

# Paradise Shelduck Moulting Survey

January/February 2020

*Results of annual counts at West Coast moulting sites.*



Glen Newton, Fish & Game Officer, February 2020



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#### **Summary**

*The endemic Paradise Shelduck (*Tadorna variegata*) is the West Coast Regions most intensely managed game bird. Large concentrations of birds can cause conflict with landowners resulting in opportunities for hunters to harvest surplus birds. Each year repeat counts are made of known moult sites to gain an index of relative abundance. This year 27,292 birds were observed in total, this is a 44% increase from the previous year and about 10,000 birds above the 25-year average. Long term monitoring (over 25years) indicates that the northern population has slowly increased by 4% but in the short term (5years) has increased by 10%. Long term monitoring (over 25years) indicates that the southern population has increased by 18% but it has been declining for the last 10 years. Both the northern and southern populations have exceeded management levels. Staff recommendations are to retain current regulations and to promote/conduct organised hunts as a way of increasing harvest and maintaining populations within prescribed management levels.*

#### **Introduction**

Paradise Shelduck (*Tadorna variegata*) ('shelduck') are an endemic New Zealand species and well distributed throughout much of the country. Highest concentrations of shelduck are typically found adjacent to areas of developed farmland. On the West Coast large concentrations of shelduck can be found in the Grey Valley and its catchments, the Buller, Karamea and South Westland.

Since monitoring began in the 1990s populations of shelduck on the West Coast have increased and numbers have exceeded the management levels prescribed in the West Coast Region Fish & Game Management Plan. This population increase is a response to improvement and expansion of their desired habitat – productive farmland (Kelly, 2010). Monitoring has now become critical, both in appeasing landowner concerns that the population is not escalating unchecked, and to allow and to promote opportunities for hunters to harvest surplus birds. This survey provides the baseline information to inform regulation setting, including season length, bag limits and special seasons.

Shelduck congregate during January to March at specific sites to moult. These areas are typically a small to medium sized water body with a nearby food supply. By identifying the location of these moult sites, shelduck populations can be monitored from year to year by counting birds present at each site.

The aim of the current survey was to:

- 1) Repeat the annual counts of known shelduck moult sites to gain an index of relative abundance of shelduck on the West Coast.
- 2) Identify any new sites holding shelduck for repeat counting in 2021.

- 3) Use route regression analysis to assess population trends in the northern and southern management units.
- 4) Provide recommendations for management of the shelduck population in context of the goals and objectives of the West Coast Region ‘Sports Fish & Game Bird Management Plan’.

## Method

Most of the 2020 moult site counts were undertaken in late January using a DJI Mavic Pro drone. Sites were flown around first to identify what birds were present. Moulting shelduck tend to swim out onto open water when they hear the drone. Video and/or photos were then taken, and the footage reviewed in the office. The remaining sites were counted aerially, using a Piper Super Cub aircraft operated by Knights Point Air from Okarito on January 24<sup>th</sup>, or from the ground/boat using binoculars/spotting scope. Where accurate counts were difficult to obtain from the air sites were revisited with the drone or on foot to get a more accurate count. During the aerial flight the location any new or changed sites were identified and counts undertaken (Appendix 1).

The number of birds and the percentage change from the previous year was calculated for all sites and then for the northern and southern management units. Fish & Game best practice ‘route regression analysis’ was then used to analyse the count data. The annual change in counts at individual sites was calculated and summarised into the northern and southern management units. Finally, the data within the northern and southern management units was summarised for population change over time.

## Results

### Overall numbers

A total of 27,292 shelduck were observed moulting across all sites in 2020. This value was up 8,345 shelduck from the 2019 count of 18,947 this equates to an approximate 44% increase in overall numbers counted from the previous year.

