

BEAK DEFORMITY IN A BROWN-HEADED COWBIRD, WITH NOTES ON CAUSES OF BEAK DEFORMITIES IN BIRDS

David A. Rintoul
Biology Division
Kansas State University
Manhattan KS 66506-4901

At 10:20 hr on 20 June 2004, I removed a male Brown-headed Cowbird (*Molothrus ater*) from a mistnet at the Myersdale Prairie banding station (39.23°N, 96.95° W) on Ft. Riley KS. This banding station is part of the Institute for Bird Populations' Monitoring Avian Productivity and Survivorship (MAPS) program, a constant-effort mistnetting initiative which aims to assess and monitor the vital rates and population dynamics of North American landbirds (Institute for Bird Populations, 2002). Upon removing the bird from the net, I noticed that his beak was not normal. The upper mandible curved down and across the left side of the lower mandible (Figures 1-3).

Based on plumage characteristics (Pyle, 1997), the bird was a second-year male, meaning that he fledged in the summer of 2003. A prominent cloacal protuberance indicated that he was in breeding condition. He weighed 45.8 g; the average weight of male Brown-headed Cowbirds banded from 1993-2004 on Ft. Riley is 45.45 g (n = 40, std. error = 0.751 g, range: 38.4 to 52.9 g). The unflattened wing chord measurement was 105 mm. The average wing chord of male Brown-headed Cowbirds banded from 1993-2004 on Ft. Riley is 107.1 mm (n = 43, std. error = 0.452 mm, range: 98 to 112 mm). All of these parameters indicated that the bird was healthy and capable of feeding, despite having a deformed beak. The bird was banded, released and flew away normally.



Figure 1 – Left lateral view.

Figure 2 – Frontal view of male Brown-headed Cowbird head.

Figure 3 – Right lateral view.

The structure of the beak is important both to the bird (as it is the main foraging tool) and to the birdwatcher (allowing rapid discrimination and classification). Partly because the beak is so obvious and important, beak deformities have been reported for many families and species of birds (Craves 1994). Various classes of beak deformities seem to be more common in some species (e.g. House Sparrows [*Passer domesticus*], European Starling [*Sturnus vulgaris*]) and some families (Icteridae and Mimidae). The frequency of birds with deformed beaks in a population is generally quite low, in the range of 0.05% (Pomeroy, 1962). This makes evolutionary sense, since birds with deformed beaks may not be able to forage efficiently or preen

efficiently (Benkman and Lindholm 1991), and thus would have lower fitness compared to normal-beaked birds in the population. Previous reports of Brown-headed cowbirds with deformed beaks are relatively uncommon. I was able to find only two published reports (Craves 1994, Sharp and Neill 1979) and one unpublished report (D. Ahlers [pers. com.](#)) of beak deformities in this species. The factors that influence the frequency of beak deformities in various species or families are not well understood, and obviously it is impossible to determine the cause(s) of the beak deformity in any individual free-living bird.

The beak, composed primarily of a keratin sheath (rhamphotheca), continues to grow throughout the life of a bird. Growth rates vary with the species; for example, replacement of the entire beak of a large parrot takes approximately 6 months (Gartrell et al. 2003). Growth of the rhamphotheca on the two separate structures that comprise a bird's beak (the upper jawbone or maxilla and the lower jawbone or mandible) must be coordinated in order for the beak to develop to the proper length and morphology. Wouterlood (1976) found that the ultimate size and shape of chicken or duck beaks depend upon the mechanical interrelationship of these two structures, mediated through the contact of the tips of the mandible and maxilla. The morphology of the beak will be changed if mandibular-maxillary contact is experimentally disrupted, causing overgrowth of one or both structures. Thus it follows that processes or events which disrupt this mandibular-maxillary contact can also disrupt normal bill development, perhaps leading to crossed-bill morphology as seen in this Brown-headed Cowbird. Indeed some beak deformities in cage birds (e.g. budgerigars) can be cured by trimming the overgrown mandible or maxilla to the appropriate length, which restores normal contact zones and thus normal growth of the beak (Boussarie 2002). Control of the growth rate of the rhamphotheca are not well understood, but contact between the mandible and maxilla was shown to mutually inhibit growth of the rhamphotheca (Wouterlood 1975). Finally, progress has been made recently in understanding the role of various hormones such as Bone Morphogenetic Protein 4 (BMP4) in controlling beak morphology (Abzhanov et al. 2004, Wu et al. 2004).

