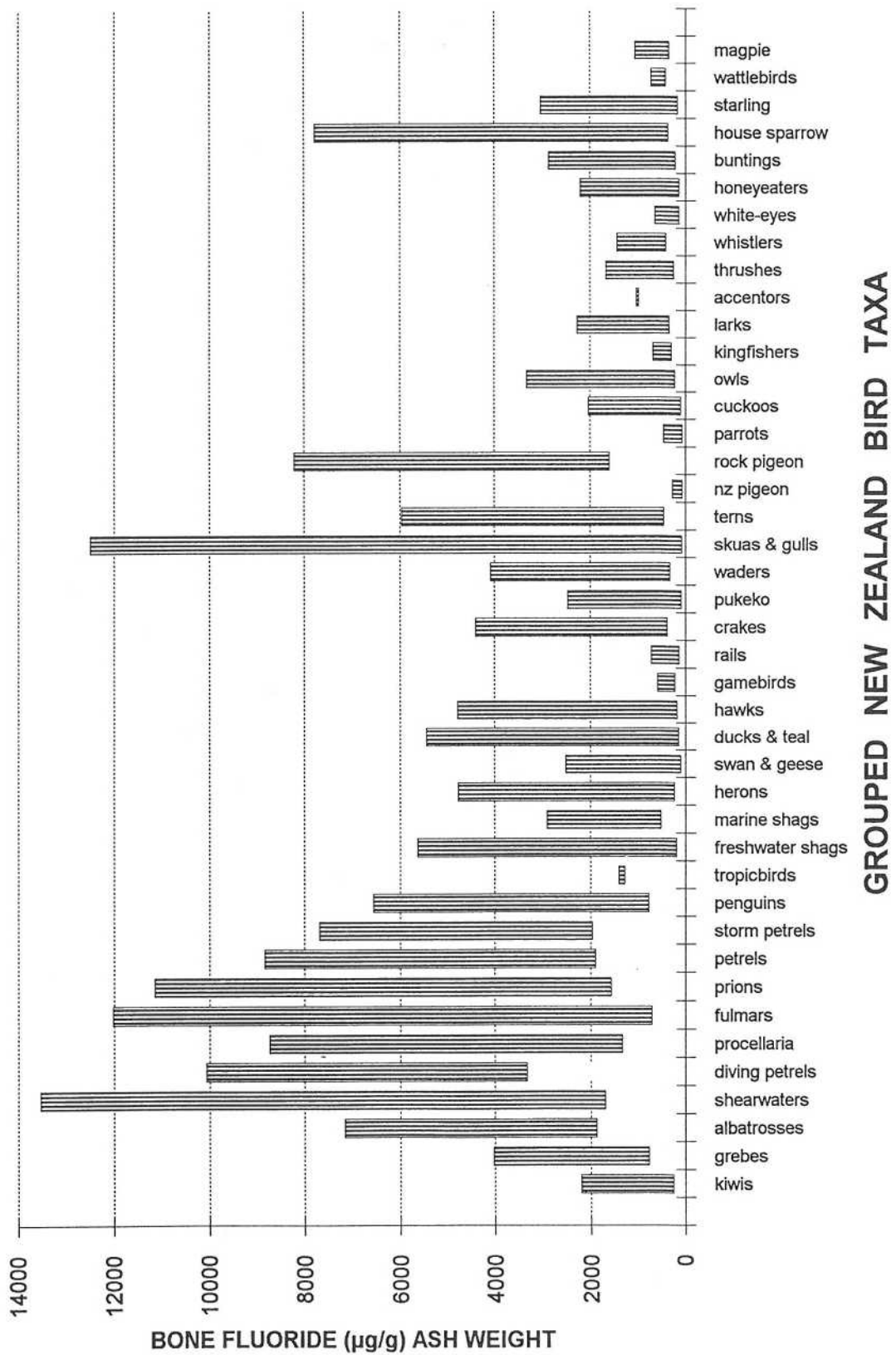
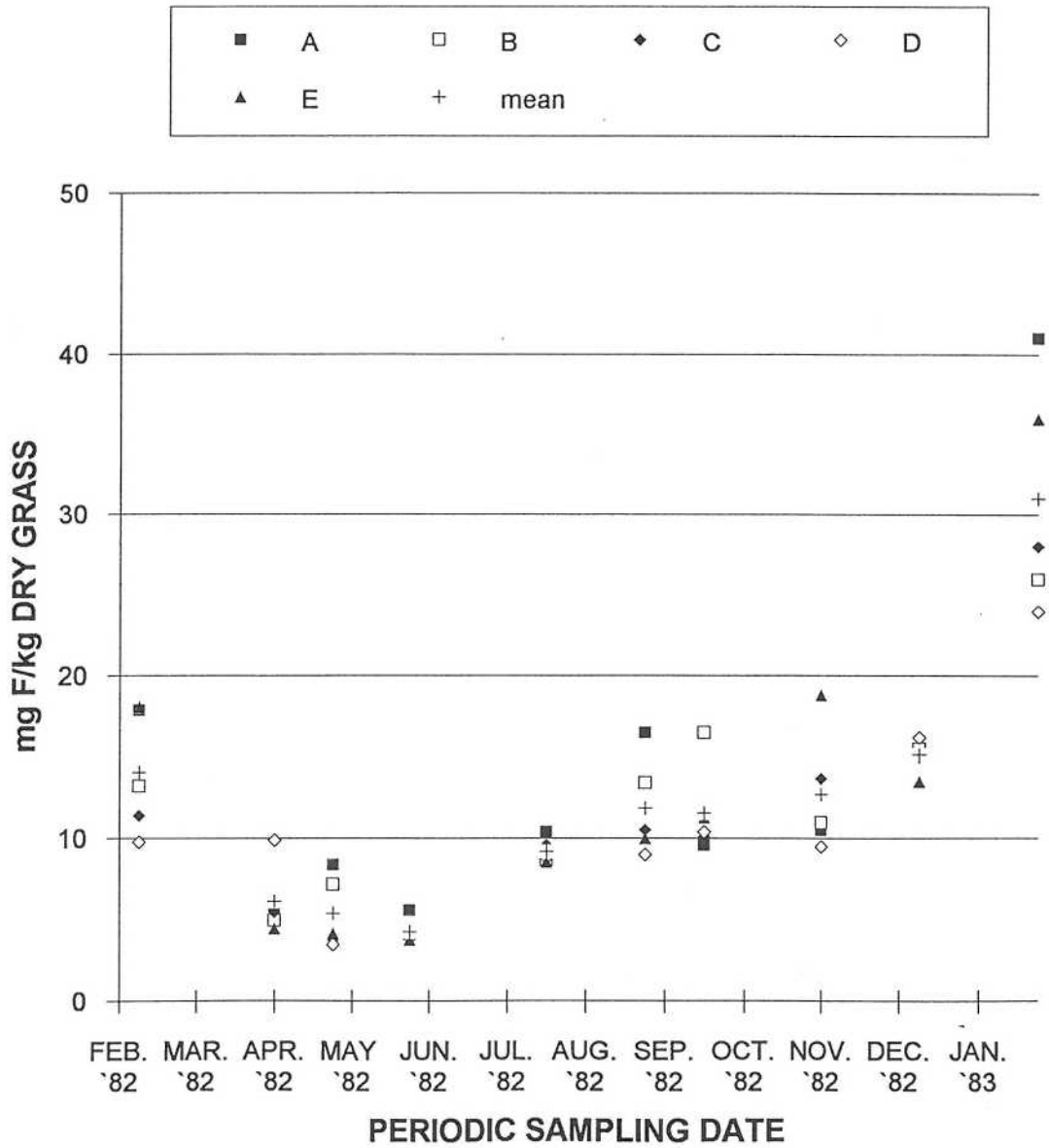


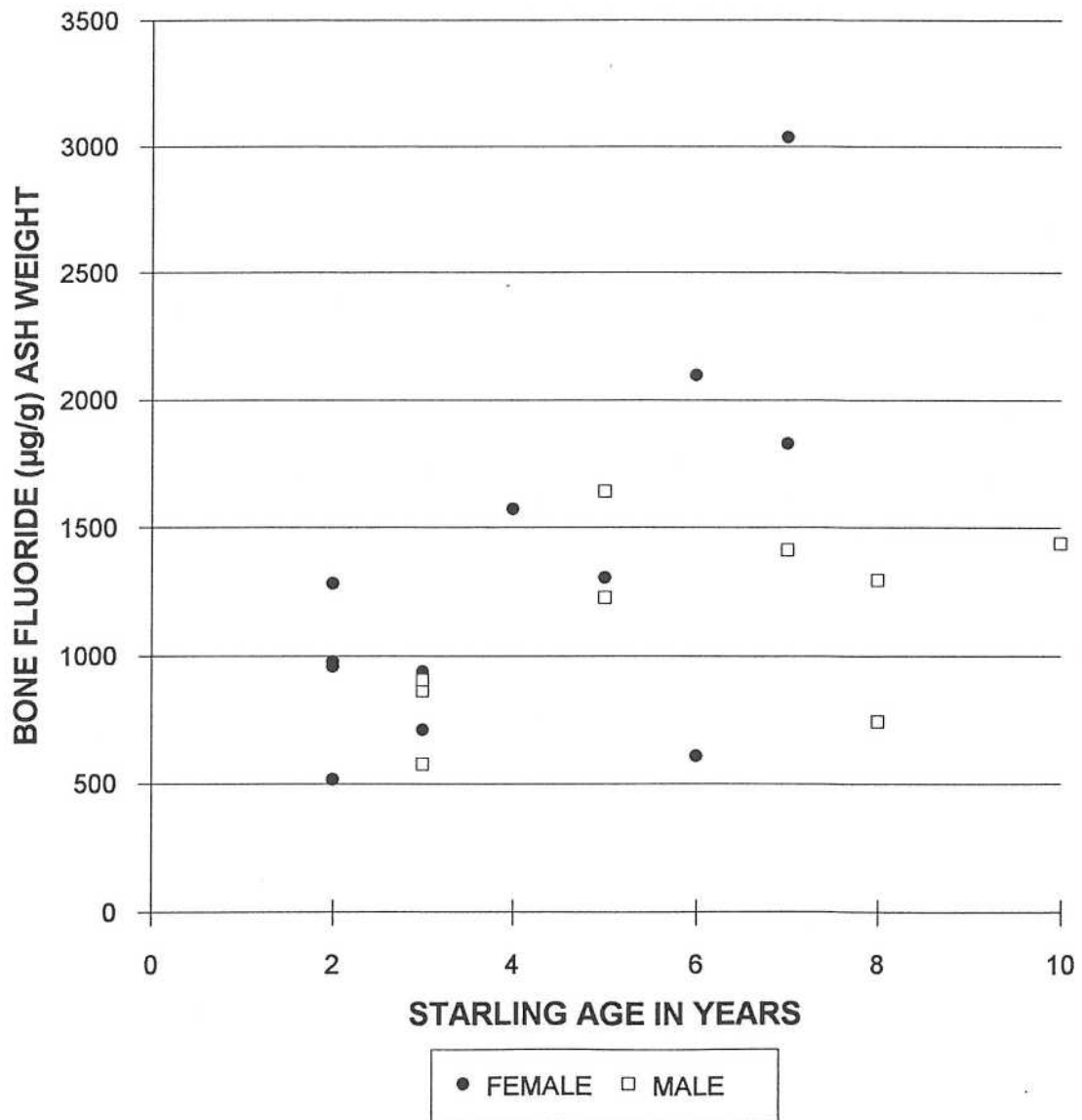
**FIGURE 1. Recorded ranges of bone fluoride ( $\mu\text{g}$ ) ash weight for individual or grouped New Zealand bird taxa.**



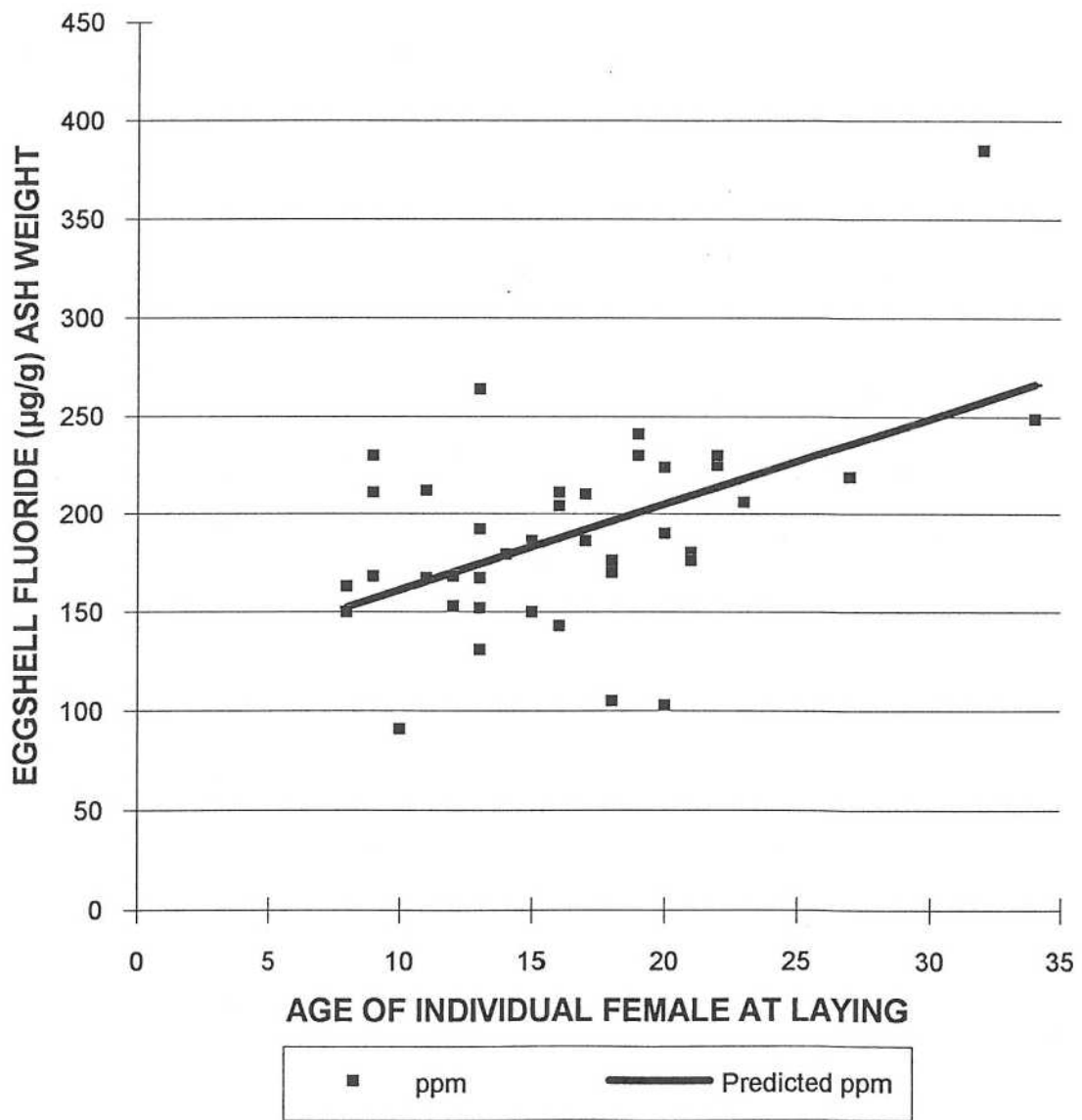
**FIGURE 2. Fluoride levels in vegetation (mg F/kg dry grass) from five plots (Samples A-E) sampled periodically at Taiaroa Head Nature Reserve, 1982-1983.**



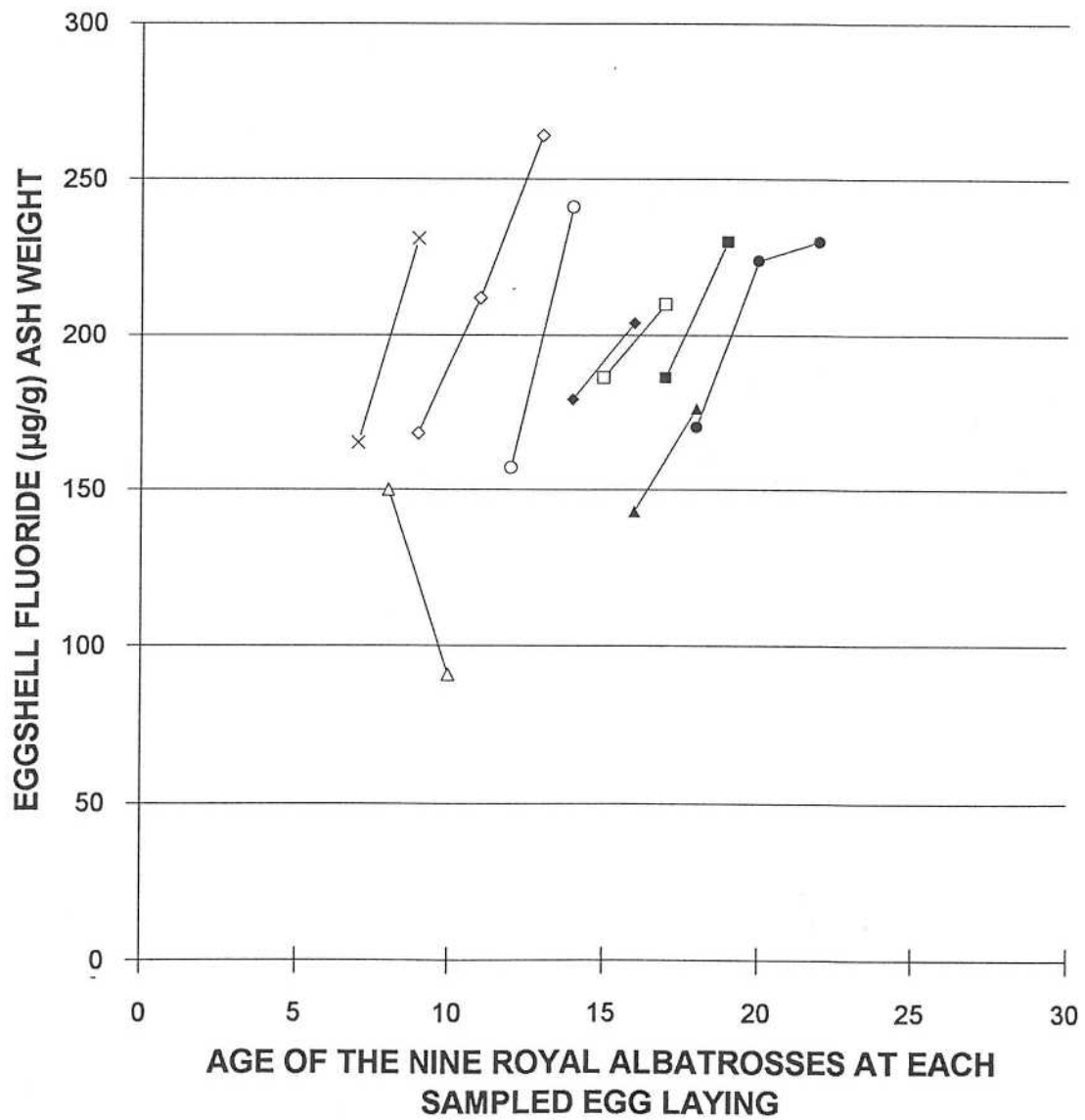
**FIGURE 3. Distribution of bone fluoride levels in Starlings of known age from Belmont, New Zealand.**



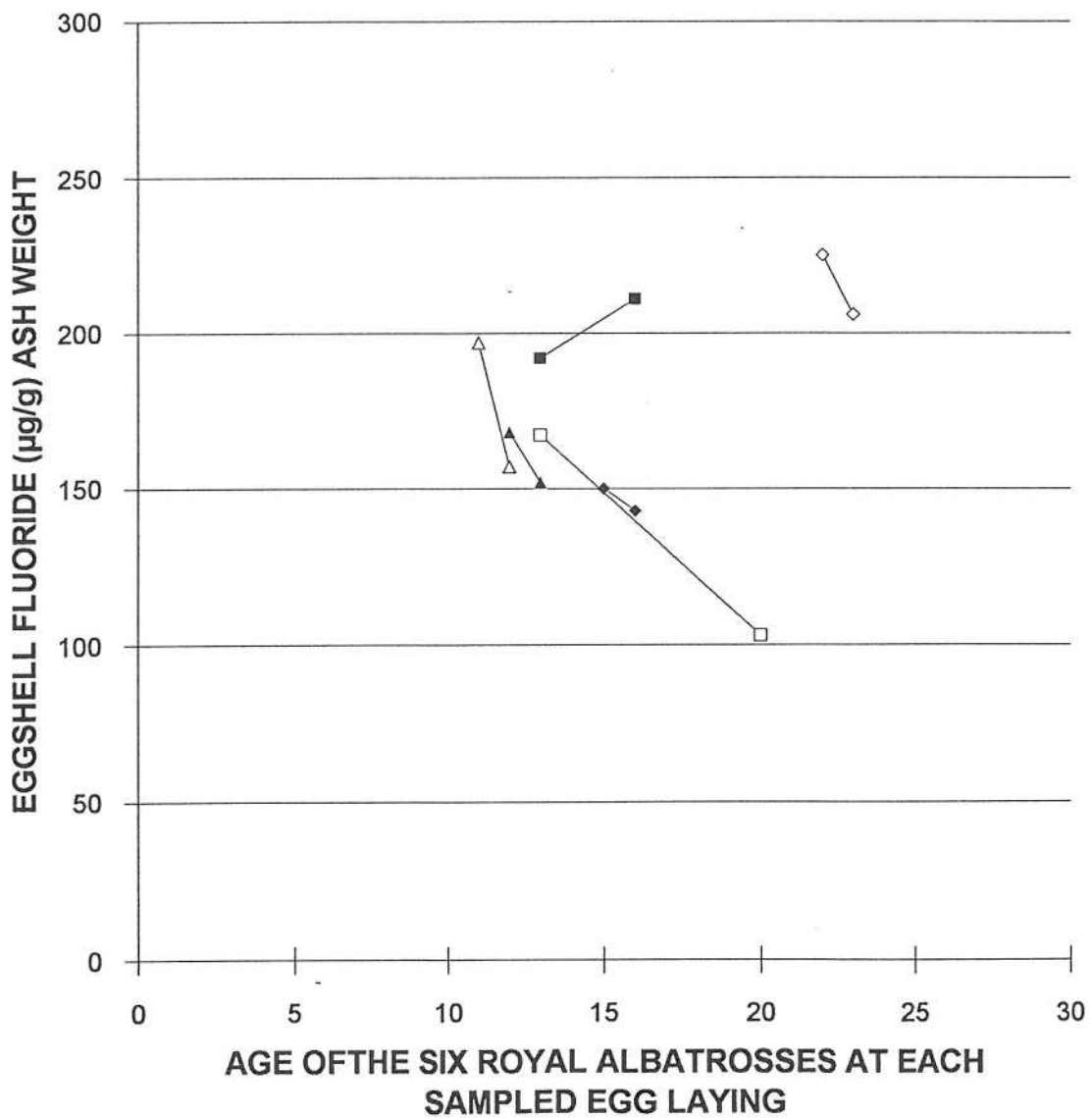
**FIGURE 4. Distribution of fluoride levels in eggshell laid by Northern Royal Albatross females of known age at Taiaroa Head, New Zealand.**



**FIGURE 5. Changes in fluoride levels in eggshell between layings, for eggs laid following the successful fledging of a chick by nine known age Northern Royal Albatross females at Taiaroa Head, New Zealand.**



**FIGURE 6. Changes in fluoride levels in eggshell between layings, for eggs laid after a period without chick rearing by six known age Northern Royal Albatross females at Taiaroa Head, New Zealand.**



**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|  | n<br>= | Age  | Range |      | Mean | SD   |
|--|--------|------|-------|------|------|------|
|  |        |      | Min   | Max= |      |      |
| North Island Brown Kiwi                  | 37     | Ad   | 250   | 2204 | 1001 | 555  |
| <i>Apteryx australis mantelli</i>        | 4      | Imm  | 394   | 578  | 497  | 92   |
|  | 41     | Comb | 250   | 2204 | 952  | 549  |
| South Island Brown Kiwi                  | 1      | Ad   | 278   | 278  | 278  |      |
| <i>A. a. australis</i>                   |        |      |       |      |      |      |
| Great Spotted Kiwi                       | 2      | Ad   | 551   | 672  | 612  | 86   |
| <i>A. haastii</i>                        |        |      |       |      |      |      |
| Australasian Crested Grebe               | 1      | Ad   | 1576  | 1576 | 1576 |      |
| <i>Podiceps cristatus australis</i>      |        |      |       |      |      |      |
| New Zealand Dabchick                     | 4      | Ad   | 331   | 4024 | 2168 | 1885 |
| <i>Poliiocephalus rufopectus</i>         |        |      |       |      |      |      |
| Wandering Albatross                      | 4      | Ad   | 2891  | 6183 | 4819 | 1539 |
| <i>Diomedea exulans</i>                  |        |      |       |      |      |      |
| Southern Royal Albatross                 | 2      | Ad   | 7065  | 7091 | 7078 | 18   |
| <i>D. epomophora epomophora</i>          |        |      |       |      |      |      |
| Black-browed Mollymawk                   | 1      | Imm  | 2706  | 2706 | 2706 |      |
| <i>D. melanophrys melanophrys</i>        |        |      |       |      |      |      |
| New Zealand Black-browed Mollymawk       | 2      | Ad   | 2754  | 3274 | 3014 | 368  |
|  | 2      | Imm  | 2556  | 3187 | 2872 | 446  |
|  | 4      | Comb | 2556  | 3274 | 2943 | 344  |
| <i>D. m. impavida</i>                    |        |      |       |      |      |      |
| New Zealand White-capped (Shy) Mollymawk | 1      | Imm  | 2713  | 2713 | 2713 |      |
| <i>D. cauta stadi</i>                    |        |      |       |      |      |      |
| Salvin's Mollymawk                       | 7      | Ad   | 3386  | 6308 | 5072 | 1118 |
|  | 2      | Imm  | 1866  | 3500 | 2683 | 1155 |
|  | 9      | Comb | 1866  | 6308 | 4541 | 1488 |
| <i>D. c. salvini</i>                     |        |      |       |      |      |      |
| Grey-headed Mollymawk                    | 3      | Ad   | 3810  | 4462 | 4102 | 331  |
|  | 3      | Imm  | 3060  | 4573 | 3675 | 795  |
|  | 1      | Unk  | 2341  | 2341 | 2341 |      |
|  | 7      | Comb | 2341  | 4573 | 3667 | 797  |
| <i>D. chrysostoma</i>                    |        |      |       |      |      |      |
| Northern Buller's Mollymawk              | 3      | Imm  | 3867  | 5811 | 4629 | 1038 |
| <i>D. buller platei</i>                  |        |      |       |      |      |      |
