

15 November 2011

# Living Lake Symposium

Monitoring and enhancing the lake's  
ecosystem services

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**Bio-Protection**

*Bioprotection science for New Zealand*


# What are ecosystem services?

Ecosystem functions for which mankind sees a value e.g.

- pollination
- biological control of pests, weeds and diseases
- soil formation and drainage
- carbon capture
- mitigation of the effects of climate
- mitigation of farmland runoff
- provision of food, including fish
- aesthetics
- culture, including kaitiakitanga







and mitigate runoff and direct pollution from intensive agriculture, especially dairy – but, we are not alone



# Hypoxic zone off Mississippi River delta



**Bio-Protection**



Lake Ellesmere was an estuary, and still is when Kaitorete Spit is opened





# Current state of the lake?

Second most polluted lake in New Zealand

High concentrations of nitrogen and phosphorus and high turbidity – and recent sewage inputs

Who is monitoring the lake?

Can monitors nutrients but what about the lake's living things and the ecosystem services they provide?

e.g. WET's important planting work, bird and fish populations, lake invertebrates etc?









# Which ecosystem services associated with riparian plantings should be monitored?

- reduction of turbidity
- trapping of silt runoff
- improvement of stream invertebrate and fish populations
- reduction of water temperature
- improved aesthetics
- improved kaitiakitanga



## What is the economic value of Lake Ellesmere?

In 1997, Costanza *et al.* evaluated ecosystem services in the world's biomes

**Table 2 Summary of average global value of annual ecosystem services**

| Biome                                | Area<br>(ha × 10 <sup>6</sup> ) | Ecosystem services (1994 US\$ ha <sup>-1</sup> yr <sup>-1</sup> ) |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                | Total value<br>per ha<br>(\$ha <sup>-1</sup> yr <sup>-1</sup> ) | Total global<br>flow value<br>(\$yr <sup>-1</sup> × 10 <sup>6</sup> ) |              |
|--------------------------------------|---------------------------------|---|----------------------------|--------------------------------|--------------------------|----------------------|-------------------------|------------------------|--------------------------|-------------------------|-------------------|-----------------------------|---------------------------|--------------------------|------------------------|----------------------------|------------------|----------------|---|---|--------------|
|                                      |                                 | 1<br>Gas<br>regulation  | 2<br>Climate<br>regulation | 3<br>Disturbance<br>regulation | 4<br>Water<br>regulation | 5<br>Water<br>supply | 6<br>Erosion<br>control | 7<br>Soil<br>formation | 8<br>Nutrient<br>cycling | 9<br>Waste<br>treatment | 10<br>Pollination | 11<br>Biological<br>control | 12<br>Habitat/<br>refugia | 13<br>Food<br>production | 14<br>Raw<br>materials | 15<br>Genetic<br>resources | 16<br>Recreation | 17<br>Cultural |   |   |              |
| Marine                               | 36,302                          |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                | 677   | 20,349  |              |
| Open ocean                           | 33,200                          | 36  |                            |                                |                          |                      |                         | 116                    |                          |                         |                   | 5                           |                           | 16                       | 0                      |                            |                  | 76             | 252   | 8,381   |              |
| Coastal                              | 3,102                           |   |                            | 88                             |                          |                      |                         | 3,677                  |                          |                         |                   | 38                          | 8                         | 93                       | 4                      |                            |                  | 82             | 82  | 4,052   | 12,068       |
| Estuaries<br>Seagrass/<br>algae beds | 180<br>200                      |   |                            | 567                            |                          |                      |                         | 21,000<br>19,002       |                          |                         |                   | 78                          | 131                       | 621                      | 26<br>2                |                            |                  | 381<br>29      | 22,832<br>19,004  | 4,110<br>3,801  |              |
| Coral reefs<br>Shelf                 | 82<br>2,660                     |   |                            | 2,750                          |                          |                      |                         | 1,431                  |                          | 58                      |                   | 5                           | 7                         | 200                      | 27                     |                            |                  | 3,008          | 1   | 6,075<br>1,610  | 375<br>4,283 |
| Terrestrial                          | 15,323                          |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                | 804   | 12,319  |              |
| Forest                               | 4,855                           |   | 141                        | 2                              | 2                        | 3                    | 96                      | 10                     | 361                      | 87                      |                   | 2                           |                           | 43                       | 136                    | 16                         | 66               | 2              | 969   | 4,700   |              |
| Tropical                             | 1,900                           |   | 223                        | 5                              | 6                        | 8                    | 245                     | 10                     | 902                      | 87                      |                   |                             |                           | 32                       | 315                    | 41                         | 112              | 2              | 2,007   | 3,813   |              |
| Temperate/boreal                     | 2,955                           |   | 88                         |                                | 0                        |                      |                         | 10                     |                          | 87                      |                   | 4                           |                           | 80                       | 25                     |                            | 38               | 2              | 302   | 894   |              |
| Grass/rangelands                     | 3,898                           | 7   | 0                          |                                | 3                        |                      | 29                      | 1                      |                          | 87                      | 25                | 23                          |                           | 67                       |                        | 0                          | 2                |                | 232   | 906   |              |
| Wetlands                             | 330                             | 133   |                            | 4,539                          | 15                       | 3,800                |                         |                        |                          | 4,177                   |                   |                             | 304                       | 256                      | 106                    |                            | 574              | 881            | 14,795  | 4,879   |              |
| Tidal marsh/<br>mangroves            | 165                             |   |                            | 1,809                          |                          |                      |                         |                        |                          | 6,696                   |                   |                             | 189                       | 466                      | 182                    |                            | 658              |                | 6,990   | 1,648   |              |
| Swamps/<br>floodplains               | 165                             | 266   |                            | 7,240                          | 30                       | 7,800                |                         |                        |                          | 1,659                   |                   |                             | 439                       | 47                       | 40                     |                            | 481              | 1,761          | 19,580  | 3,231   |              |
| Lakes/rivers                         | 200                             |   |                            |                                | 5,446                    | 2,117                |                         |                        |                          | 665                     |                   |                             |                           | 41                       |                        |                            | 230              |                | 6,496   | 1,700   |              |
| Desert                               | 1,825                           |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |   |   |              |
| Tundra                               | 743                             |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |   |   |              |
| Ice/mink                             | 1,640                           |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |   |   |              |
| Cropland                             | 1,400                           |   |                            |                                |                          |                      |                         |                        |                          |                         |                   | 14                          | 24                        |                          | 54                     |                            |                  |                |   | 92  | 128          |
| Urban                                | 332                             |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |   |   |              |
| <b>Total</b>                         | <b>51,625</b>                   | <b>1,341</b>  | <b>694</b>                 | <b>1,779</b>                   | <b>1,315</b>             | <b>1,882</b>         | <b>576</b>              | <b>53</b>              | <b>17,075</b>            | <b>2,277</b>            | <b>117</b>        | <b>417</b>                  | <b>124</b>                | <b>1,386</b>             | <b>721</b>             | <b>79</b>                  | <b>815</b>       | <b>3,015</b>   |   | <b>33,268</b>   |              |