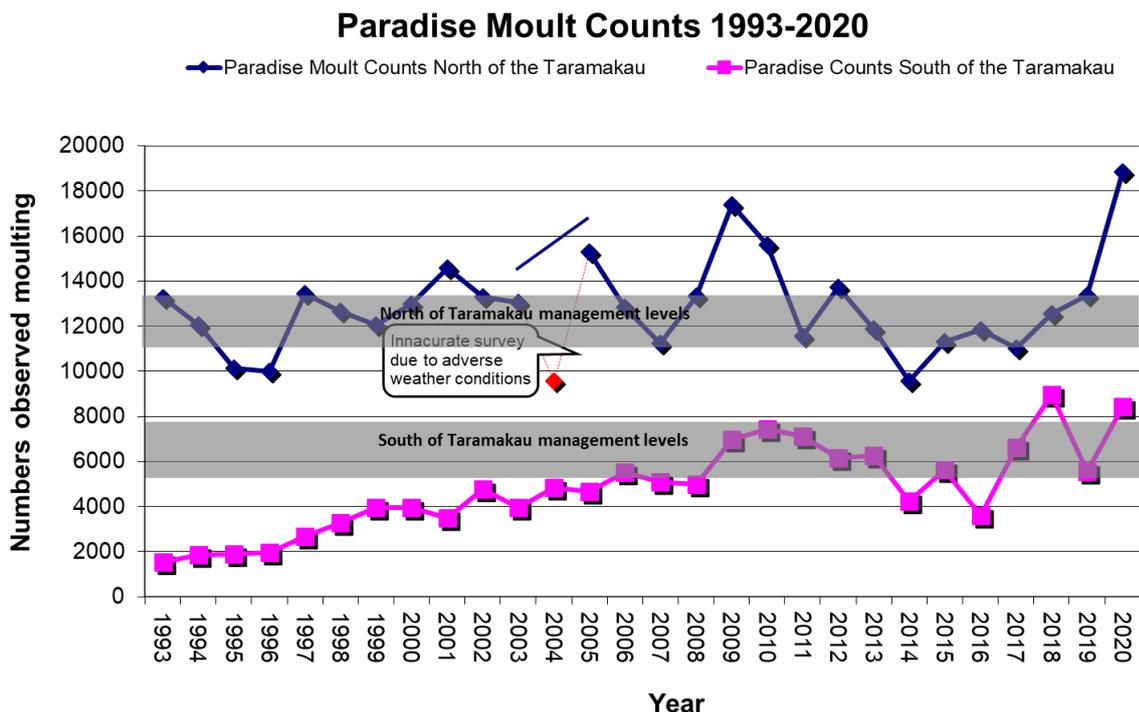


Figure 1: Number of Paradise Shelduck observed moulting in each of the separate management areas since 1993.

### Northern Management Unit (north of Taramakau River).

A total of 18,863 shelduck were observed moulting at sites north of the Taramakau River in 2019. This value was up 5,478 birds from the 2019 count of 13,385, this equates to an approximate 41% increase in overall numbers counted from the previous year (see Figure:1). Over the past 28 years (1993-2020) shelduck across all monitored sites north of the Taramakau have increased by 4% on average. However, over the past five years (2016-2020) numbers of shelduck across all sites north of the Taramakau have increased by 10% on average (Figure 2).

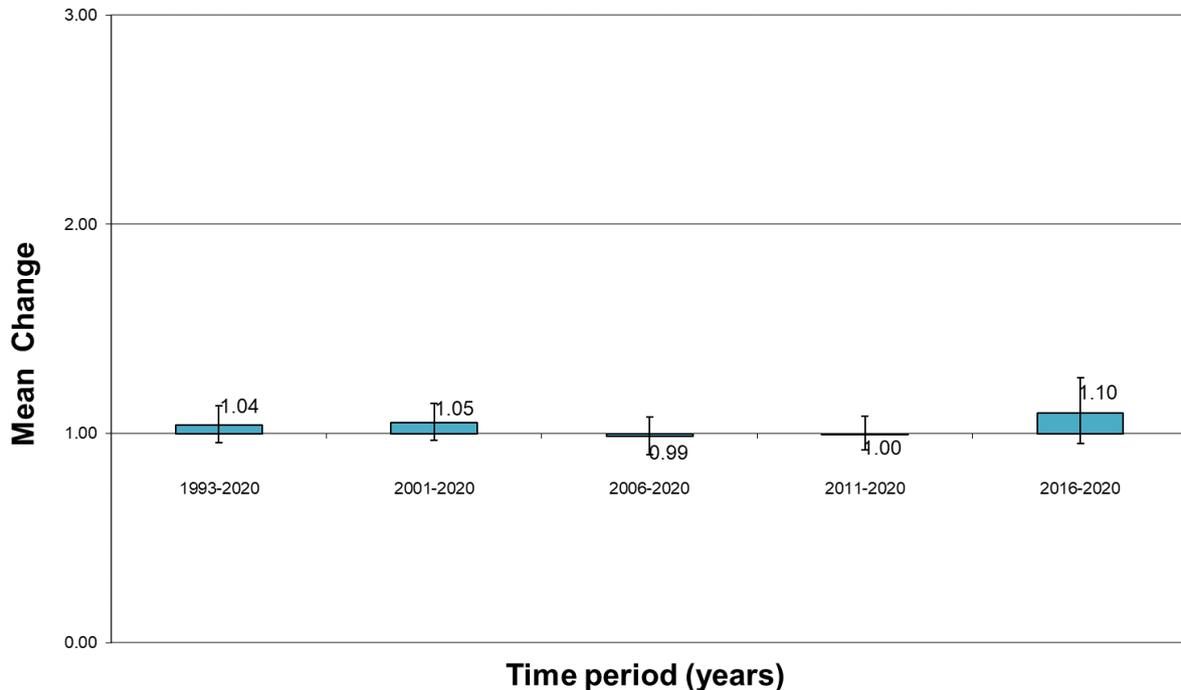


Figure 2: The mean change ( $\pm$ standard error) in Paradise Shelduck moult counts at sites north of the Taramakau River over specified time periods. Values above or below 1.0 represent an increase or decrease in population over that period.

