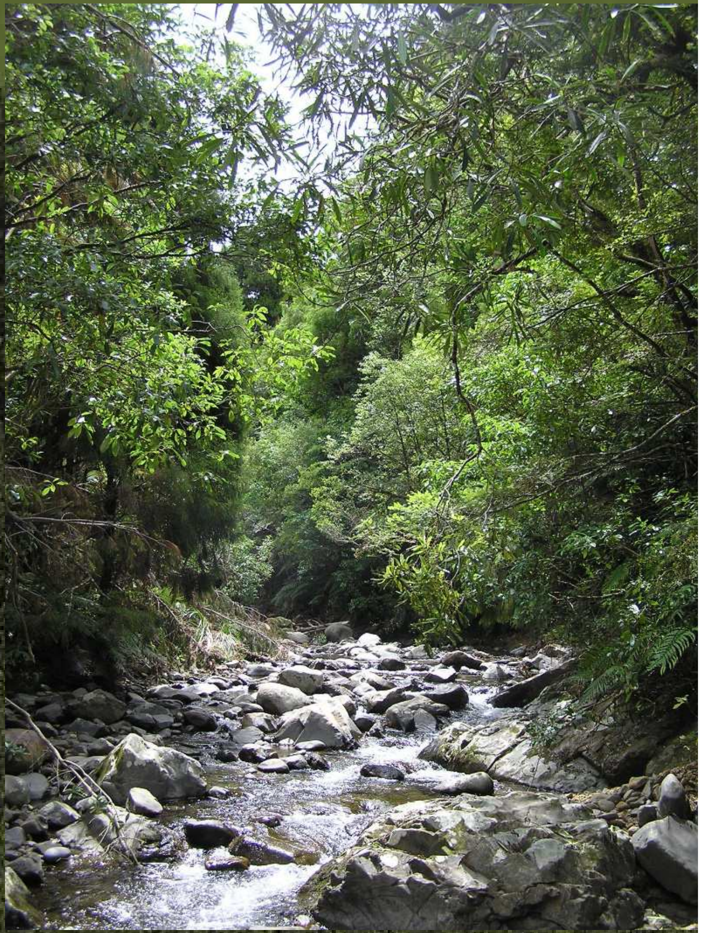
Forestry and Freshwater

The role of commercial plantation forestry in the status of our water quality



29/10/2015

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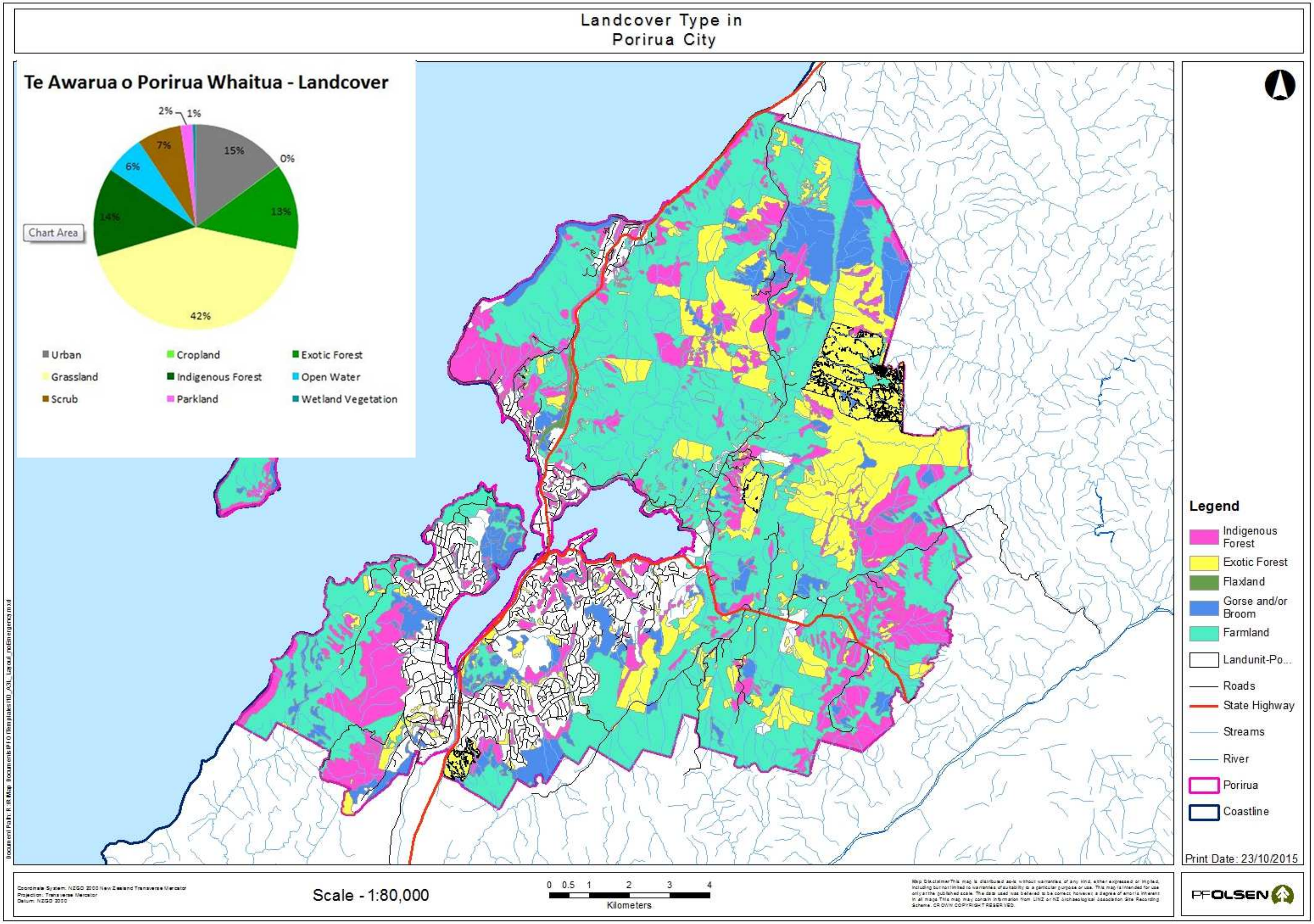
Plantations in the local mix