A review of available literature indicates three possible causes of beak deformities that have been most commonly proposed. These are: 1) exposure to toxic chemicals in the environment, 2) mutation, and 3) injury. Although it is not possible to assess the specific cause of the beak deformity in this individual cowbird, it is interesting to speculate briefly on these possible etiologies.

Exposure to toxic chemicals has been shown to cause beak deformities in several species of birds. Deformed beaks are more common in populations of birds exposed to known teratogens such as polychlorinated biphenyls (PCBs) and DDT metabolites such as DDE. Fish-eating colonial waterbirds and raptors in the Great Lakes region are known to be exposed to high levels of PCBs and other contaminants (Custer et al. 1999, Fernie et al. 2003, Gilbertson et al. 1991; Kuiken et al. 1999, Ludwig et al. 1995, Ludwig et al. 1996, Ryckman et al. 1998). Hatchlings of some of these species (e.g., Double-crested Cormorant *Phalacrocorax auritus* and Bald Eagle *Haliaeetus leucocephalus*) exhibit multiple symptoms including beak deformities (Gilbertson et al. 1991). The linkage between these developmental effects and PCB exposure is strengthened by the results of experiments in other species such as American Kestrel (*Falco sparverius*); exposure of parental birds to PCBs significantly increased the frequency of developmental abnormalities, including beak deformities, in embryos (Fernie et al. 2003).

Since the beak continues to grow and renew itself throughout the lifetime of a bird, it is of some interest to know if exposure to known teratogens can also cause defects in adult birds. At present this linkage has not been proven, but has been advanced as a possible factor in recent outbreaks of beak deformities in Black-capped Chickadees (*Poecile atricapillus*), American Crows (*Corvus brachyrhynchos*), and more than 20 other bird species in southeast Alaska (Handel 2000). Most of the chickadees reported in this outbreak have upper mandibles that are curved down and across the lower mandible, similar to that seen in the cowbird documented in this report. However, analyses of tissues from these birds did not reveal any obvious accumulation of

toxic chemicals such as DDT metabolites or PCBs.

The second possible cause of beak deformities, mutation of a critical developmental gene, also has some support in the scientific literature. Changes such as albinism and reduced beak height occurred more commonly in Barn Swallows (*Hirundo rustica*) near the radioactively contaminated Chernobyl reactor, compared to Barn Swallows from regions of the Ukraine that were distant from Chernobyl (Muller and Mousseau 2001). Mutation has also been hypothesized to be a cause of the beak deformities seen in the southeastern Alaskan birds (Handel 2000); this hypothesis remains untested. As noted above, recent reports indicate that manipulation of the expression of a single growth factor (Bmp4) can have profound effects on beak development, indicating that mutations in multiple genes may not be required in order to result in a deformity of the beak. These considerations indicate that small changes in expression of a small number of developmentally active genes could result in significant changes in beak morphology. If the genetic change does not result in a beak shape that does not reduce fitness (e.g., will still allow the bird to forage and preen appropriately), it could be retained in the next generation and perhaps even increase in frequency.

Finally, it is clear that injuries or infections can profoundly influence beak development. Gartrell et al. (2003) reported that a bacterial sinus infection was the cause of a beak deformity in an Antipodes Island Parakeet (*Cyanoramphus unicolor*) chick. Trauma has also been reported as a cause of beak deformities in other caged birds (Flammer and Clubb 1994). Given that normal beak development and growth is dependent upon contact between the tips of the mandible and maxilla, it is obvious that injuries to the tip of either the mandible or maxilla could result in a beak deformity. It is possible that the Brown-headed Cowbird reported here had an injury or infection which disrupted normal contact between the mandible and maxilla, resulting in the crossed-bill appearance.

In summary, beak deformities in Brown-headed Cowbirds appear to be quite rare. Beak deformities in other species appear to be increasing in recent years, and observers should be alert for additional examples in order to determine if these increases are apparent or real. Increased understanding of the possible causes of beak deformities will also aid in elucidation of the cause in any specific instance.