| Light-mantled Sooty Albatross            | 2      | Ad   | 3640  | 7161 | 5401 | 2490 |
|  | 2      | Imm  | 2553  | 3908 | 3231 | 958  |
|  | 4      | Comb | 2553  | 7161 | 4316 | 1985 |
| <i>Phoebetria palpebrata</i>             |        |      |       |      |      |      |
| Flesh-footed Shearwater                  | 2      | Imm  | 1724  | 2623 | 2174 | 636  |
| <i>Puffinus carneipes</i>                |        |      |       |      |      |      |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|  | n<br>= | Age  | Range |       | Mean  | SD   |
|--|--------|------|-------|-------|-------|------|
|  |        |      | Min   | Max   |       |      |
| Sooty Shearwater (Muttonbird)<br><i>P. griseus</i>                       | 4      | Imm  | 1684  | 6307  | 4166  | 2152 |
| Short-tailed Shearwater (Tasmanian Muttonbird)<br><i>P. tenuirostris</i> | 2      | Ad   | 13500 | 13542 | 13521 | 30   |
|  | 2      | Unk  | 5921  | 8906  | 7414  | 2111 |
|  | 4      | Comb | 5921  | 13542 | 10467 | 3731 |
| Fluttering Shearwater<br><i>P. gavia</i>                                 | 2      | Unk  | 6027  | 6034  | 6031  | 5    |
| Hutton's Shearwater<br><i>P. huttoni</i>                                 | 1      | Ad   | 6181  | 6181  | 6181  |      |
|  | 1      | Imm  | 4329  | 4329  | 4329  |      |
|  | 2      | Comb | 4329  | 6181  | 5255  | 1310 |
| North Island Little Shearwater<br><i>P. assimilis haurakensis</i>        | 1      | Ad   | 5349  | 5349  | 5349  |      |
|  | 1      | Imm  | 1712  | 1712  | 1712  |      |
|  | 2      | Comb | 1712  | 5349  | 3531  | 2572 |
| Common Diving Petrel<br><i>Pelecanoides u. urinatrix</i>                 | 1      | Ad   | 8178  | 8178  | 8178  |      |
|  | 2      | Unk  | 3333  | 5840  | 4587  | 1773 |
|  | 3      | Comb | 3333  | 8178  | 5784  | 2423 |
| Subantarctic Diving Petrel<br><i>P. u. exsul</i>                         | 4      | Ad   | 4645  | 10065 | 7856  | 2328 |
| South Georgian Diving Petrel<br><i>P. georgicus</i>                      | 2      | Ad   | 8540  | 8913  | 8727  | 264  |
| Grey Petrel<br><i>Procellaria cinerea</i>                                | 1      | Ad   | 8736  | 8736  | 8736  |      |
| Westland Petrel<br><i>P. westlandica</i>                                 | 3      | Ad   | 3438  | 6611  | 5265  | 1640 |
|  | 4      | Imm  | 1327  | 1723  | 1571  | 176  |
|  | 7      | Comb | 1327  | 6611  | 3154  | 2194 |
| White-chinned Petrel (Shoemaker)<br><i>P. a. aequinoctialis</i>          | 2      | Ad   | 2992  | 5428  | 4210  | 1723 |
| Kerguelen Petrel<br><i>Lugensa brevirostris</i>                          | 2      | Imm  | 7094  | 7595  | 7345  | 354  |
|  | 1      | Unk  | 5333  | 5333  | 5333  |      |
|  | 3      | Comb | 5333  | 7595  | 6674  | 1188 |
| Cape Pigeon<br><i>Daption c. capense</i>                                 | 2      | Ad   | 6055  | 10473 | 8264  | 3124 |
|  | 1      | Imm  | 6651  | 6651  | 6651  |      |
|  | 3      | Comb | 6055  | 10473 | 7726  | 2397 |
| Snares Cape Pigeon<br><i>D. c. australe</i>                              | 1      | Ad   | 10861 | 10861 | 10861 |      |



**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|                                       | n<br>= | Age  | Range |       | Mean  | SD   |
|---------------------------------------|--------|------|-------|-------|-------|------|
|                                       |        |      | Min   | Max   |       |      |
| Antarctic Petrel                      | 1      | Ad   | 12025 | 12025 | 12025 |      |
| <i>Thalassoica antarctica</i>         | 4      | Imm  | 7212  | 9474  | 7989  | 1018 |
|                                       | 5      | Comb | 7212  | 12025 | 8796  | 2009 |
| Antarctic Fulmar                      | 7      | Imm  | 4355  | 8871  | 7151  | 1800 |
| <i>Fulmarus glacialisoides</i>        | 2      | Unk  | 7470  | 7576  | 7523  | 75   |
|                                       | 9      | Comb | 4355  | 8871  | 7234  | 1568 |
| Southern Giant Petrel                 | 4      | Imm  | 894   | 6970  | 3598  | 2934 |
| <i>Macronectes giganteus</i>          |        |      |       |       |       |      |