- Landuse
  - Plantations 13%
  - Indigenous 14%
  - Scrublands 7%
  - Grassland 41%
  - Urban 15%


Landcover Type in
Porirua City
Te Awarua o Porirua Whaitua - Landcover
2%
1%
15%
0%
7%
6%
13%
14%
Chart Area
42%
Urban
Cropland
Exotic Forest
Grassland
Indigenous Forest
Open Water
Scrub
Parkland
Wetland Vegetation
Legend
Indigenous Forest
Exotic Forest
Flaxland
Gorse and/or Broom
Farmland
Landunit-Po...
Roads
State Highway
Streams
River
Porirua
Coastline
Print Date: 23/10/2015
Coordinate System: NZGD 2000 New Zealand Transverse Mercator
Projection: Transverse Mercator
Datum: NZGD 2000
Scale - 1:80,000
0 0.5 1 2 3 4
Kilometers
Map Disclaimer This map is distributed as-is without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use. This map is intended for use only at the published scale. The data used was believed to be correct, however a degree of error is inherent in all maps. This map may contain information from LINZ or NZ Archaeological Association Site Recording Scheme. CROWN COPYRIGHT RESERVED.
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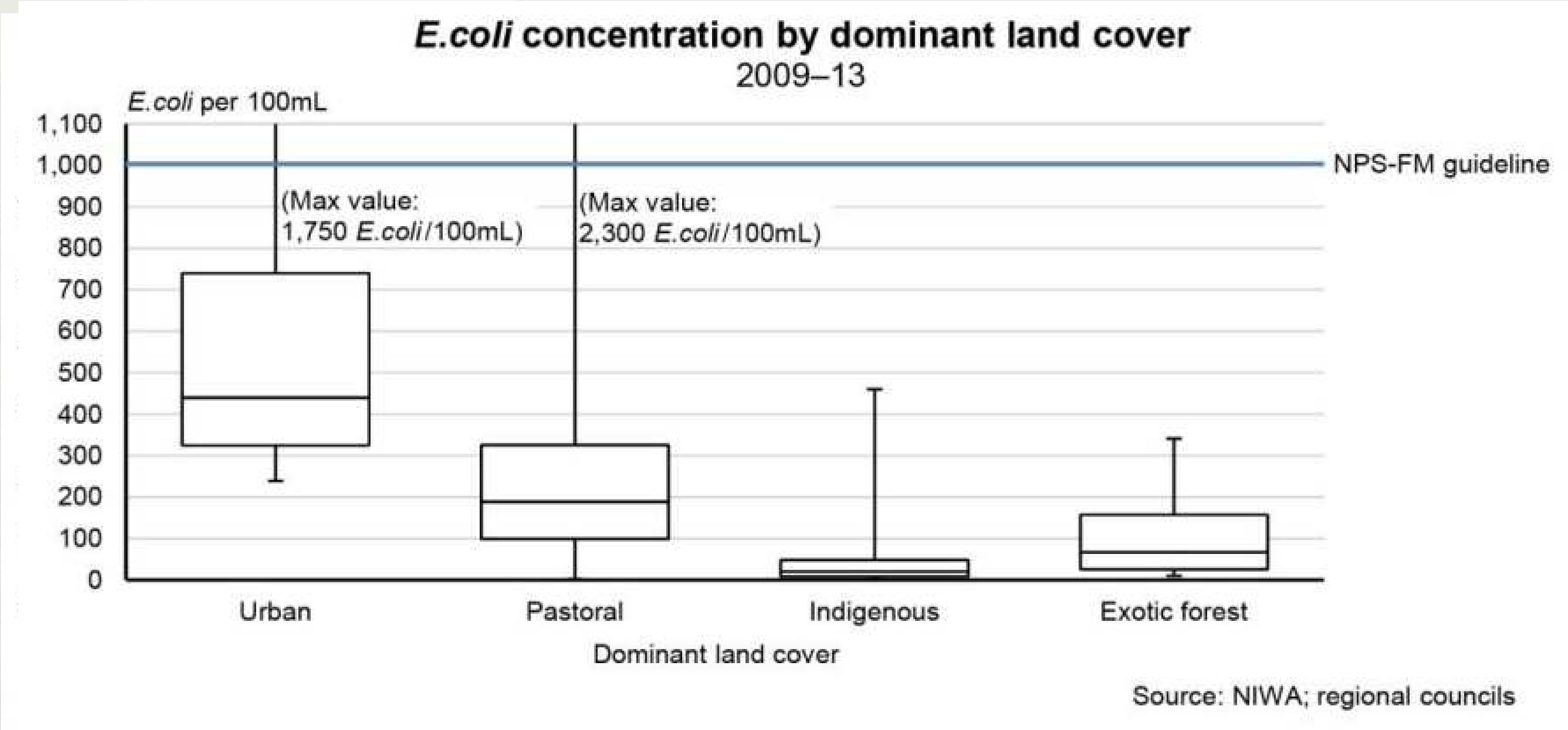
What does the data tell us



