may be assumed that birds recruiting into the breeding population for the first time or non-breeders that were not present in the colony would be susceptible to re-infection. However, there have been no reports of new infections this year. Birds exposed last year should be resistant and it may be that the disease is self-limiting with infected birds rapidly dying so that spread is limited. A worry over the winter period when gentoos tend to disperse more widely and visit colonies distant from their normal breeding sites was that infected birds could spread the virus outside the restricted area of West Falkland where the outbreak had occurred. Again this appears not to have happened. It may be that as the outbreaks occurred later in the season once chicks had moved out the colony area and were more dispersed and ambient temperatures were lower that this could have limited the spread of the disease by direct contact within a densely packed colony.

Assistance and Information Provided By:

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IMPORT LICENCE TAY/2006/105

Report No. 1 FINAL

DESCRIPTION OF SPECIMENS

Formalin fixed avian myocardium, liver, chin, foot, kidney, lung and flipper from adult and young dead and moribund Gentoo penguins.

RESULT OF HISTOLOGICAL EXAMINATION

1. Myocardium x 1

Large numbers of Gram positive bacteria in blood vessels and in capillaries between muscle fibres. There is a light accompanying granulocytic and lymphocytic infiltration.

2. Liver x 1

There are numerous dense focal infiltrations of immature granulocytes. Degenerating bacteria are visible within Kupffer cells and there are increased numbers of granulocytes circulating in the sinusoids. Biliary hyperplasia is also a feature.

3. Chin lesion chick

There is marked hyperplasia and hypertrophy of the squamous epithelium. The surface layers are necrotic and are covered by a plaque of degenerating inflammatory cells containing large numbers of bacteria. Eosinophilically staining intracytoplasmic inclusion bodies are visible within degenerating epithelial cells. Feather follicles in the surrounding dermis are inflamed.

4. Lesion from a chick foot

As above, there is marked hyperplasia and hypertrophy of the squamous epithelial cells. A focal area of ulceration is packed with necrotic debris and contains large numbers of bacteria. Eosinophilically staining intracytoplasmic inclusion bodies are visible within degenerating epithelial cells.



5. Kidney x 1

There are multifocal dense infiltrations of immature granulocytes and marked congestion of the intertubular sinusoids. Dense clusters of Gram positive bacteria are visible within reticuloendothelial cells in the interstitium.

6. Liver

Large numbers of Gram positive bacteria are visible trapped within fibrinous microthrombi in sinusoids and in the Kupffer cells. The latter also contain clumps of basophilically staining material (?degenerating bacteria). There is a dense perivascular lymphocytic and granulocytic infiltration.

7. Adult lung

The alveolar macrophages are packed with Gram positive bacteria.

8. Chick kidney

There are dense multifocal infiltrations of immature granulocytes throughout the interstitial tissue.

9. Chick heart

No abnormalities detected.

10. Adult flipper

There is marked hyperplasia and hypertrophy of the squamous epithelium with focal ulceration. The lesion is covered by a layer of fibrinogranulocytic material containing large numbers of Gram positive bacteria. The underlying dermis is acutely inflamed.

COMMENT

The lesions in chin, foot and flipper are all consistent with avian pox infection.

The presence of large numbers of Gram positive bacteria in myocardium, liver and in one of the kidney sections, suggests an overwhelming bacteraemia. There are accompanying inflammatory changes in the liver sections and to a lesser extent in the myocardium. The dense infiltrations of immature granulocytes in one of the livers and in the kidney may represent extramedullary granulopoiesis. The appearance of the organisms within Kupffer cells and other phagocytic cells is typical of erysipelas infection.

The actual portal of entry and the pathogenesis of erysipelas infection in birds has not been definitely established. Entry of the organism through breaks in mucus membranes or skin or oral ingestion of infected material have all been suggested. While erysipelas is reported in a wide range of avian species and in marine and freshwater fish, it appears to be rare in penguins.

Signed: *Grace Mackenzie* PhD BVMS MRCVS
GRACE MACKENZIE

28/3/2006

Distribution: Dept of Agriculture (E-mail/Post)