### Southern Management Unit (south of the Taramakau River)

A total of 8,429 birds were observed moulting south of the Taramakau River in 2020. This value is an increase of 2,867 birds from the 2019 count of 5,562 and equates to a 52% increase in overall numbers from the previous year (see Figure 1). Over the past 28 years (1993-2020) shelduck across all monitored sites south of the Taramakau have increased by 18%. However, over the past five years (2016-2020) distribution and numbers of shelduck across many sites south of the Taramakau have declined (Figure 3).

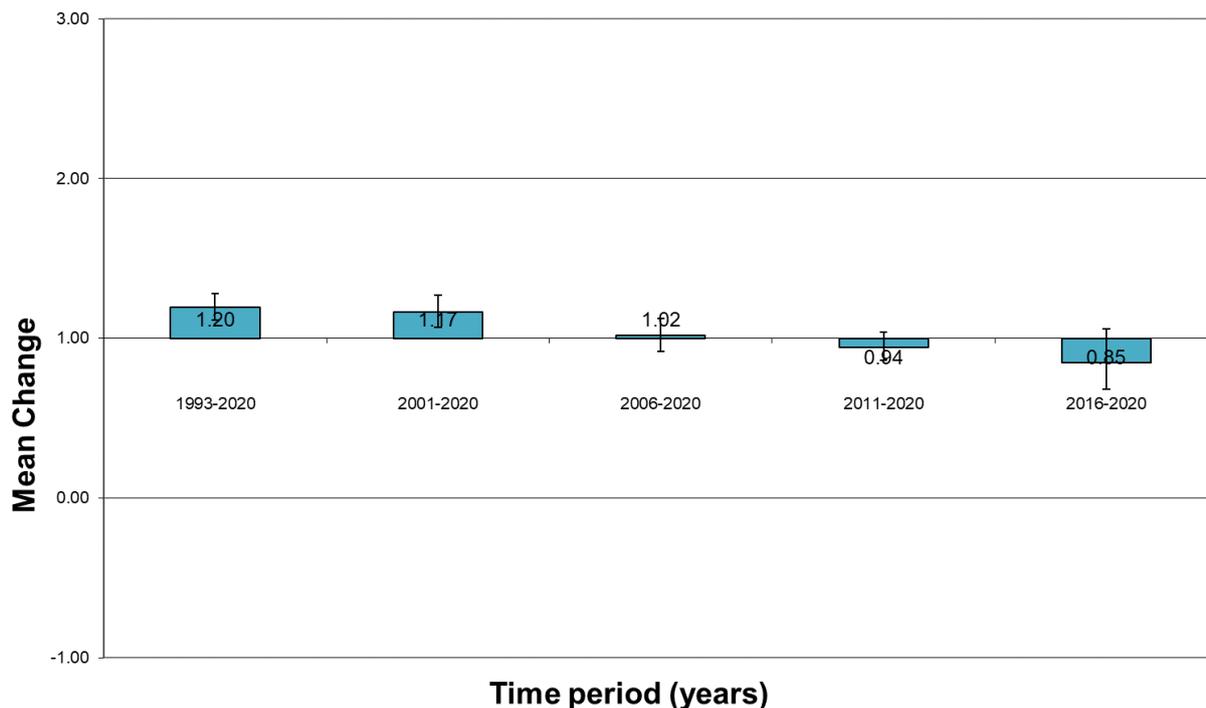


Figure 3: The mean change ( $\pm$  standard error) in Paradise Shelduck moult counts at sites south of the Taramakau River over specified time periods. Values above or below 1.0 represent an increase or decrease in population over that period.

## Discussion

### Methods

The use of a drone has enabled quick, cost effective coverage of many sites historically difficult to monitor. The accuracy of counts at these sites is thought to have improved greatly and as a result the numbers of birds recorded has potentially increased. While most known, significant moult sites, are counted each year the results are not a census of the population, rather a relative index of the actual population. The location of moult sites can vary from year to year and new sites appear. Therefore, the results will be an underestimate of the total birds on the West Coast.

### Northern Management Unit (NMU)

The analysis shows that sites in the NMU have been relatively stable in the long term (1995-2019) with a gradual increase of 4% over the period. Only 9 out of 28 sites showed a decline while the remaining 19 sites showed an increase. However, in the short-term (2016-2020) half the monitored sites (14 out of 28) have shown a decline, 2 out of 28 sites have had no change, and 12 sites have shown an increase. This is reflected in the count data with high numbers of birds in the Grey Valley (>4,500), Lake Brunner (2,809), Lake Haupri (1,842), Westport (Collins and Gillows)(1,453) and Karamea (1,530) but a decline in many of the other traditional moult sites. One site at the Moonlight Creek (3,030) has a particularly high concentration of shelduck and the areas adjacent to this site is where many of the crop predation complaints dealt with come from. As the 2020 counts were higher than 2019, and above prescribed management levels, increasing hunter pressure in these concentrated areas may reduce some of the complaints received.

