Habitat loss, nutritional stress, and the decline of the Australasian bittern in Aotearoa New Zealand

By Vanessa Kennard

Photo taken by Vanessa of male bittern at Halswell River, Lake Ellesmere (Canterbury) – November 2023

The Australasian bittern/Matuku-hūrepo (*Botaurus poiciloptilus*) is a native New Zealand species which has recently experienced population declines, thought to be a result of their wetland habitats being degraded. Since the arrival of humans, over 90% of wetlands have been lost and it has been suggested that a loss of prey species could be leading to nutritional stress in the remaining bittern populations. However, there has been no recent research on their diets and whether a lack of prey may be a contributing factor to their population decline. For my PhD research, I used a combination of analyses to assess levels of nutritional stress in bitterns, including ptilochronology, stable isotope analysis, and compound specific isotope analysis (CSIA) on feather samples. To assess whether bitterns are experiencing variability in their diets geographically (between New Zealand regions) and temporally (over time), I analysed feather samples from live birds, nests, and museum study skins (from Auckland, Canterbury and Te Papa Museums) ranging in dates from 1888 to 2024.

Ptilochronology is the measurement of the growth bars along the length of a feather. A single growth bar is grown every 24 hours, and its size is directly related to the nutritional condition of a bird. If a bird is experiencing adequate nutrition, it should have relatively uniform and regular growth bars but if it is under nutritional stress, it will have a mix of larger and smaller growth bars, corresponding to variation on days where there was and was not enough energy to expend on growth and development, respectively. The measurement of the average width and variance of growth bars along the length of a feather can thus indicate whether a bird is consuming a consistent diet or experiencing periods of nutritional stress. Upon measuring the growth bars of bittern feathers, I found contemporary populations of bitterns showed a significant increase in growth bar variability compared to their historical counterparts measured from museum collections. This indicates that contemporary birds are experiencing greater variability in their diets, which is consistent with loss of their wetland environments and changes in their prey availability. Although ptilochronology can provide a useful method to identify whether a bird has experienced variability in their diet, it cannot identify the cause of the variability. This is where stable isotope analysis and CSIA are valuable tools in providing a more direct measure of whether the birds have experienced changes in their diet and therefore trophic position.

Stable isotope analysis of $\delta^{15}N$ and $\delta^{13}C$ was performed on breast feathers collected from bitterns in the Auckland/Northland, Bay of Plenty, Waikato, Canterbury/Marlborough and West Coast regions. It was discovered that bitterns in most regions experienced an increase in $\delta^{15}N$ over time, suggesting contemporary birds may be consuming higher trophic level prey. As levels of $\delta^{15}N$ could also increase due to other causes (e.g., increased levels of agricultural run-off), I then used CSIA and identified most differences in δ15N were not the result of an increased trophic position. Instead, contemporary populations in Bay of Plenty were sitting at an entire lower trophic position than their historical counterparts. This suggests that bitterns within the Bay of Plenty area were experiencing issues with either availability or accessibility of prey, and as a result were relying on lower trophic prey as a food source. Contemporary populations from Auckland/Northland and Waikato regions also had a lower trophic position than their historical counterparts, whereas contemporary birds from the Canterbury region had a slightly higher trophic position than their historical counterparts.

My analyses indicate that contemporary bittern populations are, in general, sitting at a lower tropic position than historical populations, which is likely due to a loss of their prey base. This finding coincides with the population declines and loss of wetland habitats over the past ~100 years. In conclusion, it appears that nutritional stress is likely a contributing factor to bittern decline and the species seems to be struggling to access its traditional prey species. If conservation efforts are to be successful, my study indicates that improvements to availability of prey will be vital to improving the species' future prospects.

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