Effectiveness of Fish Habitat Compensation in Canada in Achieving No Net Loss

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Effectiveness Audit

Objective:

- Determine the effectiveness of habitat compensation projects in achieving no net loss (NNL) of habitat productivity across Canada

Methods

- We randomly selected 16 authorisations across Canada.

- Geographic stratification in five provinces – British Columbia, Manitoba, Ontario, New Brunswick, and Nova Scotia

- We selected authorisations issued between 1994 – 1997 and field work was completed in 2000 and 2001 ensuring a post-construction age range of 4 – 8 years.


N
W
E
S
130° W
60° N
Yukon
Northwest Territories
Canada
Alberta
Saskatchewan
Manitoba
Ontario
Quebec
Newfoundland
Prince Edward Island
Nova Scotia
New Brunswick
U.S.A.
★ No Net Loss of Habitat Productivity Audit
0 300 600 900 1200 Kilometers

Methods - Effectiveness

- Treatment sites (n = 2 to 4) were selected in both HADD and Compensation sites and paired to un-impacted reference sites (n = 2 to 4).
- Data were pooled to develop mean response values.
- In this way we considered the habitat productivity of the compensatory, modified (HADD site) and lost habitats (reference site).

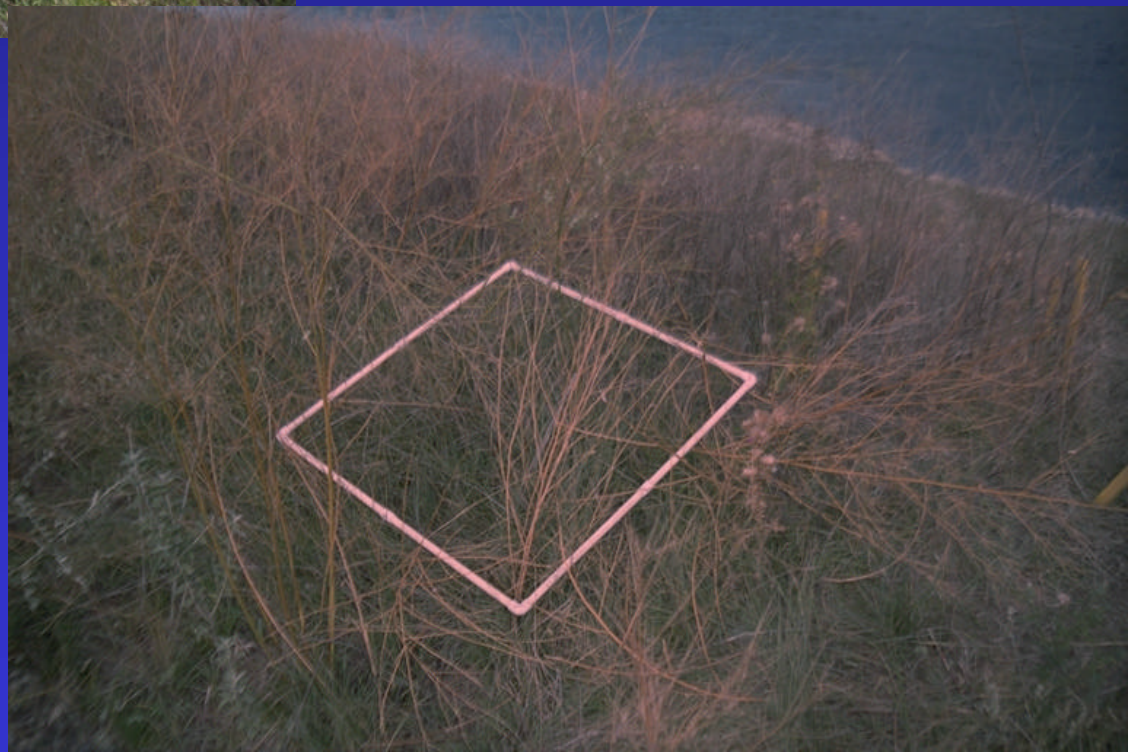
Treatment and reference sites were netted off and the areas measured so that response variables could be quantified per unit area.

Methods - Effectiveness

1. Total surface area of gains and losses in habitat were measured and compensation ratios (compensation area:HADD area) were calculated.

