RISK FACTORS AFFECTING CLINICAL DISEASE

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Quantifying probabilities

- Predicting probabilities for disease occurrence

Risk Factor Studies

- Risk factor studies are observational studies
- Significant risk factors
  - Are associated with an increase chance of fish having the disease
  - Can be used to recommend disease control protocols
  - May be used to form hypotheses for future research

Quantifying probabilities

- Straightforward in cross-sectional studies which take a snapshot of entire area / industry / or segment of industry
  - Important to avoid bias inclusion of factors or cases
- Quantify number of cases occurring when factor is <u>present</u> compared to when factor is <u>absent</u>

		CASES	CONTROLS	Hazard Ratio
Number of lice treatments with SLICE™ (SliceTx)	more	**6**	**64**	0.0857
	less	**35**	**152**	0.1872

Factor consider potential problem

Proportion positive

0.1872/0.0857 = 2.2

More lice treatments: $\frac{6}{64 + 6} = 0.0857$

Less lice treatments: $\frac{35}{152 + 35} = 0.1872$

How many more cases occur when less lice treatment compared to more lice treatments?

2.2 times as many cases occur if factor present compared to absent

ISA mortality in second year (1997) of growth

Confidence Interval

Variable	Level	Hazard Ratio	Conf. Int.	
Cumulative mortality in first year (1996) of growth	low	reference		
	medium	1.52	0.73	3.19
	high	3.61	1.63	8.01

Confidence Interval (95% CI) is the estimated limits which our point estimate would occur 95% of the time if we repeated this *many* times

There are 1.52 times as many cases when cages have *medium mortality in 1st year* compared to *low mortality in 1st year*

We are 95% confident that the true HR is between 0.73 and 3.19

There are 3.61 times as many cases when cages have high *mortality in 1st year* compared to *low mortality in 1st year*

We are 95% confident that the true HR is between 1.63 and 8.01

Case study – Infectious Salmon Anemia

- Information collected from
  - 83 of the 85 qualifying farms (97.6% participation)
  - 267 cages
- Information analyzed in groups
  - Site factors (74 different factors)
  - Cage factors (37)
  - Hatchery factors (14)

Cage risk factor data

Results from 250 cages

Factor	level	Odds ratio
Number of lice treatments with SLICE™	>2 times	1
	≤2 times	2.67
Depth of cage	>9 m	1
	≤9 m	2.96
Meters underneath net at low tide	≤3 m	1
	>3 m	2.26

Cage risk factor data

Results from 206 cages

Factor	level	Odds ratio
Number of pollock farmer perceived to be in the cage	<1000	1
	≥1000	4.40
Depth of cage	>9 m	1
	≤9 m	3.51
Meters underneath net at low tide	≤3 m	1
	>3 m	3.34

Hatchery risk factor data

Results from 233 cages

Factor	Level	Odds ratio
Juvenile weight	<99 g	1
	≥99 g	2.40

Combined risk factor data

Results from 260 cages

Factor	level	Odds ratio
Distance to processing boats traveling past site	>1 km	1
	≤1 km	9.43
Dry feed is delivered by feed company	no	1
	yes	4.03
Depth of cage	>9 m	1
	≤9 m	3.34
Number of lice treatments with any product	>2 times	1
	≤2 times	3.31
Closest neighbor with ISA	>0.5 km	1
	≤0.5 km	2.41

Combined risk factor data

Results from 199 cages

Factor	level	Odds ratio
Number of cages with post transfer mortalities greater than 5%	no cages	1
	≥1 cage	4.52
Depth of cage	>9 m	1
	≤9 m	3.28
Smolt weight	<99 g	1
	≥99 g	2.95
Dry feed is delivered by feed company	no	1
	yes	2.68

Survival analysis data

Results from 83 sites

Factor	level	Odds ratio
Nearest neighbor with ISA categorized	≥5 km	1
	≥2 km but <5 km	1.17
	≥0.5 km but <2km	2.01
	<0.5 km	5.50
Distance to processing boats traveling past site	>1 km	1
	≤1 km	7.47
Dry feed is delivered by feed company	no	1
	yes	2.66

Objectives of Infectious Pathogen control practices

- 1. reduce new cases / new transmissions
- 2. Reduce infections becoming mortality cases

Exposure to live or dead infected fish

- Younger fish exposed to older fish
  - Year class separation for sites
    - Eliminated multiple YC sites
    - YC overlap problem for several years
  - Year class separation for areas
    - Area (or Bay) management areas

Variable	Level	Hazard Ratio	Conf. Int.	
Propn. cages	<0.9			
96 year class	> 0.9	0.38	0.22	0.67

Hammell & Dohoo, JFD, 2005

Year class separation

- Reduce exposure to potentially infected (older) fish
  - Started in 1997 with most sites have 2-3 year classes
  - Now essentially 100% of sites are single YC
- Most BMAs are single YC

Practices to reduce potential for pathogen spread

- Mortality collection
  - Frequent mortality collection - through airlift system or frequent diving
  - Diving – different bag (disinfected) for every cage
  - Divers inspect high mortality cages last
  - Disinfect between cages, at least between groups of cages
  - Separate dive suits for each site
    - Better than disinfect between sites

- Sites at which divers worked at multiple sites were more likely to become problem sites (RR = 3.3) Hammell, Dohoo JFD 2005
- Transmission of virus by diver likely occurring
- (Could not examine difference between divers who disinfect and divers who do not)

Mortality disposal

- "certify" mort collection practices/companies
- Restrict use of morts
- Restricted handling practices (bagging, transport, etc)
  - Covered on site
  - Taken to shore on regular basis
  - Neutralized (e.g. acidification)

Harvest practices

- Containment of all blood materials
  - Regular audits of harvest vessels
- Separate vessels for ISA positive sites / BMA
- Altered boat traffic to processing plant
- Processing plants
  - ISA biocontainment (acidification, heat, other)
  - Decontamination audited (testing effluent included)

Early depopulation of positive fish

- Frequency (depends on zone: suspect vs free)
- Testing of all suitable mortalities (to a limit)
- Early detection and then rapid depopulation
  - False positives contribute to success of depopulations … but they are costly!
  - False negatives contribute to transmission (within and between sites)

Summary

- Reduce Introductions
  - Exposure to live or dead infected fish
  - Exposure to virus contaminated water
  - Exposure to contaminated equipment
  - Exposure to contaminated people
- Reduce infections becoming clinical cases