### Southern Management Unit (SMU)

The analysis shows that on average the 15 sites monitored long term (1993-2020) have increased by 18% with only 2 of 15 sites showing a decline while the remaining 13 sites showed an increase. Interestingly, the analysis shows that on average the 22 sites monitored short term (2016-2020)

have decreased by 15% with half of the 22 sites showing a decline and the other half an increase. This suggests that bird numbers after an initial increase have stabilised and are now dropping. However, what has happened is that birds are now in low numbers or absent from many historical moult sites but in very high numbers at a select few sites. Since each site has the same weighting a suggested decline by the analysis can occur when total numbers are actually increasing. This meant this seasons count was the second highest on record after the 2018 count. The hot dry spell that predominated mid to late January potentially would have exacerbated this trend as birds were moulting early and found clustered in large groups. This was evident on Lake Rotokino (2,350birds), Okarito Lagoon (2,150birds), Groves Swamp (1,250birds) and to a lesser degree L&M pond Arahura (710birds), Lake Pratt (450birds), Fox Oxidation Ponds (400birds) and Lake Ianthe (400birds). These seven sites accounted for 91% of total birds counted. This could be due to birds moulting in new sites, or to different observers and planes undertaking the counts. The lack of crop predation complaints received from the SMU this season potentially reflects the concentration of birds in areas disconnected from pasture.

### **New sites**

The preference for moulting sites is most likely influenced by the availability of food nearby and seasonal conditions such as rainfall. Dry summers could lead to birds choosing to moult on larger waterbodies as smaller waterbodies dry up. Site fluctuations were again noticeable in this year's counts with two new sites located and counted. One in the Waitaha Riverbed above the SH6 bridge and one in Glasseye Creek.

### **Gamebird Regulations**

When the results from both the annual moult counts, and the game harvest survey are combined, management tools can be put in place to maintain a sustainable shelduck population while providing maximum hunter opportunity. In 2019, an estimated total of 3,630 shelduck were harvested by West Coast and out of region licence holders. West Coast licence holders harvested on average only six shelduck for the 2019 season. While there is considerable scope within the current regulations ie. a three-month season and 15 bird daily bag limit for the shelduck population to be kept within prescribed management levels the population is still increasing. Promotion of the hunting opportunity through organised hunts would be beneficial as is opening up the March summer season to all hunters. This provides a useful means for dispersing birds following the moult period when most of the crop predation complaints are dealt with.

### **Staff Recommendations**

- Repeat the annual counts of all known shelduck moult sites including newly identified sites to gain an index of relative abundance of shelduck on the West Coast.
- Retain current bag limits and season duration.
- Continue to promote the West Coast shelduck population as an underutilised resource and rewarding hunting opportunity.
- Undertake organised hunts in areas with high shelduck populations and properties where significant crop predation occurs post moult.

### **References**

**Kelly, D (2010).** *Paradise Shelduck Moult Survey 2010.* Fish & Game West Coast internal report.

**Fish & Game West Coast Region (2011).** *Sports Fish and Game Management Plan for the West Coast Fish & Game Region.* Fish & Game West Coast, internal report.