National Data = generally encouraging

Other regions

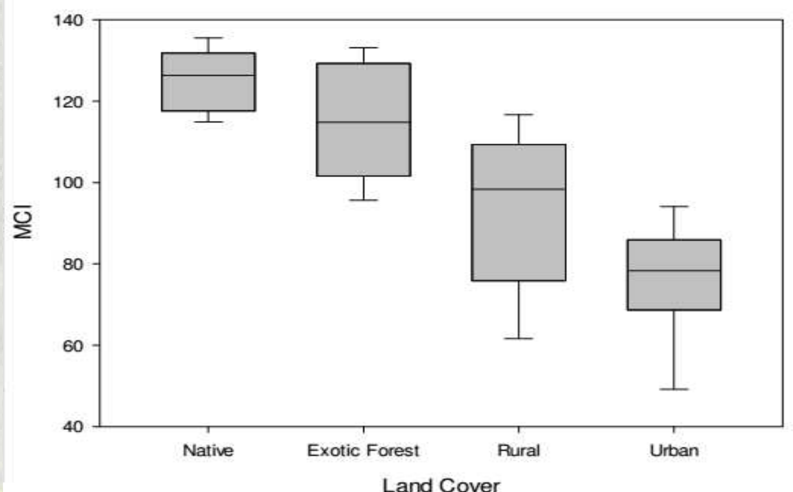
- National datasets generally indicates plantation forests maintain an average status a bit below undisturbed native forest but above pastoral farming and urban.

- Other regional data confirms….

But pure forestry sites underrepresented.

Auckland 6% of sample

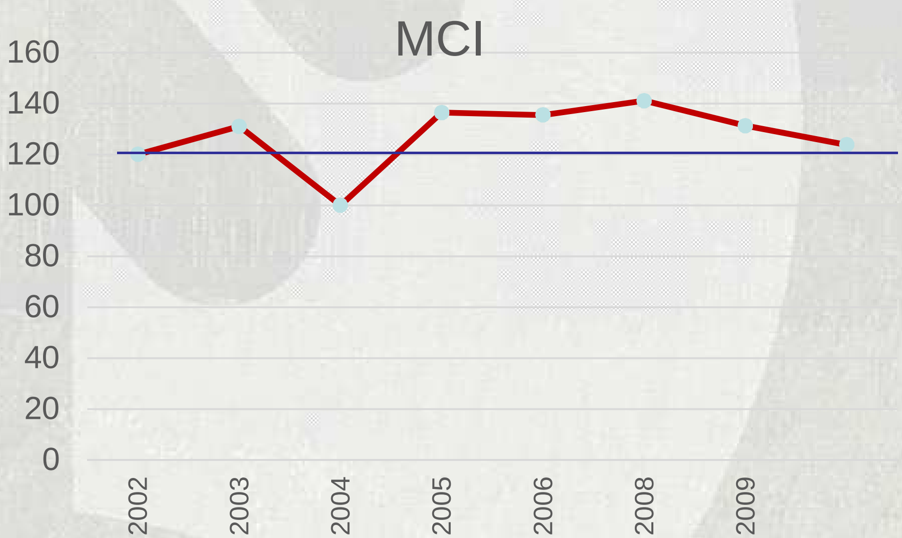
Land cover	Water Quality Index	Water Quality Class
Native	91.7	Excellent
Exotic Forest	81.9	Good
Rural	66.7	Fair
Urban	54.3	Fair