Numbers in the body of the table are in \$ ha<sup>-1</sup> yr<sup>-1</sup>; Row and column totals are in \$ yr<sup>-1</sup> × 10<sup>6</sup>; column totals are the sum of the products of the per ha services in the table and the area of each biome, not the sum of the per ha services themselves. Shaded cells indicate services that do not occur or are known to be negligible. Open cells indicate lack of available information.

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| Biome                     | Area<br>(ha × 10 <sup>6</sup> ) | Ecosystem services (1994 US\$ ha <sup>-1</sup> yr <sup>-1</sup> ) |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                | Total value<br>per ha<br>(\$ ha <sup>-1</sup> yr <sup>-1</sup> ) | Total global<br>flow value<br>(\$ yr <sup>-1</sup> × 10 <sup>9</sup> ) |     |
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| Seagrass                  | 200                             |   |                            |                                |                          |                      |                         | 19,002                 |                          |                         |                   |                             |                           |                          | 2                      |                            |                  |                | 19,004   | 3,801  |     |
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| Shelf                     | 2,660                           |   |                            |                                |                          |                      |                         | 1,431                  |                          |                         |                   | 39                          |                           | 68                       | 2                      |                            |                  | 70             | 1,610  | 4,283  |     |
| Terrestrial               | 15,323                          |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                | 804  | 12,319   |     |
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| Tundra                    | 743                             |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |  |  |     |
| Ice/rock                  | 1,640                           |   |                            |                                |                          |                      |                         |                        |                          |                         |                   |                             |                           |                          |                        |                            |                  |                |  |  |     |
| Cropland                  | 1,430                           |   |                            |                                |                          |                      |                         |                        |                          |                         |                   | 14                          | 24                        |                          | 54                     |                            |                  |                |  | 92   | 128 |
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| <b>Total</b>              | <b>51,625</b>                   | <b>1,341</b>  | <b>694</b>                 | <b>1,779</b>                   | <b>1,315</b>             | <b>1,882</b>         | <b>576</b>              | <b>53</b>              | <b>17,075</b>            | <b>2,277</b>            | <b>117</b>        | <b>417</b>                  | <b>124</b>                | <b>1,386</b>             | <b>721</b>             | <b>79</b>                  | <b>815</b>       | <b>3,015</b>   |  | <b>33,268</b>  |     |

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## So what is the economic value of Lake Ellesmere?