**Newton, G. (2019).** *Paradise Shelduck Moult Survey January/February 2019.* Fish & Game West Coast internal report.

# Appendices

## Appendix A: Aerial and ground counts of moult sites from 1993 to 2019.

### NMU

| Area                      | 1993         | 1994         | 1995         | 1996         | 1997         | 1998         | 1999         | 2000         | 2001         | 2002         | 2003         | 2004         | 2005         | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         |
|---------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| L. Haupiri                | 702          | 794          | 762          | 540          | 660          | 660          | 490          | 420          | 450          | 450          | 300          | 200          | 350          | 180          | 80           | 320          | 200          | 20           | 20           | 100          | 230          | 230          | 150          | 330          | 430          | 250          | 1491         | 1842         |
| L. Poerua                 | 190          | 216          | 298          | 480          | 210          | 300          | 160          | 320          | 150          | 600          | 300          | 450          | 300          | 160          | 70           | 110          | 450          | 50           | 300          | 30           | 120          | 108          | 232          | 596          | 790          | 400          | 592          | 460          |
| Lake Brunner              | 2722         | 1400         | 1440         | 1200         | 2200         | 1950         | 2100         | 2550         | 2050         | 400          | 1680         | 750          | 1000         | 800          | 1000         | 1350         | 1400         | 300          | 500          | 900          | 500          | 700          | 1655         | 2100         | 1020         | 1500         | 1548         | 2809         |
| Arnold River              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 66           | 68           |
| Ikamatua                  | 1522         | 1500         | 2062         | 2500         | 2800         | 2200         | 1800         | 2000         | 2500         | 1900         | 1410         | 600          | 2500         | 1600         | 1200         | 1500         | 1000         | 1000         | 120          | 700          | 120          | 70           | 3            | 0            | 80           | 0            | 5            | 2            |
| Ikamatua                  |              |              |              |              | 600          | 550          | 400          | 400          | 1000         | 700          | 3            | 0            | 1000         | 1350         | 700          | 1500         | 1750         | 2000         | 1300         | 600          | 500          | 980          | 900          | 420          | 750          | 355          | 415          | 907          |
| Barrytown Lagoon          | 156          | 219          | 164          | 204          | 266          | 230          | 215          | 165          | 270          | 300          | 210          | 150          | 300          | 450          | 450          | 320          | 400          | 370          | 400          | 290          | 230          | 290          | 330          | 170          | 192          | 333          | 450          | 628          |
| Fergusons pond            | 300          | 2900         | 1600         | 0            | 175          | 350          | 550          | 12           | 450          | 0            | 5            | 0            | 0            | 150          | 200          | 150          | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 20           | 0            | 0            | 0            |
| Karamea                   | 226          | 383          | 354          | 580          | 740          | 450          | 780          | 850          | 1450         | 1400         | 1120         | 1300         | 570          | 660          | 1000         | 1000         | 1100         | 2000         | 200          | 1200         | 1450         | 950          | 1450         | 1100         | 950          | 1050         | 967          | 1530         |
| Glasseye Lake             |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 223          |
| Virgin Flat               |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 700          | 650          | 600          | 450          | 580          | 700          | 124          | 218          | 195          | 53           |
| Collins and Gillows       | 340          | 437          | 426          | 542          | 873          | 890          | 705          | 990          | 1186         | 1330         | 1060         | 1100         | 1050         | 1600         | 1085         | 700          | 950          | 1850         | 1200         | 1000         | 288          | 450          | 580          | 350          | 380          | 520          | 962          | 1453         |
| Kokiri pond               | 2400         | 2200         | 2400         | 2280         | 3200         | 3000         | 2100         | 3500         | 3350         | 4000         | 3200         | 1800         | 2600         | 2500         | 1500         | 2500         | 3000         | 3500         | 3300         | 2000         | 1800         | 1900         | 1500         | 1100         | 426          | 560          | 937          | 733          |
| Ahaura River              | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 50           | 50           | 35           | 50           | 95           | 120          | 115          | 56           | 114          | 110          | 113          | 400          | 305          | 190          |
| Grey River                | 3902         | 400          | 74           | 182          | 10           | 80           | 200          | 160          | 0            | 0            | 230          | 230          | 165          | 150          | 570          | 410          | 1960         | 200          | 280          | 320          | 747          | 191          | 910          | 1261         | 2579         | 2700         | 2571         | 3030         |