2001-02	120
2002-03	131.1111
2003-04	100
2004-05	136.3636
2005-06	135.4545
2007-08	141.1111
2008-09	131.25
2012-13	123.8095

Other examples

Mangapapa Bay of Plenty



West Coast

2013 MCI results

Location	Sunday Creek	Austrians Ck	Redjacks Creek	Ongionui (12 Mile)	Blackmums Ck	Moores Creek	Palmers Creek	German Gully Stream
MCI	136	127	146	139	130	114	116	145
QMCI	6	6	8	8	6	7	8	8

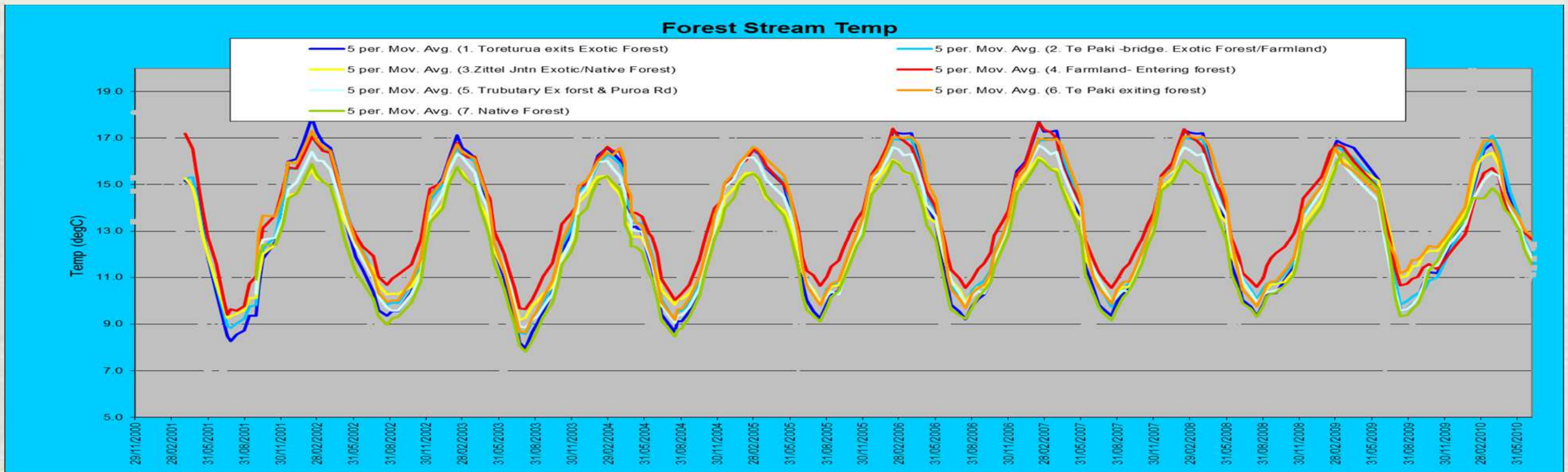
Sunday Creek	Estimated fishing area = 220m2			
	Fish abundance (fish/m2)			
	2003	2006	2008	2010
Longfin eel	0.073	0.095	0.005	0
Shortfin eel	0	0.009	0.005	0
Inanga	0	0	0	0
Koaro	0.16	0.06	0.01	0
Shortjaw kokopu	0	0	0	0
Banded Kokopu	0.28	0.36	0.11	0.02
Brown trout	0	0	0	0
Bluegill bully	0	0	0	0
Upland bully	0	0	0	0
Redfin bully	0.04	0.03	0.05	0
Dwarf galaxias	0	0	0	0
Lamprey	0	0.015	0	0

Water Temperature

Measured from a long term in-forest monitoring site during harvest.

Native fish have maximum temperature acceptability of approximately 25°C (shortfin and longfin eels) and about 20°C for many bully species and below 20°C for trout and galaxid species. Introduced sport fish (salmon and trout) are stressed when temperatures exceed 20°C (Quinn, Hickey, 1990).

When considering macroinvertebrates water temperature is a key determinant of diversity. Stoneflies are largely confined to rivers between 13 and 19°C and mayflies are less common in rivers with maximum temperatures greater than 21.5°C (Quinn, Hickey, 1990).