– 31 –

LITERATURE CITED

- Abzhanov, A., M. Protas, B. R. Grant, P. R. Grant, and C. J. Tabin. 2004. Bmp4 and morphological variation of beaks in Darwin's finches. *Science* 305(5689):1462-1465.
- Benkman, C. W. and A. K. Lindholm. 1991. The advantages and evolution of a morphological novelty. *Nature* 349:519-520.
- Boussarie D. Anomalies and disorders in beak and feathers. 2002. Proceedings of the Small Animal Veterinary Association 2002 Congress, Granada.
- Craves, J. A. 1994. Passerines with deformed bills. *North American Bird Bander* 19(1):14-18.
- Custer, T. W., C. M. Custer, R. K. Hines, S. Gutreuter, K. L. Stromborg, P. D. Allen, and M. J. Melancon. 1999. Organochlorine contaminants and reproductive success of double-crested cormorants from Green Bay, Wisconsin, USA. *Environmental Toxicology and Chemistry* 18(6):1209-1217.
- Fernie, K., G. Bortolotti, and J. Smits. 2003. Reproductive abnormalities, teratogenicity, and developmental problems in American kestrels (*Falco sparverius*) exposed to polychlorinated biphenyls. *Journal of Toxicology and Environmental Health-Part A* 66(22):2089-2103.
- Flammer, K. and S. Clubb. 1994. Neonatology. In: Ritchie, B., G. Harrison and L. Harrison, Eds. *Avian Medicine: Principles and Applications*. Wingers Publishing. Lake Worth, FL.
- Gartrell, B. D., M. R. Alley, and T. Kelly. 2003. Bacterial sinusitis as a cause of beak deformity

- in an Antipodes Island parakeet (*Cyanoramphus unicolor*). New Zealand Veterinary Journal 51(4):196-198.
- Gilbertson, M., T. Kubiak, J. Ludwig, and G. Fox. 1991. Great-Lakes Embryo Mortality, Edema, and Deformities Syndrome (Glemeds) In Colonial Fish-Eating Birds - Similarity to Chick-Edema Disease. Journal of Toxicology and Environmental Health 33(4):455-520.
- Handel, C. 2000. Deformed Black-capped Chickadees in south-central Alaska.
<http://www.absc.usgs.gov/research/bpif/chickadees.html>.
- Institute for Bird Populations. 2002. Monitoring avian productivity and survivorship (MAPS) program. <http://www.birdpop.org/maps.htm>.
- Kuiken, T., G. A. Fox, and K. L. Danesik. 1999. Bill malformations in double-crested cormorants with low exposure to organochlorines. Environmental Toxicology and Chemistry 18(12):2908-2913.
- Ludwig, J. P., H. J. Auman, D. V. Weseloh, G. A. Fox, J. P. Giesy, and M. E. Ludwig. 1995. Evaluation of the effects of toxic chemicals in Great Lakes Cormorants: Has causality been established? Colonial Waterbirds 18: 60-69.
- Ludwig, J. P., H. Kurita-Matsuba, H. J. Auman, M. E. Ludwig, C. L. Summer, J. P. Giesy, D. E. Tillitt, and P. D. Jones. 1996. Deformities, PCBs, and TCDD-equivalents in double-crested cormorants (*Phalacrocorax auritus*) and Caspian terns (*Hydroprogne caspia*) of the Upper Great Lakes 1986-1991: Testing a cause-effect hypothesis. Journal of Great Lakes Research 22(2): 172-197.
- Muller, A. P. and T. A. Mousseau. 2001. Albinism and phenotype of barn swallows (*Hirundo rustica*) from Chernobyl. Evolution. 55(10):2097-2104.
- Pomeroy, D. E. 1962. Birds with abnormal bills. British Birds 55:49-72.
- Pyle, P. 1997. Identification guide to North American birds: Part I: Columbidae to Ploceidae. Bolinas CA: Slate Creek Press. 732 p.
- Ryckman, D. P., D. V. Weseloh, P. Hamr, G. A. Fox, B. Collins, P. J. Ewins, and R. J. Norstrom. 1998. Spatial and temporal trends in organochlorine contamination and bill deformities in double-crested cormorants (*Phalacrocorax auritus*) from the Canadian Great Lakes. Environmental Monitoring and Assessment 53(1):169-195.
- Sharp, M. S. and R. L. Neill. 1979. Physical deformities in a population of wintering blackbirds. Condor 81:427-430.
- Wouterlood, F. G. 1975. The mutual relations of structures in the growing bill of chick *Gallus domesticus* and duck *Anas platyrhynchos* embryos. Part 1 Normal embryonic growth and growth after excision of the prospective upper or lower bill in terms of external dimensions. Netherlands Journal of Zoology 25(3):353-368.
- Wouterlood, F. G. 1976. The mutual relations of structures in the growing bill of chick *Gallus domesticus* and duck *Anas platyrhynchos* embryos Part 2 Normal growth of duck embryos external dimensions the size, shape and position of skeletal elements in the heads of chick and duck embryos lacking an upper or lower bill. Netherlands Journal of Zoology 26(2):266-294.
- Wu, P., T. X. Jiang, S. Suksaweang, R. B. Wideltz, and C. M. Chuong. 2004. Molecular shaping of the beak. Science. 305(3589):1465-1466.