| Grey River Ngahere        |              |              |              |              | 450          | 510          | 530          | 580          | 750          | 1150         | 2500         | 1260         | 3000         | 560          | 350          | 900          | 500          | 1000         | 280          | 1950         | 2500         | 500          | 400          | 1150         | 309          | 2500         | 345          | 530          |
| Runanga Oxidation Ponds   |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 0            | 0            | 250          | 400          | 400          | 300          | 80           | 300          | 200          | 400          | 350          | 350          | 429          | 987          |
| Inangahua/Buller          | 166          | 77           | 78           | 148          | 150          | 160          | 160          | 220          | 180          | 160          | 85           | 100          | 100          | 90           | 60           | 100          | 80           | 80           | 200          | 150          | 150          | 290          | 280          | 170          | 130          | 118          | 259          | 487          |
| Bell Hill Airstrip        |              |              | 440          | 850          | 400          | 10           | 1400         | 310          | 4            | 100          | 550          | 1250         | 2200         | 1800         | 2200         | 1600         | 3000         | 1600         | 1400         | 900          | 950          | 450          | 276          | 250          | 120          | 68           | 166          | 215          |
| Bell Hill house           |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 0            | 0            | 450          | 500          | 400          | 190          | 1            | 300          | 290          | 17           | 8            | 0            | 178          | 730          |
| Bell Hill New Pond        |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 159          |
| Waipuna Farm Pond         |              |              |              | 163          | 0            | 220          | 150          | 1            | 0            | 0            | 2            | 50           | 50           | 50           | 30           | 70           | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            |
| Waipuna Farm              |              |              |              | 340          | 0            | 0            | 0            | 120          | 0            | 0            | 0            | 95           | 0            | 0            | 30           | 100          | 0            | 160          | 150          | 205          | 195          | 139          | 225          | 34           | 90           | 300          | 43           | 237          |
| Lake Kangaroo             | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 130          | 0            | 150          | 180          | 160          | 0            | 8            | 20           | 30           | 6            | 27           | 10           | 30           | 20           | 0            |
| Lady Lake                 |              |              |              |              | 700          | 1110         | 270          | 360          | 800          | 820          | 410          | 200          | 110          | 350          | 80           | 310          | 200          | 250          | 80           | 250          | 120          | 60           | 145          | 25           | 40           | 0            | 64           | 89           |
| Lake Swan                 | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 200          | 600          | 200          | 150          | 0            | 150          | 100          | 125          | 220          | 180          | 97           | 170          | 100          | 151          | 250          |
| Mawheraiti                |              |              |              |              |              |              | 65           | 10           | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 100          | 0            | 40           | 0            | 37           | 104          | 93           | 321          | 0            | 100          |
| Greenstone Pond           | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 0            | 350          | 20           | 100          | 110          | 40           | 55           | 50           | 0            | 85           | 70           | 87           | 60           |
| Reefton Oxi ponds         |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 300          | 70           | 319          | 450          | 380          | 550          | 581          | 573          |
| Camerons (new River pond) |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 50           | 100          | 50           | 0            | 115          | 120          |
| Reddale Pond              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              | 1600         | 700          | 750          | 400          | 800          | 1100         | 200          | 360          | 398          |
| <b>Total</b>              | <b>13267</b> | <b>12051</b> | <b>10140</b> | <b>10011</b> | <b>13434</b> | <b>12670</b> | <b>12075</b> | <b>12968</b> | <b>14590</b> | <b>13310</b> | <b>13065</b> | <b>9535</b>  | <b>15295</b> | <b>12780</b> | <b>11255</b> | <b>13340</b> | <b>17405</b> | <b>15610</b> | <b>11575</b> | <b>13713</b> | <b>11181</b> | <b>9576</b>  | <b>10879</b> | <b>10950</b> | <b>9867</b>  | <b>12372</b> | <b>13385</b> | <b>18863</b> |
| <b>Change</b>             |              | <b>-1216</b> | <b>-1911</b> | <b>-129</b>  | <b>3423</b>  | <b>-764</b>  | <b>-595</b>  | <b>893</b>   | <b>1622</b>  | <b>-1280</b> | <b>-245</b>  | <b>-3530</b> | <b>5760</b>  | <b>-2515</b> | <b>-1525</b> | <b>2085</b>  | <b>4065</b>  | <b>-1795</b> | <b>-4035</b> | <b>2138</b>  | <b>-2532</b> | <b>-1605</b> | <b>1303</b>  | <b>71</b>    | <b>-1083</b> | <b>2505</b>  | <b>1013</b>  | <b>5478</b>  |
| <b>% Change</b>           |              | <b>-9</b>    | <b>-16</b>   | <b>-1</b>    | <b>34</b>    | <b>-6</b>    | <b>-5</b>    | <b>7</b>     | <b>13</b>    | <b>-9</b>    | <b>-2</b>    | <b>-27</b>   | <b>60</b>    | <b>-16</b>   | <b>-12</b>   | <b>19</b>    | <b>30</b>    | <b>-10</b>   | <b>-26</b>   | <b>18</b>    | <b>-18</b>   | <b>-14</b>   | <b>14</b>    | <b>1</b>     | <b>-10</b>   | <b>25</b>    | <b>8</b>     | <b>41</b>    |