2. Taking a multi-metric approach, we selected four variables (at several trophic levels) to quantify magnitude of change in habitat productivity.

- Periphyton biomass
- Invertebrate density
- Fish biomass
- Riparian coverage



Methods - Effectiveness

- The mean treatment variables were weighted by the difference in area (i.e. compensation ratio) relative to reference sites.

- ANOVA was used to compare response variables between treatment and reference sites to determine if the projects achieved NG, NNL, or NL.

Methods - Effectiveness

- It is possible to have no change in production (biomass) in a particular indicator but have a shift in species composition.

- Diversity of fish species, invertebrate orders, and riparian non-woody and woody species were measured to capture changes in community structure.

Key Results - Effectiveness

- All 16 projects were located in riverine habitats:

- 12 were like for like
- 2 were like for un-like
- 2 were increase like productivity

- Common compensation techniques:

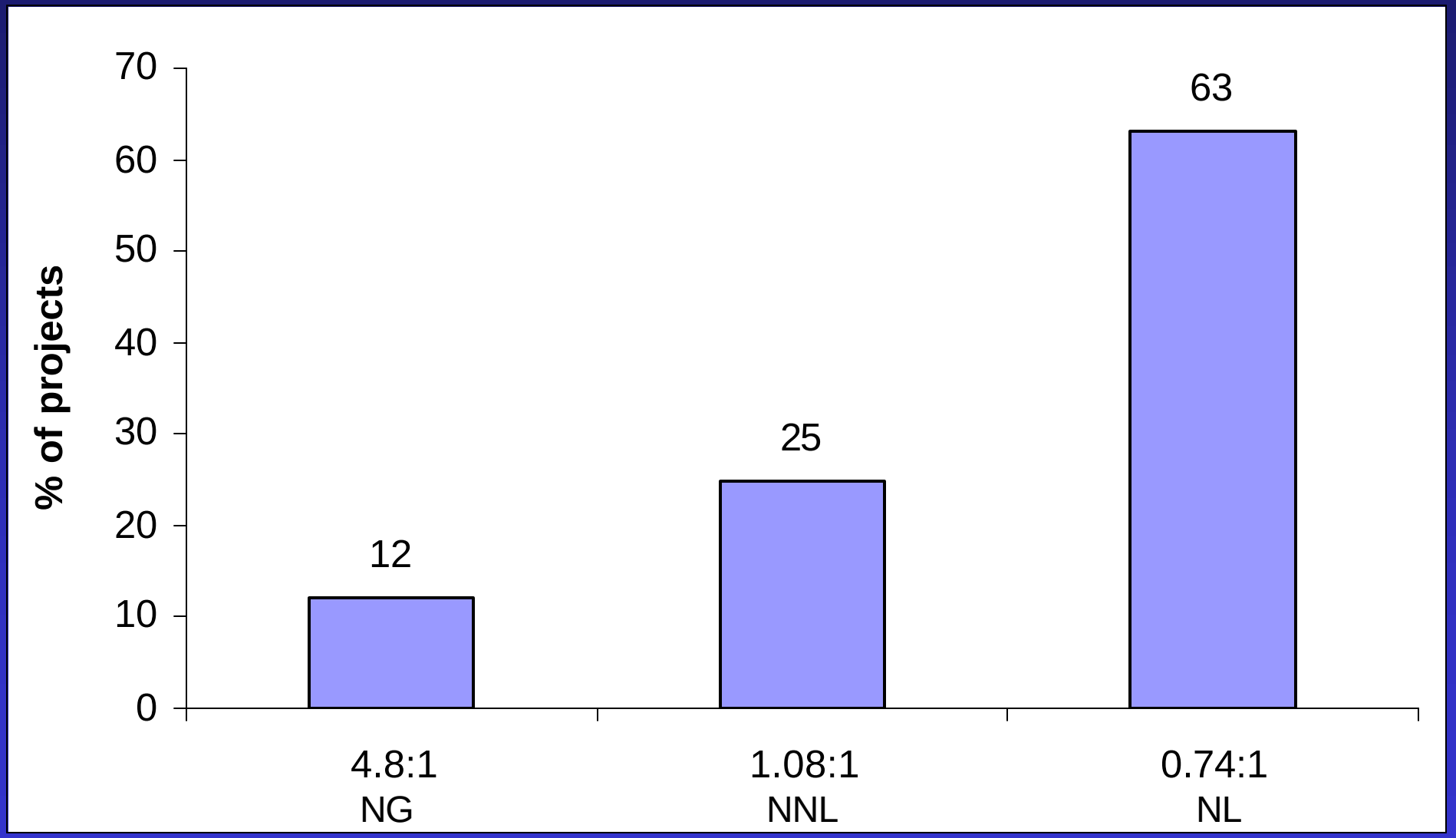
- riparian re-vegetation,
- channel creation
- habitat complexing (e.g. boulders, large woody debris, or pools).