US\$22,832 x 19,000 ha =

US\$400 million/year

A grossly simplified calculation but based on a fisheries nursery, recreation including boating and birding, ecotourism, aesthetics including mauri for Maori



## Wading birds?

Highest populations in Australasia of banded dotterel, pied stilt and caspian tern



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and an important staging post for wrybill



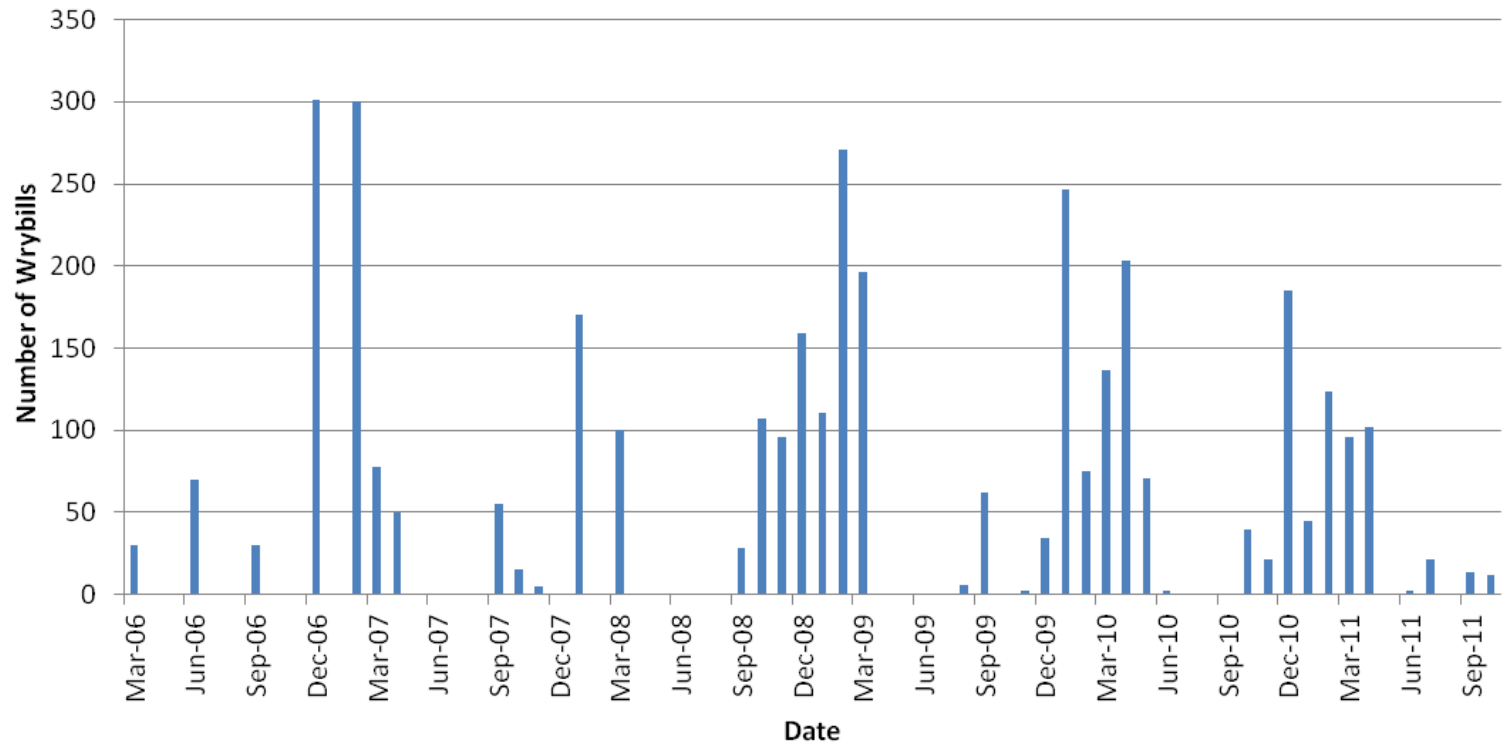
4,000 wrybills in NZ in 2011, and declining





# Monthly Wrybill (*Anarhynchus frontalis*) counts at Te Waihora - Lake Ellesmere

Data from Colin Hill and Steve Wratten



# The future:

- Taumutu marae to house a Te Waihora environmental display
- Benjamin Bradley from Victoria University, Wellington to be a LU-funded Summer Scholar quantifying ecosystem services from riparian plantings
- Continuing pollution of the lake?
- Serious funding for monitoring including mud invertebrates and flounder and eel ecology and population dynamics
- Whakaora te Waiora needs to fund mud invertebrate, fish and bird monitoring and other ecosystem services, including those in the lake's feeder streams. Do not only concentrate on the Halswell River.

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