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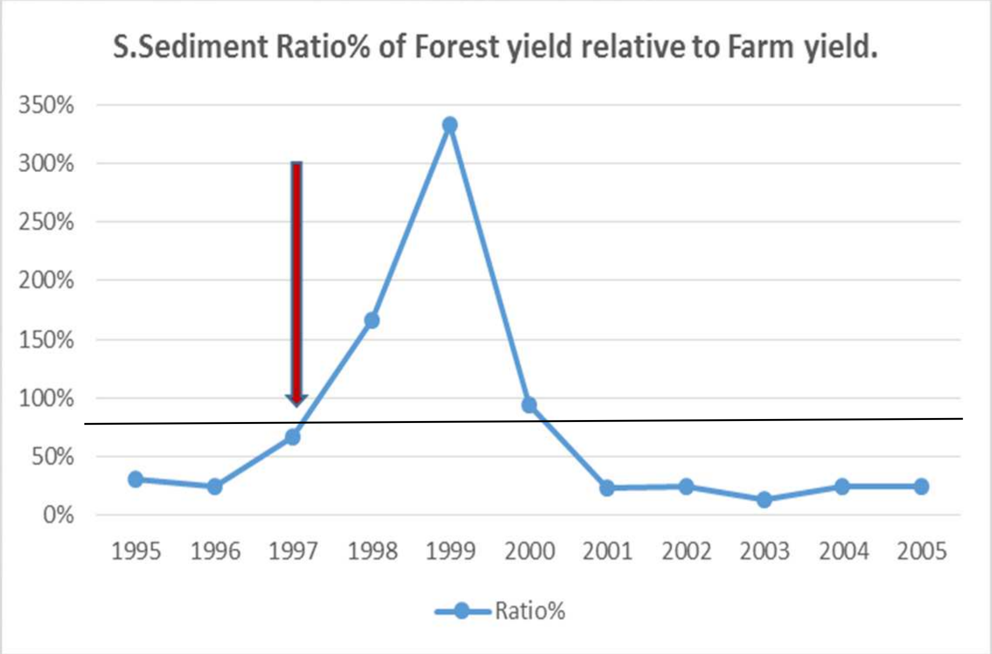
Forestry’s concern – Periodic sedimentation

- At time of harvest and particularly earthworks.
- Predominantly in small headwaters streams.
- Exacerbated by historic plantings right to stream edge and or poor establishment layout relative to harvesting needs.
- Second rotations should be better.

Forestry's concern – Periodic sedimentation

- Highly erodible sedimentary formations.
- Paired catchments – pastoral grazing (sheep) and plantation.
- Standard practice at the time.
- Peak during harvesting – more specifically roading earthworks.
- Declines quickly afterwards
- Overall sediment yield still well down on pastoral landuse.

Pakuratahi Study – Hawkes Bay



Forestry's concern – Periodic sedimentation

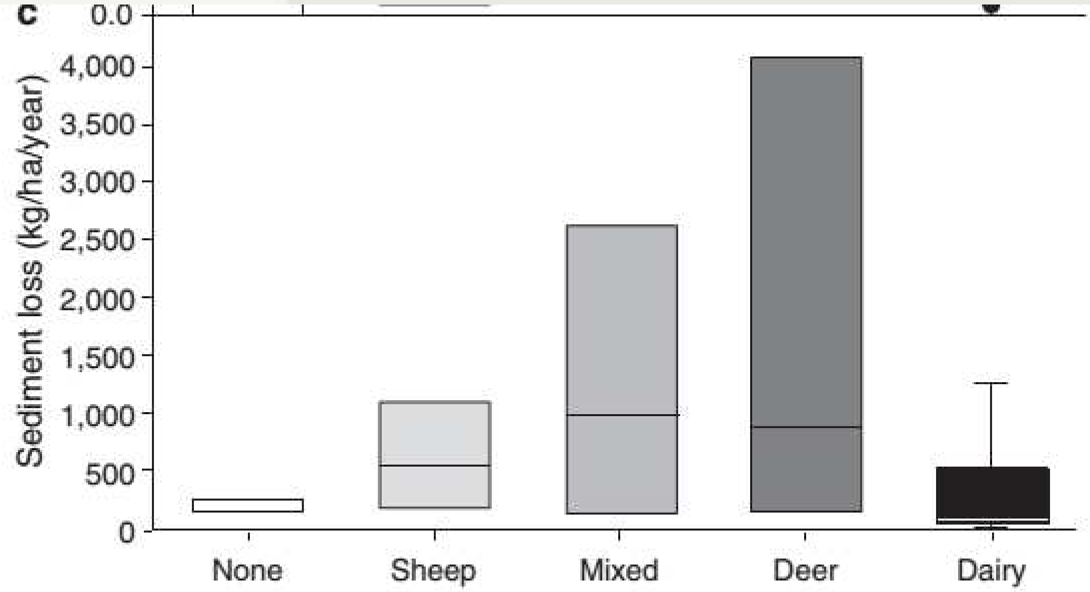


Figure 4. Box plots showing the median concentration, bounded by the 25th and 75th percentiles, the 10th and 90th percentiles as whiskers, and any outliers, for (a) N, (b) P, and (c) sediment annual loads for each stock class of land use. 'None' refers to non-agricultural rural land uses, such as exotic plantation and native forest, while 'mixed' refers to a catchment with more than one stock land-use class.