Key Results

- Similar to the compliance audit, actual compensation area to HADD area ratios were much smaller than required (Mean age of projects = 4.3 yrs. (range: 2 – 9))
- In-channel required 6.8:1, actual 1.5:1.
- Riparian required 1.2:1, actual 0.8:1.

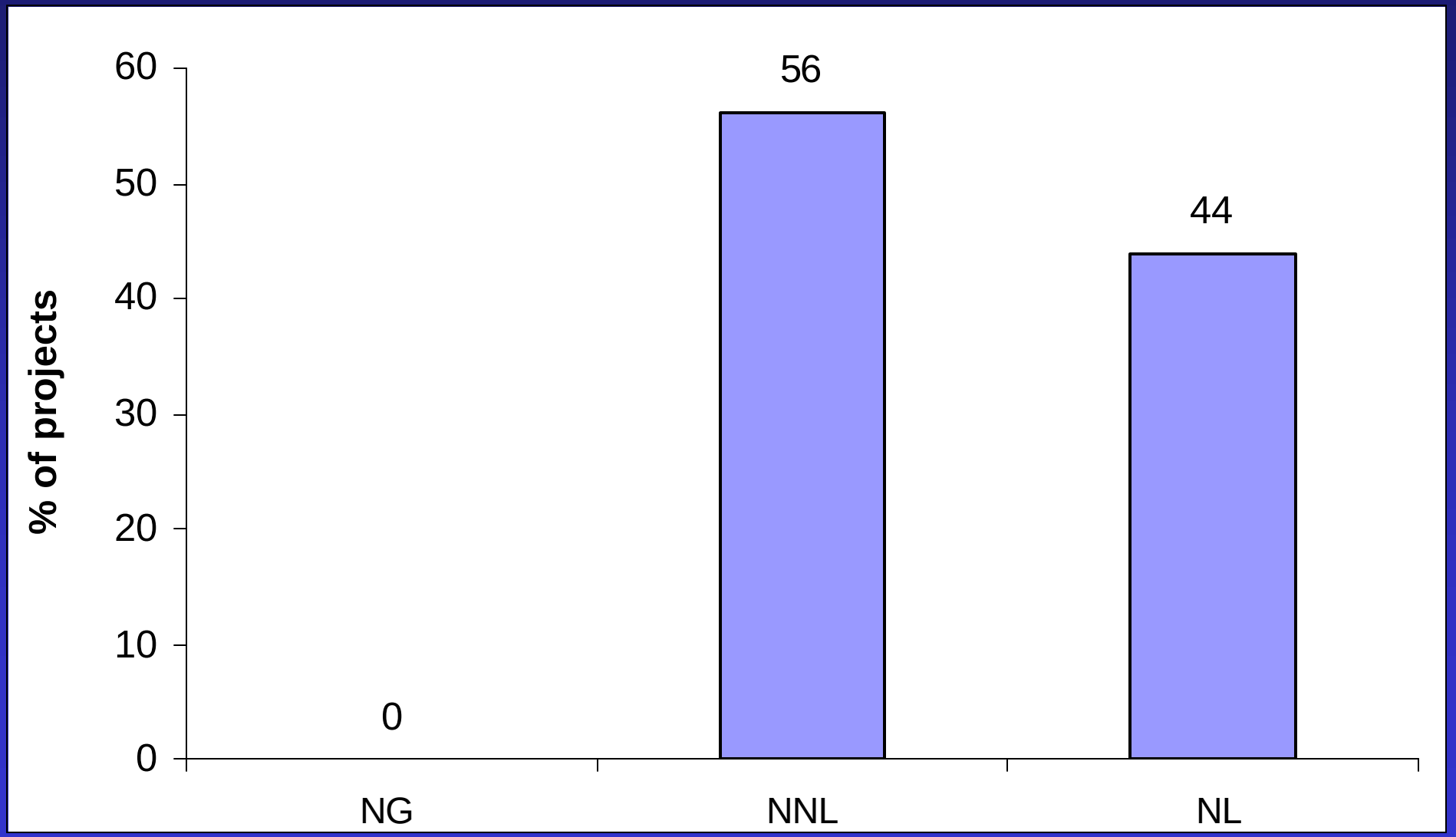
Key Results - Effectiveness

Actual ratios:



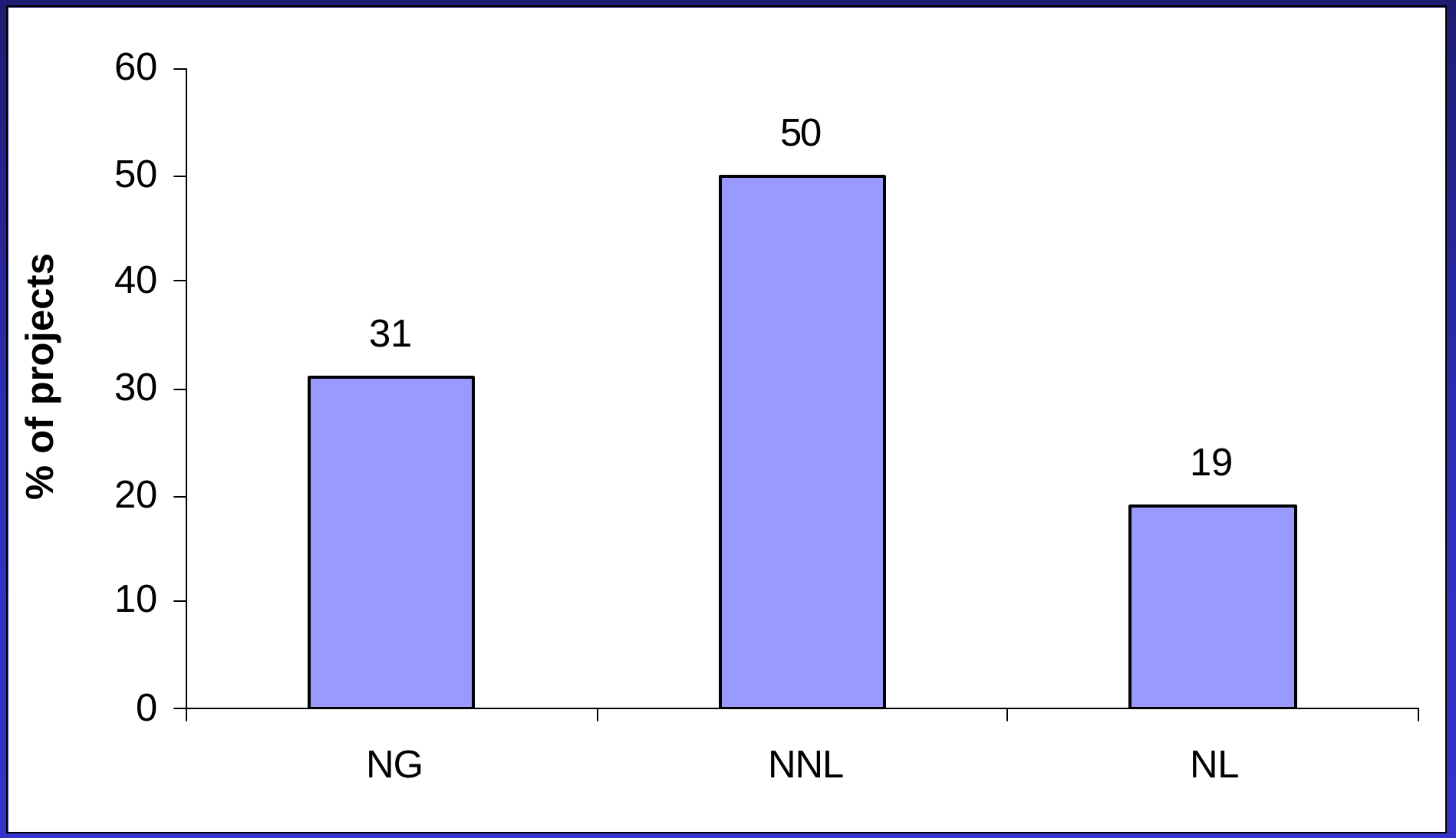
Key Results - Effectiveness

Artificial ratio 1.0:1



Key Results - Effectiveness

Artificial ratio 2.0:1



Conclusions and Recommendations

1. Need for a multi-metric approach

- Invertebrates and periphyton are rarely measured in assessments of compensatory projects.