| Northern Giant Petrel                 | 3      | Ad   | 1300  | 6053  | 3986  | 2436 |
| <i>M. halli</i>                       | 2      | Imm  | 711   | 3596  | 2154  | 2040 |
|                                       | 5      | Comb | 711   | 6053  | 3253  | 2240 |
| Fairy Prion                           | 6      | Ad   | 3105  | 11154 | 7732  | 2647 |
| <i>Pachyptila turtur</i>              | 2      | Imm  | 6328  | 9638  | 7983  | 2341 |
|                                       | 6      | Unk  | 2090  | 9142  | 4665  | 2645 |
|                                       | 14     | Comb | 2090  | 11154 | 6453  | 2898 |
| Fulmar Prion                          | 6      | Ad   | 7394  | 10000 | 8985  | 908  |
| <i>P. crassirostris crassirostris</i> | 1      | Imm  | 3077  | 3077  | 3077  |      |
|                                       | 7      | Comb | 3077  | 10000 | 8141  | 2382 |
| Antarctic Prion                       | 1      | Unk  | 4312  | 4312  | 4312  |      |
| <i>P. desolata banksi</i>             |        |      |       |       |       |      |
| Broad-billed Prion                    | 2      | Unk  | 1596  | 7564  | 4580  | 4220 |
| <i>P. vittata</i>                     |        |      |       |       |       |      |
| Blue Petrel                           | 2      | Ad   | 4835  | 8602  | 6719  | 2664 |
| <i>Halobaena caerulea</i>             | 2      | Imm  | 6667  | 8602  | 7635  | 1368 |
|                                       | 4      | Comb | 4835  | 8602  | 7177  | 1808 |
| Pycroft's Petrel                      | 1      | Ad   | 7678  | 7678  | 7678  |      |
| <i>Pterodroma pycrofti</i>            |        |      |       |       |       |      |
| Cook's Petrel                         | 2      | Ad   | 7255  | 7403  | 7329  | 105  |
| <i>P. cookii</i>                      | 2      | Imm  | 1885  | 2600  | 2243  | 506  |
|                                       | 4      | Comb | 1885  | 7403  | 4786  | 2952 |
| Black-winged Petrel                   | 1      | Ad   | 8841  | 8841  | 8841  |      |
| <i>P. nigripennis</i>                 |        |      |       |       |       |      |
| Chatham Petrel                        | 1      | Ad   | 7667  | 7667  | 7667  |      |
| <i>P. axillaris</i>                   |        |      |       |       |       |      |
| Mottled Petrel                        | 1      | Ad   | 8261  | 8261  | 8261  |      |
| <i>P. inexpectata</i>                 | 1      | Imm  | 6176  | 6176  | 6176  |      |
|                                       | 2      | Comb | 6176  | 8261  | 7219  | 1474 |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|  | n<br>= | Age  | Range |      | Mean | SD   |
|--|--------|------|-------|------|------|------|
|  |        |      | Min   | Max  |      |      |
| Grey-faced Petrel<br><i>P. macroptera gouldi</i>                           | 3      | Ad   | 5714  | 7143 | 6581 | 762  |
| White-headed Petrel<br><i>P. lessonii</i>                                  | 3      | Ad   | 3981  | 8194 | 6447 | 2197 |
|  | 1      | Unk  | 6250  | 6250 | 6250 |      |
|  | 4      | Comb | 3981  | 8194 | 6398 | 1796 |
| Grey-backed Storm Petrel<br><i>Oceanites nereis</i>                        | 3      | Ad   | 1955  | 6722 | 4499 | 2400 |
|  | 1      | Unk  | 4713  | 4713 | 4713 |      |
|  | 4      | Comb | 1955  | 6722 | 4553 | 1962 |
| New Zealand White-faced Storm Petrel<br><i>Pelagodroma marina maoriana</i> | 2      | Unk  | 4118  | 6901 | 5510 | 1968 |
| Black-bellied Storm Petrel<br><i>Fregatta tropica</i>                      | 1      | Unk  | 7692  | 7692 | 7692 |      |
| Yellow-eyed Penguin<br><i>Megadyptes antipodes</i>                         | 2      | Imm  | 1690  | 4534 | 3112 | 2011 |
| Blue Penguin<br><i>Eudyptula minor</i>                                     | 12     | Ad   | 1290  | 4630 | 3269 | 945  |
|  | 2      | Imm  | 775   | 4192 | 2484 | 2416 |
|  | 2      | Unk  | 2816  | 3281 | 3049 | 329  |
|  | 16     | Comb | 775   | 4630 | 3144 | 1060 |
| Eastern Rockhopper Penguin<br><i>Eudyptes cchrysocome filholi</i>          | 4      | Ad   | 3419  | 6383 | 5074 | 1246 |
| Fiordland Crested Penguin<br><i>E. pachyrhynchus</i>                       | 2      | Ad   | 2824  | 4037 | 3431 | 858  |
| Erect-crested Penguin<br><i>E. sclated</i>                                 | 4      | Ad   | 2038  | 6571 | 4838 | 2032 |
|  | 1      | Imm  | 1831  | 1831 | 1831 |      |
|  | 5      | Comb | 1831  | 6571 | 4237 | 2215 |
| Red-tailed Tropic Bird<br><i>Phaethon rubricauda</i>                       | 1      | Ad   | 1274  | 1274 | 1274 |      |
| White-tailed Tropicbird<br><i>P. lepturus dorotheae</i>                    | 1      | Imm  | 1411  | 1411 | 1411 |      |
| Australasian Gannet<br><i>Morus serrator</i>                               | 1      | Ad   | 6094  | 6094 | 6094 |      |
| Black Shag (Black Cormorant)<br><i>Phalacrocorax carbo novaehollandiae</i> | 7      | Imm  | 184   | 3913 | 2057 | 1322 |
|  | 1      | Unk  | 3974  | 3974 | 3974 |      |
|  | 8      | Comb | 184   | 3974 | 2297 | 1399 |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**  
**Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation**

|                                     | n<br>= | Age                    | Range |      | Mean | SD   |
|-------------------------------------|--------|------------------------|-------|------|------|------|
|                                     |        |                        | Min   | Max  |      |      |
| Little Shag (Little Pied Cormorant) | 1      | Ad                     | 5635  | 5635 | 5635 |      |
| <i>P. melanoleucos brevirostris</i> | 4      | Unk                    | 1800  | 4115 | 2984 | 1020 |
|                                     | 5      | Comb                   | 1800  | 5635 | 3514 | 1478 |
| Stewart Island Shag                 | 4      | Ad                     | 1575  | 3049 | 2411 | 622  |
| <i>Leucocarbo chalconotus</i>       | 2      | Imm                    | 1089  | 1362 | 1226 | 193  |
|                                     | 6      | Comb                   | 1089  | 3049 | 2016 | 784  |
| Bounty Island Shag                  | 11     | Ad                     | 2131  | 3951 | 2907 | 529  |
| <i>L. ranfurlyi</i>                 |        |                        |       |      |      |      |
| Spotted Shag                        | 4      | Ad                     | 1997  | 2459 | 2285 | 215  |
| <i>Stictocarbo p. punctatus</i>     | 10     | Imm                    | 509   | 1779 | 1170 | 459  |
|                                     | 14     | Comb                   | 509   | 2459 | 1489 | 655  |
| White-faced Heron                   | 1      | Imm                    | 976   | 976  | 976  |      |
| <i>Ardea n. novaehollandiae</i>     | 3      | Unk                    | 618   | 4767 | 2435 | 2122 |
|                                     | 4      | Comb                   | 618   | 4767 | 2070 | 1880 |
|                                     | 3      | <i>Stewart et. al.</i> | 1006  | 3264 | 2208 | 1135 |
| Cattle Egret                        | 4      | Imm                    | 227   | 678  | 436  | 204  |
| <i>Bubulcus ibis coromandus</i>     |        |                        |       |      |      |      |
| Australasian Bittern                | 2      | Unk                    | 484   | 3557 | 2021 | 2173 |
| <i>Botaurus poiciloptilus</i>       |        |                        |       |      |      |      |
| Black Swan                          | 3      | Unk                    | 88    | 478  | 230  | 216  |
| <i>Cygnus atratus</i>               |        |                        |       |      |      |      |
| Canada Goose                        | 2      | Ad                     | 1995  | 2520 | 2258 | 371  |
| <i>Branta canadensis maxima</i>     | 2      | Unk                    | 2020  | 2060 | 2040 | 28   |
|                                     | 4      | Comb                   | 1995  | 2520 | 2149 | 249  |
| Paradise Shelduck                   | 1      | Ad                     | 915   | 915  | 915  |      |
| <i>Tadorna variegata</i>            | 1      | Unk                    | 794   | 794  | 794  |      |
|                                     | 2      | Comb                   | 794   | 915  | 855  | 86   |
| Mallard                             | 5      | Ad                     | 669   | 1059 | 923  | 149  |
| <i>Anas p. platyrhynchos</i>        | 5      | Imm                    | 329   | 1100 | 551  | 313  |
|                                     | 12     | Unk                    | 235   | 1942 | 648  | 464  |
|                                     | 22     | Comb                   | 235   | 1942 | 688  | 393  |
|                                     | 11     | <i>Stewart et. al.</i> | 430   | 5440 | 1902 | 1375 |
| Grey Duck                           | 7      | Imm                    | 368   | 1295 | 681  | 412  |
| <i>A. s. superciliosa</i>           |        |                        |       |      |      |      |
| Grey Teal                           | 2      | Imm                    | 610   | 646  | 628  | 25   |
| <i>A. gracilis</i>                  | 6      | Unk                    | 784   | 1667 | 1278 | 306  |
|                                     | 8      | Comb                   | 610   | 1667 | 1116 | 397  |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|                                      | n<br>= | Age                    | Range |      | Mean | SD   |
|--------------------------------------|--------|------------------------|-------|------|------|------|
|                                      |        |                        | Min   | Max  |      |      |
| Brown Teal                           | 1      | Imm                    | 1106  | 1106 | 1106 |      |
| <i>A. aucklandica chlorotis</i>      | 1      | Unk                    | 134   | 134  | 134  |      |
|                                      | 2      | Comb                   | 134   | 1106 | 620  | 687  |
| New Zealand Shoveler                 | 1      | Ad                     | 4062  | 4062 | 4062 |      |
| <i>A. rhynchotis variegata</i>       | 3      | Imm                    | 470   | 753  | 634  | 147  |
|                                      | 4      | Comb                   | 470   | 4062 | 1491 | 1718 |
| New Zealand Scaup                    | 7      | Unk                    | 199   | 4576 | 2129 | 1491 |
| <i>A. novaeseelandiae</i>            |        |                        |       |      |      |      |
| Australasian Harrier                 | 10     | Ad                     | 166   | 2917 | 1118 | 778  |
| <i>Circus approximans</i>            | 13     | Unk                    | 222   | 1087 | 708  | 257  |
|                                      | 23     | Comb                   | 166   | 2917 | 886  | 572  |
|                                      | 14     | <i>Stewart et. al.</i> | 379   | 4775 | 1445 | 1099 |
| New Zealand Falcon                   | 1      | Ad                     | 2285  | 2285 | 2285 |      |
| <i>Falco novaeseelandiae</i>         | 1      | Imm                    | 1398  | 1398 | 1398 |      |
|                                      | 2      | Comb                   | 1398  | 2285 | 1842 | 627  |
| Chukor                               | 2      | Ad                     | 333   | 580  | 457  | 175  |
| <i>Alectoris chukar</i>              |        |                        |       |      |      |      |
| Pheasant                             | 1      | Unk                    | 213   | 213  | 213  |      |
| <i>Phasianus colchicus</i>           |        |                        |       |      |      |      |
| Banded Rail                          | 2      | Ad                     | 408   | 461  | 435  | 37   |
| <i>Rallus philippensis assimilis</i> |        |                        |       |      |      |      |
| North Island Weka                    | 2      | Ad                     | 131   | 726  | 429  | 421  |
| <i>Gallirallus australis greyi</i>   |        |                        |       |      |      |      |
| Western Weka                         | 1      | Ad                     | 245   | 245  | 245  |      |
| <i>G. a. australis</i>               | 2      | Unk                    | 120   | 193  | 157  | 52   |
|                                      | 3      | Comb                   | 120   | 245  | 186  | 63   |
| Spotless Crake                       | 1      | Ad                     | 372   | 372  | 372  |      |
| <i>Porzana tabuensis plumbea</i>     | 1      | Unk                    | 476   | 476  | 476  |      |
|                                      | 2      | Comb                   | 372   | 476  | 424  | 74   |
| Marsh Crake                          | 2      | Ad                     | 3462  | 4394 | 3928 | 659  |
| <i>P. pusilla affinnis</i>           | 2      | Unk                    | 1315  | 1417 | 1366 | 72   |
|                                      | 4      | Comb                   | 1315  | 4394 | 2647 | 1528 |
| Pukeko (Swamphen)                    | 7      | Ad                     | 76    | 405  | 235  | 135  |
| <i>Porphyrio p. melanotus</i>        | 3      | Imm                    | 173   | 315  | 222  | 81   |
|                                      | 37     | Unk                    | 183   | 2040 | 598  | 347  |
|                                      | 47     | Comb                   | 76    | 2040 | 520  | 346  |
|                                      | 16     | <i>Stewart et. al.</i> | 143   | 1400 | 489  | 344  |

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Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|   | n<br>= | Age                    | Range |       | Mean | SD   |
|---|--------|------------------------|-------|-------|------|------|
|   |        |                        | Min   | Max   |      |      |
| South Island Pied Oystercatcher<br><i>Haematopus ostralegus finschi</i> | 14     | Unk                    | 774   | 2910  | 1773 | 602  |
|   | 14     | <i>Stewart et. al.</i> | 393   | 1965  | 1243 | 508  |
| Australasian Pied Stilt<br><i>Himantopus himantopus leucocephalus</i>   | 5      | Ad                     | 1321  | 4053  | 2435 | 1204 |
|   | 1      | Imm                    | 318   | 318   | 318  |      |
|   | 25     | Unk                    | 360   | 4080  | 1563 | 924  |
|   | 31     | Comb                   | 318   | 4080  | 1663 | 1022 |
| Banded Dotterel<br><i>Charadrius b. bicinctus</i>                       | 1      | Ad                     | 1948  | 1948  | 1948 |      |
|   | 1      | Unk                    | 2696  | 2696  | 2696 |      |
|   | 2      | Comb                   | 1948  | 2696  | 2322 | 529  |
| Shore Plover<br><i>Thinornis novaeseelandiae</i>                        | 1      | Imm                    | 800   | 800   | 800  |      |
| Spur-winged Plover<br><i>Vanellus miles novaehollandiae</i>             | 3      | Ad                     | 559   | 970   | 705  | 230  |
|   | 1      | Imm                    | 402   | 402   | 402  |      |
|   | 4      | Comb                   | 402   | 970   | 629  | 241  |
| Chatham Island Snipe<br><i>Coenocorypha pusilla</i>                     | 1      | Ad                     | 1599  | 1599  | 1599 |      |
| Eastern Bar-tailed Godwit<br><i>Limosa lapponica baueri</i>             | 1      | mm                     | 1190  | 1190  | 1190 |      |
|   | 1      | Unk                    | 439   | 439   | 439  |      |
|   | 2      | Comb                   | 439   | 1190  | 815  | 531  |
| Arctic Skua<br><i>Stercoradus parasiticus</i>                           | 1      | Imm                    | 2500  | 2500  | 2500 |      |
| Southern Black-backed Gull<br><i>Larus d. dominicanus</i>               | 13     | Ad                     | 124   | 4699  | 1228 | 1158 |
|   | 7      | Imm                    | 66    | 2846  | 963  | 963  |
|   | 33     | Unk                    | 678   | 3050  | 1489 | 577  |
|   | 53     | Comb                   | 66    | 4699  | 1355 | 811  |
|   | 16     | <i>Stewart et. al.</i> | 754   | 3140  | 1907 | 729  |
| Red-billed Gull<br><i>L. novaehollandiae scopulinus</i>                 | 3      | Ad                     | 2055  | 3837  | 2722 | 972  |
|   | 3      | Imm                    | 1055  | 4855  | 2346 | 2173 |
|   | 35     | Unk                    | 1008  | 12500 | 5305 | 3046 |
|   | 41     | Comb                   | 1008  | 12500 | 4899 | 3026 |
|   | 16     | <i>Stewart et. al.</i> | 1058  | 8050  | 4003 | 2122 |
| Black-billed Gull<br><i>L. bulleri</i>                                  | 7      | Unk                    | 1160  | 5800  | 2333 | 1648 |
| White-fronted Tern<br><i>Sterna striata</i>                             | 4      | Ad                     | 1359  | 2702  | 2028 | 595  |
|   | 1      | Imm                    | 435   | 435   | 435  |      |
|   | 5      | Comb                   | 435   | 2702  | 1709 | 879  |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|   | n<br>= | Age                    | Range |      | Mean | SD   |
|---|--------|------------------------|-------|------|------|------|
|   |        |                        | Min   | Max  |      |      |
| Arctic Tern<br><i>S. paradisaea</i>                             | 1      | mm                     | 5970  | 5970 | 5970 |      |
| New Zealand Pigeon<br><i>Hemiphaga n. novaeseelandiae</i>       | 2      | Imm                    | 53    | 85   | 69   | 23   |
|   | 8      | Unk                    | 60    | 276  | 151  | 90   |
|   | 10     | Comb                   | 53    | 276  | 135  | 87   |
| Rock Pigeon<br><i>Columba livia</i>                             | 11     | Ad                     | 1584  | 8209 | 2879 | 1830 |
| North Island Kaka<br><i>Nestor meridionalis septentrionalis</i> | 1      | Imm                    | 376   | 376  | 376  |      |
| Eastern Rosella<br><i>Platycercus eximius</i>                   | 1      | Ad                     | 104   | 104  | 104  |      |
|   | 1      | Unk                    | 59    | 59   | 59   |      |
|   | 2      | Comb                   | 59    | 104  | 82   | 32   |
| Red-crowned Parakeet<br><i>Cyanoramphus n. novaezealandiae</i>  | 1      | Ad                     | 456   | 456  | 456  |      |
| Yellow-crowned Parakeet<br><i>C. a. auriceps</i>                | 1      | Imm                    | 110   | 110  | 110  |      |
|   | 1      | Unk                    | 76    | 76   | 76   |      |
|   | 2      | Comb                   | 76    | 110  | 93   | 24   |
| Shining Cuckoo<br><i>Chrysococcyx l. lucidus</i>                | 4      | Unk                    | 86    | 507  | 276  | 198  |
| Long-tailed Cuckoo<br><i>Eudynamis taitensis</i>                | 1      | Ad                     | 36    | 36   | 36   |      |
|   | 1      | Imm                    | 2032  | 2032 | 2032 |      |
|   | 2      | Unk                    | 204   | 1050 | 627  | 598  |
|   | 4      | Comb                   | 36    | 2032 | 831  | 916  |
| Morepork<br><i>Ninox n. novaeseelandiae</i>                     | 14     | Unk                    | 210   | 3333 | 945  | 942  |
| New Zealand Kingfisher<br><i>Halcyon sancta vagans</i>          | 1      | Imm                    | 375   | 375  | 375  |      |
|   | 2      | Unk                    | 283   | 675  | 479  | 277  |
|   | 3      | Comb                   | 283   | 675  | 444  | 205  |
| Skylark<br><i>Alauda arvensis</i>                               | 2      | Unk                    | 328   | 2267 | 1298 | 1371 |
|   | 2      | Comb                   | 328   | 2267 | 1298 | 1371 |
| Hedge Sparrow<br><i>Prunella modularis</i>                      | 1      | <i>Stewart et. al.</i> | 1021  | 1021 | 1021 |      |
| Blackbird<br><i>Turdus merula</i>                               | 4      | Ad                     | 236   | 1659 | 775  | 650  |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|   | n<br>= | Age  | Range |      | Mean | SD   |
|---|--------|------|-------|------|------|------|
|   |        |      | Min   | Max  |      |      |
| Song Thrush                             | 1      | Ad   | 1189  | 1189 | 1189 |      |
| <i>T. philomelos</i>                    | 1      | Unk  | 331   | 331  | 331  |      |
|   | 2      | Comb | 331   | 1189 | 760  | 607  |
| Whitehead                               | 4      | Unk  | 396   | 1428 | 723  | 476  |
| <i>Mohoua albicilla</i>                 |        |      |       |      |      |      |
| Brown Creeper                           | 1      | Unk  | 670   | 670  | 670  |      |
| <i>M. novaeseelandiae</i>               |        |      |       |      |      |      |
| Grey Warbler                            | 1      | Unk  | 2212  | 2212 | 2212 |      |