SMU

| Area              | 1993        | 1994        | 1995        | 1996        | 1997        | 1998        | 1999        | 2000        | 2001        | 2002        | 2003        | 2004        | 2005        | 2006        | 2007        | 2008        | 2009        | 2010        | 2011        | 2012        | 2013        | 2014         | 2015        | 2016         | 2017        | 2018        | 2019         | 2020        |    |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|--------------|-------------|-------------|--------------|-------------|----|
| L. Arthur         | 100         | 68          | 150         | 239         | 200         | 120         | 170         | 135         | 50          | 60          | 58          | 20          | 30          | 20          | 0           | 0           | 20          | 4           | 40          | 50          | 86          | 135          | 175         | 80           | 190         | 50          | 92           | 80          |    |
| L. Rotokino       | 1196        | 840         | 1430        | 1307        | 1960        | 1992        | 2470        | 2825        | 2350        | 3120        | 3050        | 2300        | 2000        | 2000        | 1500        | 1900        | 2800        | 1000        | 700         | 1490        | 2070        | 430          | 1530        | 570          | 1210        | 4000        | 1440         | 2350        |    |
| Lake Wahapo       | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 200         | 20          | 0           | 0           | 25          | 70          | 30          | 40          | 98           | 0           | 60           | 150         | 100         | 150          | 30          |    |
| Saltwater Lagoon  | 0           | 940         | 0           | 0           | 0           | 0           | 0           | 250         | 50          | 0           | 0           | 0           | 30          | 0           | 50          | 0           | 10          | 0           | 60          | 100         | 90          | 61           | 45          | 50           | 31          | 50          | 90           | 0           |    |
| Five Mile Lagoon  | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 280         | 260         | 80          | 70          | 50          | 130         | 100         | 103         | 104          | 110         | 160          | 94          | 70          | 34           | 0           |    |
| Totara Lagoon     | 239         | 0           | 320         | 420         | 210         | 370         | 165         | 170         | 160         | 165         | 80          | 0           | 100         | 100         | 70          | 135         | 0           | 120         | 140         | 170         | 295         | 81           | 38          | 235          | 295         | 20          | 225          | 122         |    |
| Lake Pratt        | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 200         | 350         | 200         | 400         | 250         | 150         | 160         | 200         | 280          | 120         | 200          | 250         | 200         | 140          | 450         |    |
| Cook Lagoon       | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 300         | 350         | 300         | 300         | 350         | 1200        | 300         | 300         | 0            | 120         | 50           | 150         | 50          | 72           | 0           |    |
| Cook River        |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 130         | 59           | 284         | 70           | 296         | 0           | 140          | 400         |    |
| Waitaha Lagoon    | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 170         | 350         | 400         | 350         | 370         | 250         | 360         | 240         | 140         | 300         | 230          | 150         | 5            | 30          | 10          | 4            | 165         |    |
| Arahura           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 200         | 390         | 780         | 88          | 230         | 280         | 940         | 500         | 900         | 1500        | 600         | 1200        | 920         | 500         | 665          | 450         | 184          | 422         | 450         | 384          | 710         |    |
| Kapitea Reservoir | 0           | 0           | 0           | 0           | 320         | 810         | 610         | 450         | 510         | 650         | 520         | 136         | 390         | 100         | 30          | 110         | 120         | 20          | 5           | 65          | 5           | 29           | 54          | 20           | 2           | 20          | 40           | 30          |    |
| Grove Swamp       | 0           | 0           | 0           | 0           | 0           | 0           | 300         | 140         | 40          | 0           | 150         | 2000        | 1500        | 700         | 550         | 700         | 1500        | 4000        | 2000        | 1100        | 1650        | 1300         | 1550        | 380          | 745         | 2000        | 1400         | 1250        |    |
| Hokitika River    | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 300         | 500         | 180         | 0           | 100         | 50          | 240         | 64          | 56           | 53          | 208          | 205         | 50          | 137          | 170         |    |
| Whataroa River    |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 50          | 0           | 110          | 0           | 66           | 170         | 0           | 10           | 14          | 0  |
| Lake lanthe       |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 180         | 300         | 50          | 200          | 160         | 200          | 338         | 200         | 330          | 400         |    |
| Lake Mapourika    |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 20          | 10          | 0           | 0            | 2           | 8            | 2           | 0           | 0            | 2           |    |
| Okarito Lagoon    | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 500         | 0           | 0           | 550         | 900         | 780         | 70          | 484          | 530         | 565          | 1854        | 1600        | 600          | 2150        |    |
| Wanganui Lagoon   | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 0           | 60          | 110         | 0           | 0           | 0           | 0           | 0           | 0            | 0           | 5            | 0           | 10          | 3            | 2           |    |
| Poerua River pond |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 70          | 18          | 0            | 65          | 60           | 140         | 0           | 70           | 30          |    |
| Hari Hari farms   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 150         | 20          | 6            | 0           | 185          | 68          | 0           | 55           | 4           |    |
| Gillespies beach  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |              | 60          | 5            | 0           | 0           | 0            | 2           | 0  |
| Lake Kaniere      |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             | 150         | 17           | 70          | 0            | 147         | 70          | 140          | 44          |    |
| Waiho River       |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |              |             | 120          | 0           | 0           | 0            | 0           | 0  |
| Taramakau         |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |              |             |              |             |             |              | 100         | 40 |
| <b>Total</b>      | <b>1535</b> | <b>1848</b> | <b>1900</b> | <b>1966</b> | <b>2690</b> | <b>3292</b> | <b>3965</b> | <b>3970</b> | <b>3500</b> | <b>4775</b> | <b>3946</b> | <b>4856</b> | <b>4680</b> | <b>5540</b> | <b>5090</b> | <b>4985</b> | <b>6970</b> | <b>7429</b> | <b>7135</b> | <b>6175</b> | <b>6251</b> | <b>4235</b>  | <b>5632</b> | <b>3590</b>  | <b>6619</b> | <b>8960</b> | <b>5562</b>  | <b>8429</b> |    |
| <b>Change</b>     |             | <b>313</b>  | <b>52</b>   | <b>66</b>   | <b>724</b>  | <b>602</b>  | <b>673</b>  | <b>5</b>    | <b>-470</b> | <b>1275</b> | <b>-829</b> | <b>910</b>  | <b>-176</b> | <b>860</b>  | <b>-450</b> | <b>-105</b> | <b>1985</b> | <b>459</b>  | <b>-294</b> | <b>-960</b> | <b>76</b>   | <b>-2016</b> | <b>1397</b> | <b>-2042</b> | <b>3029</b> | <b>2341</b> | <b>-3398</b> | <b>2867</b> |    |
| <b>% Change</b>   |             | <b>20</b>   | <b>3</b>    | <b>3</b>    | <b>37</b>   | <b>22</b>   | <b>20</b>   | <b>0</b>    | <b>-12</b>  | <b>36</b>   | <b>-17</b>  | <b>23</b>   | <b>-4</b>   | <b>18</b>   | <b>-8</b>   | <b>-2</b>   | <b>40</b>   | <b>7</b>    | <b>-4</b>   | <b>-13</b>  | <b>1</b>    | <b>-32</b>   | <b>33</b>   | <b>-36</b>   | <b>84</b>   | <b>35</b>   | <b>-38</b>   | <b>52</b>   |    |