Forestry's concern – Periodic sedimentation

Table 1 **Sediment generation data from different sources in Cpt 49 Whangapoua Forest following harvesting (Phillips et al. 2002; Marden et al. in press).**

Process	Sediment generating site	Area (ha)	Total sediment (t)	Sediment generation rate (t/ha)	Surface Lowering (mm)
	Undisturbed	14.5	Nil	Nil	Nil
	Roads & landings	2.0	n/a	n/a	n/a
Slopewash	Shallow disturbance	15.5	16	1	-0.07
	Deep disturbance	3.6	48	13	-1.1
Landsliding	Landslide source zone n=36	0.12	600	1500	-125
Soil scraping	Deep disturbance	3.6	1200	333	-28
Totals	All sources	36.0	1864	52	-4.3

Forestry's concern – Periodic sedimentation

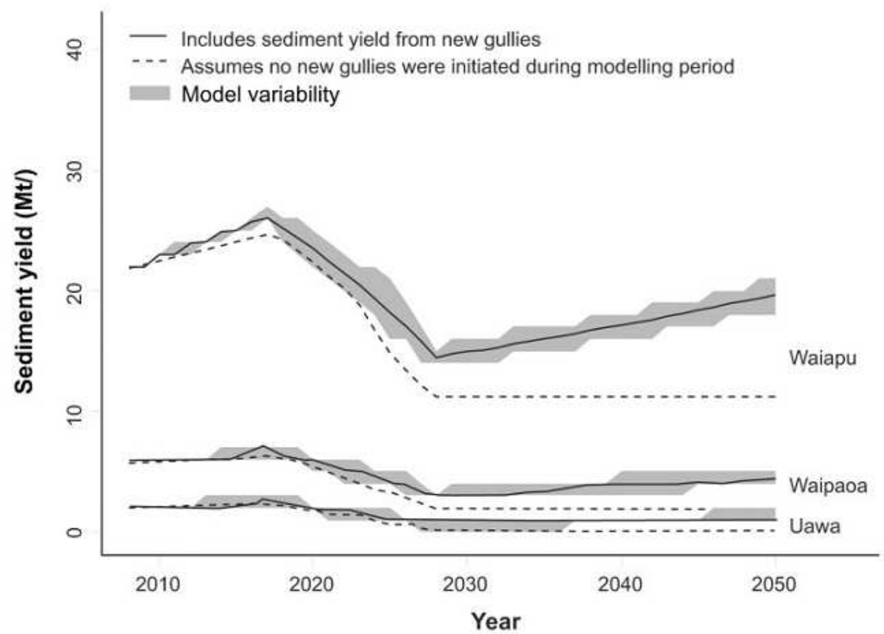


Figure 5 Modelled reductions in gully-derived sediment yield (Mt/a) if all remaining gullies within the respective catchments were to be reforested by year 2020. Solid line includes sediment yield from new gullies initiated but not treated during the modelling period. Dashed line assumes no new gullies were initiated during the modelling period (from Marden *et al.* 2011).

So what does the industry do?

Responsible operators should……

- Be working to Industry codes.
- Increasing focus on good planning and execution.
- Increasing focus on water – Voluntary setbacks on all streams…
  - 5m streams up to 3.0 wide.
  - 10m all larger streams.
  - Sediment controls.

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How the codes/rules start to play out….

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Biggest risk – Debris flows

- Landslides deposit orders of magnitude more sediment.
- High intensity storm events more frequent...climate change?
- Much of NZ forestry on steeplands…failed under pasture but plantation system not bomb proof!