- Our multi-metric approach provided a more complete picture of habitat productivity, rather than simply using fish biomass as an indicator of habitat productivity.

- Invariably, habitat alterations do not exclusively affect a particular species in isolation of other biota.

- In many cases, selecting one surrogate of habitat productivity, rather than an array of ecological indicators at different trophic levels, would have led to erroneous conclusions.

Conclusions and Recommendations

2. Need to consider ecological bottlenecks

- In general, we found that compensation sites were selected opportunistically rather than based on ecological bottlenecks and potential for success.

Conclusions and Recommendations

3. Need to consider environmental limitations

- Natural sites selected for compensation had environmental limitations that were largely ignored.

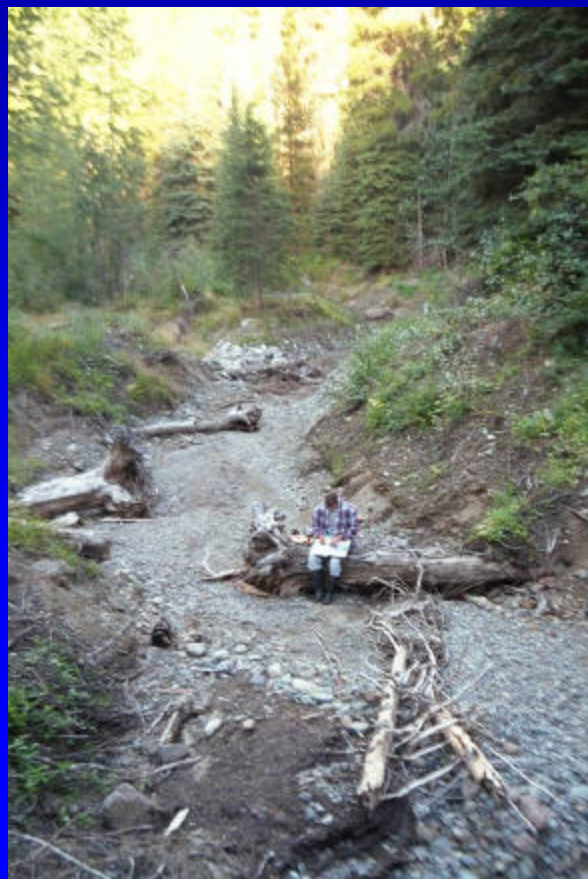
- For example, compensation sites selected for re-vegetation tended to have very low success.

- The difficulty in re-establishing vegetation at barren sites is not altogether surprising. There are generally good reasons why riparian vegetation is not currently flourishing at these locations.

Conclusions and Recommendations

4. Sustainability should be factored into siting

- Many projects were positioned in landscape locations that will not ensure sustainability (i.e. prone to isolation or destruction during channel forming flood events).



Conclusions and Recommendations

5. Our findings are conservative

- We concluded a NNL outcome on many projects that potentially did not achieve this goal. High ecosystem variability meant differences had to be large in order to detect responses.

- The gross disparity in physical area of compensated versus impacted habitats was an over-riding factor for many projects.

- Unquestionably it is exceedingly difficult to achieve equivalent habitat productivity when replacing only a fraction of the habitat lost.

Conclusions and Recommendations

6. Compliance does not ensure ecological success.

- However, even if compliance was 100% it is unlikely that all of the projects would have achieved NNL.

- National guidelines recommend DFO should “aim for compensation ratios of 1:1 as a minimum”. In our study, close to half of the projects would not have achieved NNL with this ratio.

- We demonstrated that artificially increasing ratios to 2:1, was not sufficient to achieve a net gain in habitat productivity for all projects.

Conclusions and Recommendations

7. The ability to replicate ecosystem function is limited

- Improvements in compensation science and institutional approaches are necessary to achieve NNL.