Appendix B: West Coast Region Paradise Shelduck moult count sites.

| Moult Area              | NZTM Map grid reference |           |           |           |
|-------------------------|-------------------------|-----------|-----------|-----------|
|                         | Northing                | Easting   | Northing  | Easting   |
| L. Haupiri              | 5286391.6               | 1492479.8 |           |           |
| L. Poerua               | 5270574.8               | 1476089   |           |           |
| Lake Brunner            | 5283205.2               | 1475503.2 |           |           |
| Ikamatua                | 5320364.6               | 1491629.2 |           |           |
| Ikamatua                | 5321226.3               | 1491977.2 |           |           |
| Barrytown Lagoon        | 5327157.7               | 1460956.3 |           |           |
| Karamea                 | 5434333.2               | 1524774.8 |           |           |
| Virgin flat             | 5366728.3               | 1476234.5 |           |           |
| Collins and Gillows     | 5374297.5               | 1480421.9 |           |           |
| Kokiri pond             | 5295944.1               | 1466377.7 |           |           |
| Ahaura River            | 5290399.1               | 1501656   | 5299918.4 | 1496530   |
| Grey River              | 5317371.8               | 1490202   | 5305236.3 | 1469544.9 |
| Grey River Ngahere      | 5303381                 | 1468471.8 |           |           |
| Runanga Oxidation Ponds | 5305572.1               | 1456214.1 |           |           |
| Inangahua/Buller        | 5363806.6               | 1510086.6 |           |           |
| Bell Hill Airstrip      | 5288284.4               | 1479090.3 |           |           |
| Bell Hill House         | 5286461.7               | 1485843.4 |           |           |
| Waipuna Farm pond       | 5219923.9               | 1496637.4 |           |           |
| Waipuna Farm            | 5309914.6               | 1496662.7 |           |           |
| Kangaroo Lake           | 5280914.9               | 1480401.7 |           |           |
| Lady Lake               | 5282324.1               | 1483041.4 |           |           |
| Lake Swan               | 5276598                 | 1479592.2 |           |           |
| Mawheraiti              | 5335951.8               | 1497432.6 |           |           |
| Greenstone Pond         | 5277640                 | 1454678.5 |           |           |
| Reddale Pond            | 5339256.4               | 1508720.5 |           |           |
| Reefton Ponds           | 5337230                 | 1504823.3 |           |           |
| L. Arthur               | 5248056                 | 1444683   |           |           |
| L. Rotokino             | 5218444.3               | 1391019.8 |           |           |
| L. Wahapo               | 5207542.5               | 1378773.9 |           |           |
| Saltwater Lagoon        | 5218445.1               | 1384909.2 |           |           |
| Five Mile Lagoon        | 5205162.7               | 1364472   |           |           |
| Totara Lagoon           | 5255928.5               | 1425496.2 |           |           |
| Lake Pratt              | 5196286.2               | 1370685.3 |           |           |
| Cook Lagoon             | 5184874.4               | 1339758.6 |           |           |
| Waitaha Lagoon          | 5239832.6               | 1407604   |           |           |
| Arahura                 | 5270233.6               | 1442185.1 |           |           |
| Kapitea Reservoir       | 5272033.4               | 1452226.9 |           |           |
| Grove Swamp             | 5255748.5               | 1430778.7 |           |           |
| Hokitika River          | 5265407.4               | 1436224   |           |           |
| Whataroa River          | 5217600.8               | 1386907.3 | 5254807.1 | 1433662.3 |
| Lake Ianthe             | 5230228.7               | 1406335.3 |           |           |
| Lake Mapourika          | 5199140.6               | 1372443.9 |           |           |
| Okarito Lagoon          | 5213936.1               | 1373735   |           |           |
| Wanganui Lagoon         | 5231805.4               | 1390435.9 |           |           |
| Poerua River pond       | 5222394.3               | 1393511.6 |           |           |
| Hari Hari farms         | 5224603                 | 1403356.4 |           |           |
| Lake Kaniere            | 5252602.6               | 1449532.2 |           |           |
| Gillespies beach creek  | 5188677.5               | 1343434.5 |           |           |
| Camerons pond           | 5287587.5               | 1447367.5 |           |           |