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Big Storms Cause Landslides

Stream Recovery -Issue subject to some joint research between Industry and BoP RC

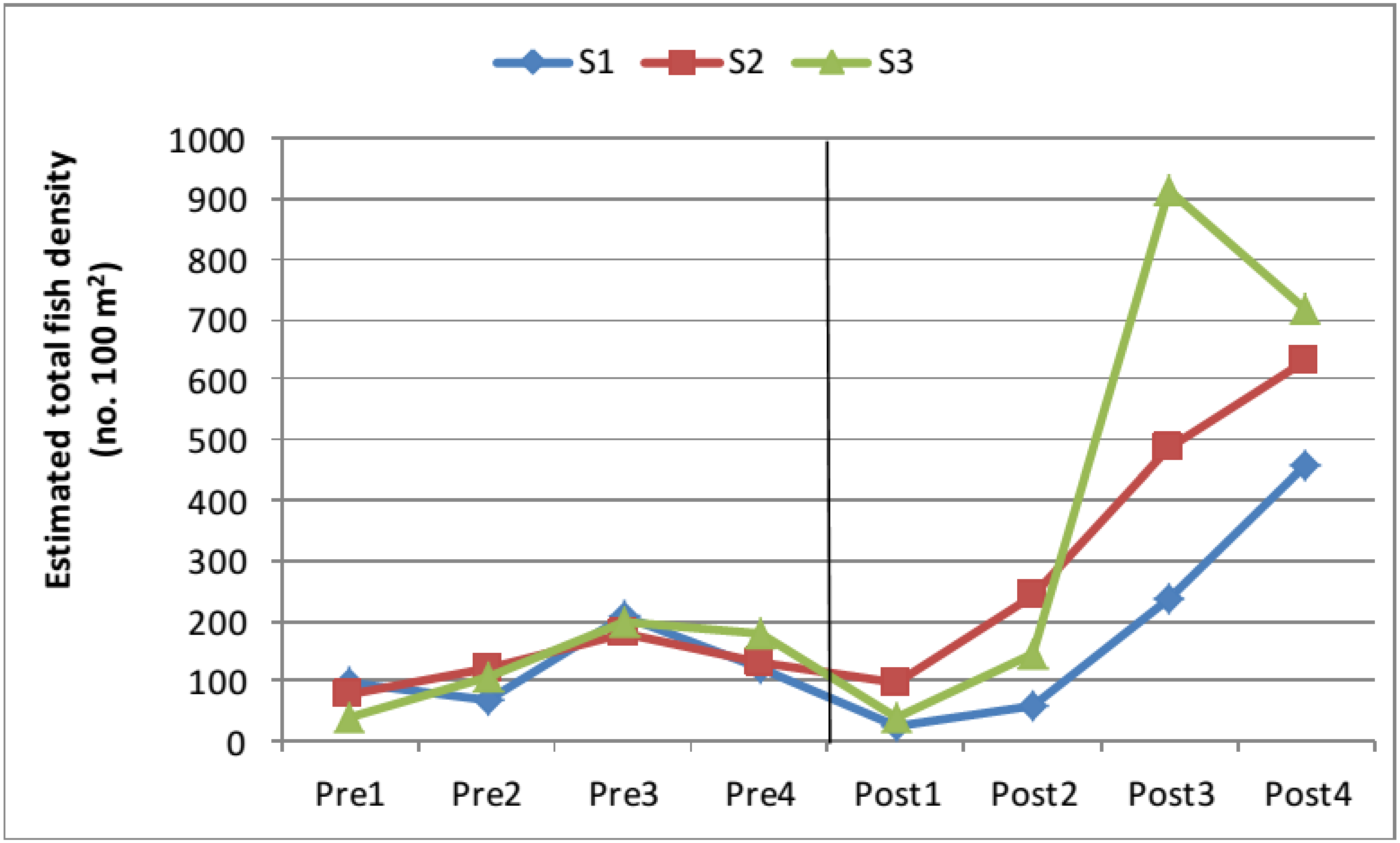

Figure 11: Estimated fish density at each site, before (Pre) and after (Post) the extreme weather event. The vertical line separates pre and post event data points

Other influences

Flood amelioration

- Forests
  - Canopies intercept about 20% of rainfall in low - moderate rainfall events.
  - Root systems and low compaction allow rain infiltration.
  - Below about 30% clearance in an individual catchment, hydrological effects unlikely.
  - In very intense storms – moderation effect reduced.
  - Dryland environments or over-allocated water demand, plantations may reduce peak yield.

