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## MERCURY LEVELS IN PINK-FOOTED SHEARWATERS (*PUFFINUS CREATOPUS*) BREEDING ON MOCHA ISLAND, CHILE

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### INTRODUCTION

The Pink-footed Shearwater *Puffinus creatopus* is an endemic coastal-oceanic Chilean species, breeding on the Juan Fernandez islands and on the Isla Mocha, and migrating trans-equatorially to north Pacific waters (Harrison 1985). Owing to its very small breeding range, to the vulnerability of the better known Isla Mocha population during reproduction (Guicking 1999, Guicking *et al.* in press a) and to the declining population size (Schlatter 1984, Guicking *et al.* in press a), this species has been categorized as vulnerable (Rottmann & Lopez-Callejas 1992, Collar *et al.* 1994).

As knowledge on ecology and reproduction of Pink-footed Shearwaters is poor, in 1997 we started natural history investigations on the Isla Mocha, also with respect to pollution, which may be a possible threat for this species.

In this paper I report the contamination of Pink-footed Shearwater adults and chicks with mercury. This heavy metal is a natural

component of the environment, but originates also from anthropogenic sources, accumulates in top predators like seabirds and is of toxicological relevance for life (e.g., Scheuhammer 1987, Furness 1993). Feathers incorporate methylmercury in a dose-dependent way (Lewis & Furness 1981) and are an adequate matrix to indicate body mercury pools of this heavy metal in adult (e.g., Lewis *et al.* 1994) and young birds (Lewis & Furness 1991, Becker *et al.* 1993, 1994).

### STUDY AREA AND METHODS

During March 1998, adult Pink-footed Shearwaters were caught under licence in the breeding colony on Isla Mocha (38°22'S, 73°56'W), and 5–10 body feathers from 20 birds were taken, respectively. During 10–14 April 1998, both body feathers and down could be collected simultaneously from 8 chicks about 10 weeks old (the hatching peak on Mocha occurs end of January, Becker & Guicking unpubl. data of 1999). Feathers or

TABLE 1. Mercury levels ( $\text{ng g}^{-1}$  fresh weight) in feathers of adults (body feathers) and chicks (down, body feathers) of Pink-footed Shearwaters on Isla Mocha in 1998. Letters indicate significant differences (capital,  $P < 0.001$ ; small letter,  $P < 0.05$ ; adults/chicks: *U*-test; within chicks: Wilcoxon-test).

Age class	Feather type	Mercury ( $\text{ng g}^{-1}$ )
Adult (n = 20)	Body feather (A)	$3878 \pm 1300$ <sup>BC</sup>
Chick (n = 8)	Down (B)	$1419 \pm 491$ <sup>A,c</sup>
	Body feather (C)	$357 \pm 99$ <sup>A,b</sup>

down were stored in envelopes at room temperatures until the analysis in 1999. Down and body feathers were washed alternately with bidistilled water and acetone (p. a.) in an ultrasonic bath. After digestion (Kruse 1979), mercury was determined by the cold vapour atomic absorption technique using a flow injection mercury system (Sommer *et al.* 1997). The methods have been validated with satisfactory results by reference materials and by intercalibrations with two laboratories as well as by the European QUASIMEME quality assurance programme.

## RESULTS AND DISCUSSION

Adult Pink-footed Shearwater feathers were significantly higher contaminated with mercury than the plumage of chicks (Table 1). Chick down had significantly higher mercury levels than body feathers growing at older age of the chick (Table 1).

The mercury contamination of adult Pink-footed Shearwaters was low compared to other Procellariiformes from the sub-Antarctic (Thompson *et al.* 1993), but in the same order of magnitude as in adult Herring Gulls *Larus argentatus* breeding in the heavily polluted Wadden Sea [body feather mercury levels of 4870, 6410 (Lewis *et al.* 1993) or 5200  $\text{ng g}^{-1}$  (Mattig *et al.* 1996)]. Also down of Pink-footed Shearwater chicks had comparable levels than down of Herring Gull chicks from the Wadden Sea (1300  $\text{ng g}^{-1}$ , Becker *et al.*

1994). Body feathers of Herring Gull chicks, however (1420  $\text{ng g}^{-1}$ ), or of other species from the Wadden Sea (see Becker *et al.* 1994) were much higher contaminated with mercury than body feathers of Pink-footed Shearwater chicks.

As mercury contamination of eggs of another more coastal seabird, the Kelp Gull *Larus dominicanus* from different sites along the Chilean coast, was very low (44–175  $\text{ng g}^{-1}$  fresh weight, Muñoz & Becker in press), it seems unlikely that the high levels in adult Pink-footed Shearwaters originated from mercury uptake during the breeding season when the birds stay in Chilean waters, even if higher water mercury levels in Concepción Bay were reported in the mid-eighties (Chuecas 1989). This shearwater is a long-distance migrant, wandering inshore along the Pacific coasts to north Pacific waters. Satellite-tracking suggested (Guicking *et al.* unpubl.), that individuals stop migration to stay for some days in areas where they probably find a good food supply. This migration strategy implies a risk for the birds, if coastal seas used are polluted, e.g., near estuaries. Consequently, it seems most likely that the mercury contamination of adults originated from migration or wintering, when also the body feathers are moulted (Warham 1990, 1996), reflecting the body mercury pools built up until moult.

But how the big differences in contamination between down developing in the egg already, and the later growing feather types in

chicks can be explained? Whereas mercury levels in the egg and consequently in chick down reflect the mercury burden of the female parent, levels in body feathers of chicks are largely due to mercury ingested by food (Lewis & Furness 1991, Becker *et al.* 1993, 1994). The development of body mercury load is a dynamic process resulting from mercury elimination and uptake by food. If during a given time period the amount eliminated and that ingested are in the same order, there will be no change of the levels in feathers growing subsequently. This was the case in some lower polluted seabird chicks in the Wadden Sea fed by mercury polluted food (Becker *et al.* 1994), explaining similar mercury levels in chicks' down and body feathers in the Wadden Sea. In Pink-footed Shearwaters, however, the strong decrease of mercury concentrations from relatively highly polluted down, owing to presumably high egg contents, to body feathers (Table 1) is a further hint to very low mercury uptake by food originating from the foraging areas around the breeding site Isla Mocha which needs confirmation, however. Correspondingly, in Kelp Gull chicks from a colony in southern Chile (near Mehuin), a decrease from down to low levels in body feathers was observed (down 844 ng g<sup>-1</sup>, body feathers 486 ng g<sup>-1</sup>, unpubl. data).

The mercury levels found may not have negative effects on reproduction or chick health (see Scheuhammer 1987). However, as long distance migrant foraging inshore along the coasts of industrial countries Pink-footed Shearwaters may be at risk by other environmental chemicals.

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