| <i>Gerygone igata</i>                   |        |      |       |      |      |      |
| North Island Fantail                    | 1      | Unk  | 1831  | 1831 | 1831 |      |
| <i>Rhipidura fuliginosa placabilis</i>  |        |      |       |      |      |      |
| Silvereve                               | 4      | Unk  | 123   | 638  | 327  | 222  |
| <i>Zosterops l. lateralis</i>           |        |      |       |      |      |      |
| Poor Knights Bellbird                   | 10     | Ad   | 302   | 2202 | 818  | 542  |
| <i>Anthornis melanura oneho</i>         |        |      |       |      |      |      |
| Bellbird                                | 1      | Ad   | 178   | 178  | 178  |      |
| <i>A. m. melanura</i>                   |        |      |       |      |      |      |
| Tui                                     | 2      | Ad   | 422   | 495  | 459  | 52   |
| <i>Prosthemadera n. novaeseelandiae</i> | 2      | Unk  | 121   | 139  | 130  | 13   |
|   | 4      | Comb | 121   | 495  | 294  | 192  |
| Yellowhammer                            | 7      | Ad   | 632   | 1979 | 1161 | 452  |
| <i>Emberiza citrinella</i>              | 4      | Unk  | 283   | 868  | 573  | 273  |
|   | 11     | Comb | 283   | 1979 | 947  | 482  |
| Chaffinch                               | 2      | Ad   | 384   | 401  | 393  | 12   |
| <i>Fringilla coelebs</i>                | 1      | Unk  | 654   | 654  | 654  |      |
|   | 3      | Comb | 384   | 654  | 480  | 151  |
| Greenfinch                              | 2      | Ad   | 682   | 1312 | 997  | 445  |
| <i>Carduefs chloris</i>                 | 5      | Unk  | 466   | 2870 | 1284 | 986  |
|   | 7      | Comb | 466   | 2870 | 1202 | 837  |
| Goldfinch                               | 1      | Ad   | 1885  | 1885 | 1885 |      |
| <i>C. carduefs</i>                      | 2      | Unk  | 201   | 438  | 320  | 168  |
|   | 3      | Comb | 201   | 1885 | 841  | 912  |
| House Sparrow                           | 7      | Ad   | 349   | 2500 | 1391 | 916  |
| <i>Passer domesticus</i>                | 11     | Unk  | 774   | 7777 | 3559 | 1968 |
|   | 18     | Comb | 349   | 7777 | 2716 | 1938 |

**APPENDIX ONE. Known bone fluoride levels ( $\mu\text{g/g}$ ) ash weight for New Zealand birds.**

Ad = Adult; Imm = Immature; Unk = Unknown; Comb = Combined; SD = Standard deviation

|                                 | <b>n</b> | <b>Age</b>             | <b>Range</b> |            | <b>Mean</b> | <b>SD</b> |
|---------------------------------|----------|------------------------|--------------|------------|-------------|-----------|
|                                 | <b>=</b> |                        | <b>Min</b>   | <b>Max</b> |             |           |
| Starling                        | 28       | Ad                     | 518          | 3036       | 1169        | 560       |
| <i>Sturnus vulgaris</i>         | 1        | Imm                    | 698          | 698        | 698         |           |
|                                 | 14       | Unk                    | 632          | 1204       | 912         | 178       |
|                                 | 43       | Comb                   | 518          | 3036       | 1075        | 479       |
|                                 | 14       | <i>Stewart et. al.</i> | 157          | 1390       | 703         | 355       |
| North Island Kokako             | 2        | Ad                     | 396          | 704        | 550         | 218       |
| <i>Callaeas cinerea wilsoni</i> |          |                        |              |            |             |           |
| Australian Magpie               | 5        | Unk                    | 325          | 1042       | 629         | 322       |
| <i>Gymnorhina tibicen</i>       |          |                        |              |            |             |           |
| Rook                            | 1        | Imm                    | 927          | 927        | 927         |           |
| <i>Corvus frugilegus</i>        |          |                        |              |            |             |           |