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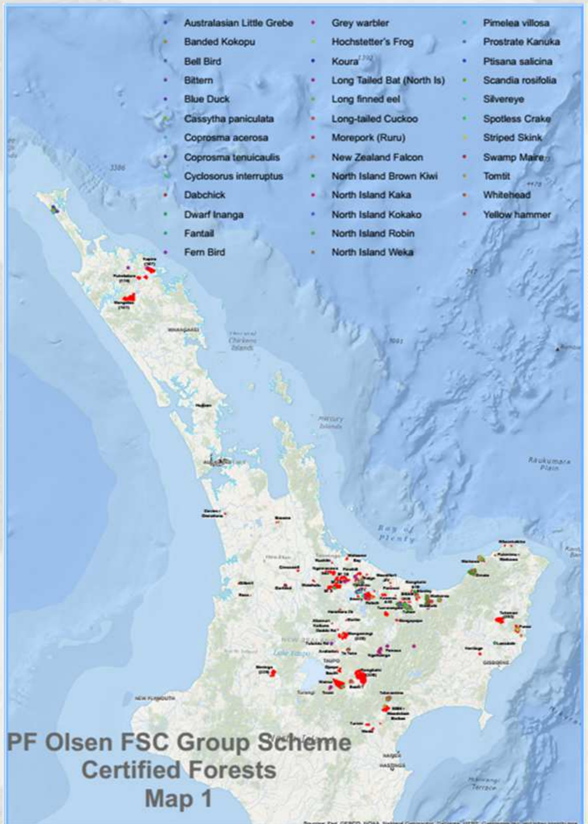
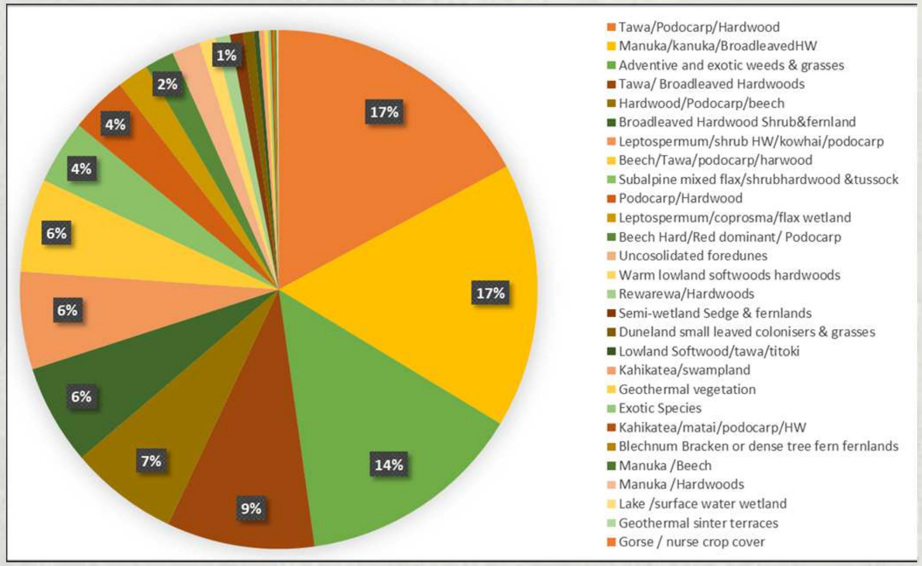
Biodiversity

Fauna



Terrestrial/wetland reserves



10,600ha reserves = 19%

Ecosystem Services

Table 3. Indicative values (in $ per ha per year) of key ecosystem services in the Ōhiwa catchment.

Ecosystem service		Land use[1]							
Type	**Details**	**Productive**				**Natural**			**Total**
		Dry stock	**Exotic forestry**	**Dairy**	**Horticulture**	**Indigenous forest**	**Scrub**	**Wetlands and mangroves**	
Provisioning	Food, wool, wood, pulp	158	483	1,686	8,810				11,137
Regulating	Carbon sequestration/ emission and GHG regulation	-16	48	-41					-9
	Avoided erosion and flood/disturbance regulation		121			166	166	12,737	13,190
	Regulating nutrient (nitrogen) supply (e.g. avoided leaching)	-3,200	2,800	-12,000	10,000	2,800	2,800		-16,800
	Pollination	69	206	69	233	206	206		989
	Water regulation [2]	8	6	8		6	6	42	76
	Waste treatment		244			244	244	11,721	12,453
	Pest and disease regulation/ Biological control	164	11	105	65	11	11		367
	Water supply		8			8	8	10,664	
Social	Recreation		900			1,800		1,978	4,678
	Species conservation		257			414		494	1,165
Supporting	Nutrient cycling		994			994	994		2,982
	Soil formation	3	14	3	6	28	28		82
Net ES Value ($/ha/yr)		***-2,814***	***6,092***	***-10,170***	***-885***	***6,677***	***4,463***	***37,636***	***40,990***
Area (ha)		4,914	3,201	2,854	51	3,576	2,380	316	17,292
TOTAL VALUE ($ per land use per year)		**-13,827,996**	**19,500,492**	**-29,025,180**	**-45,145**	**23,876,952**	**10,621,940**	**11,892,976**	**22,993,580**

[1] Blank cells indicate that there were no appropriate data found to represent those values. A blank space does not necessarily mean that the ecosystem service has no value. It is very likely the non-market of that particular ecosystem service can be estimated because that value had already been estimated for other land uses.

[2] Water regulation is defined in the MEA (2005) as "The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas."