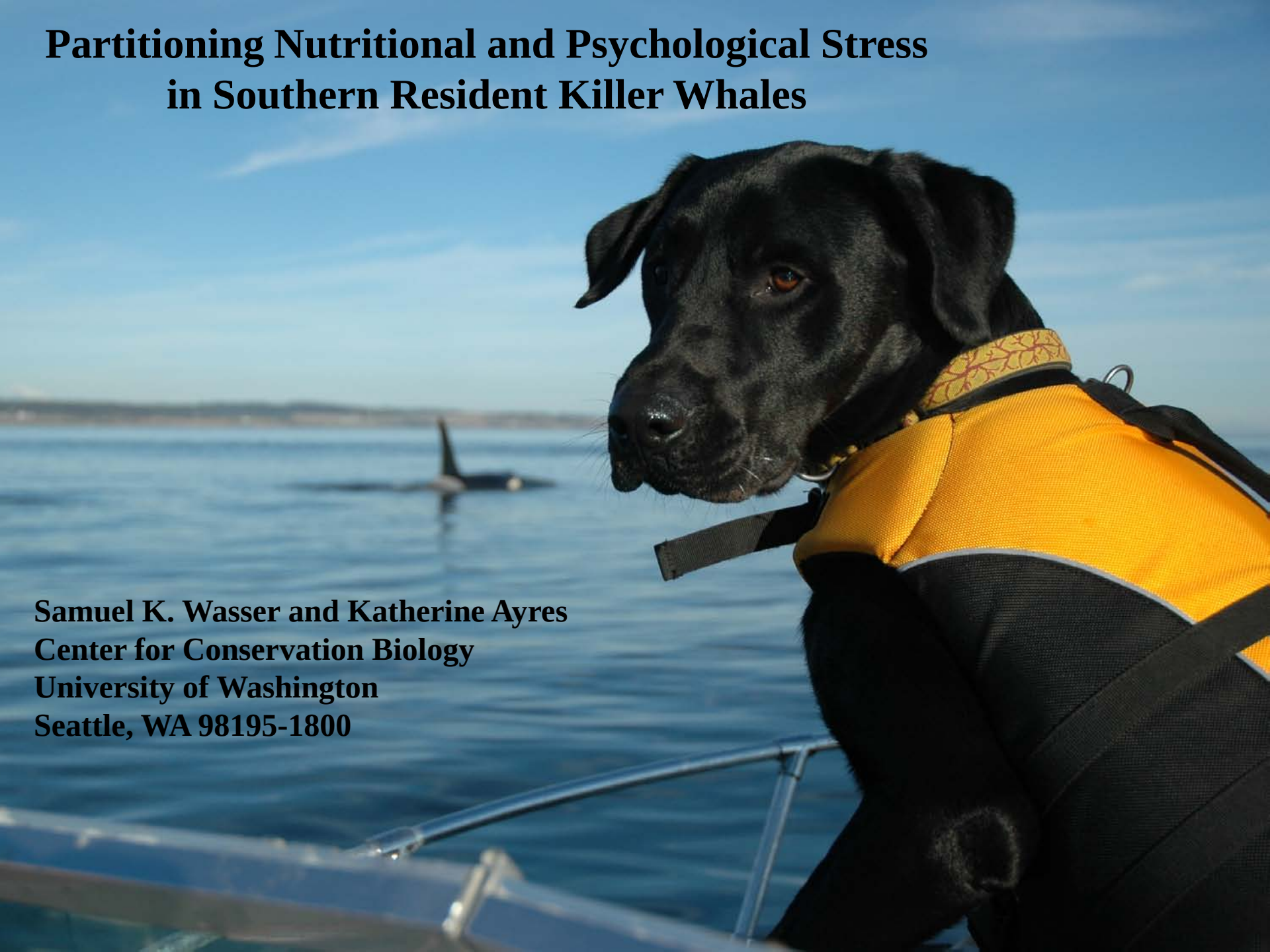
Partitioning Nutritional and Psychological Stress in Southern Resident Killer Whales



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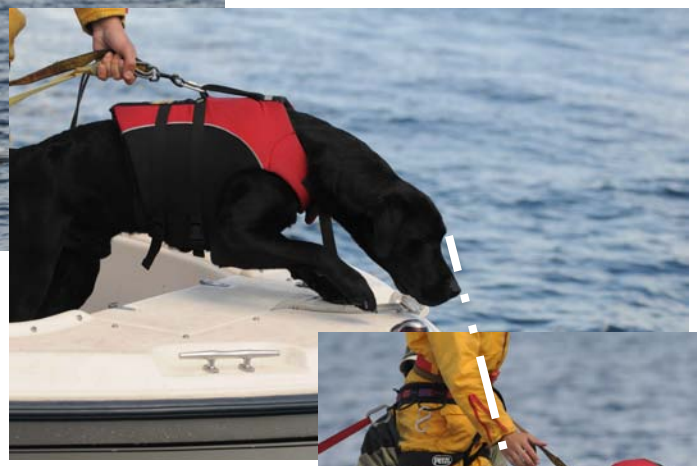
Center for Conservation Biology
University of Washington
Seattle, WA 98195-1800

Information from Feces

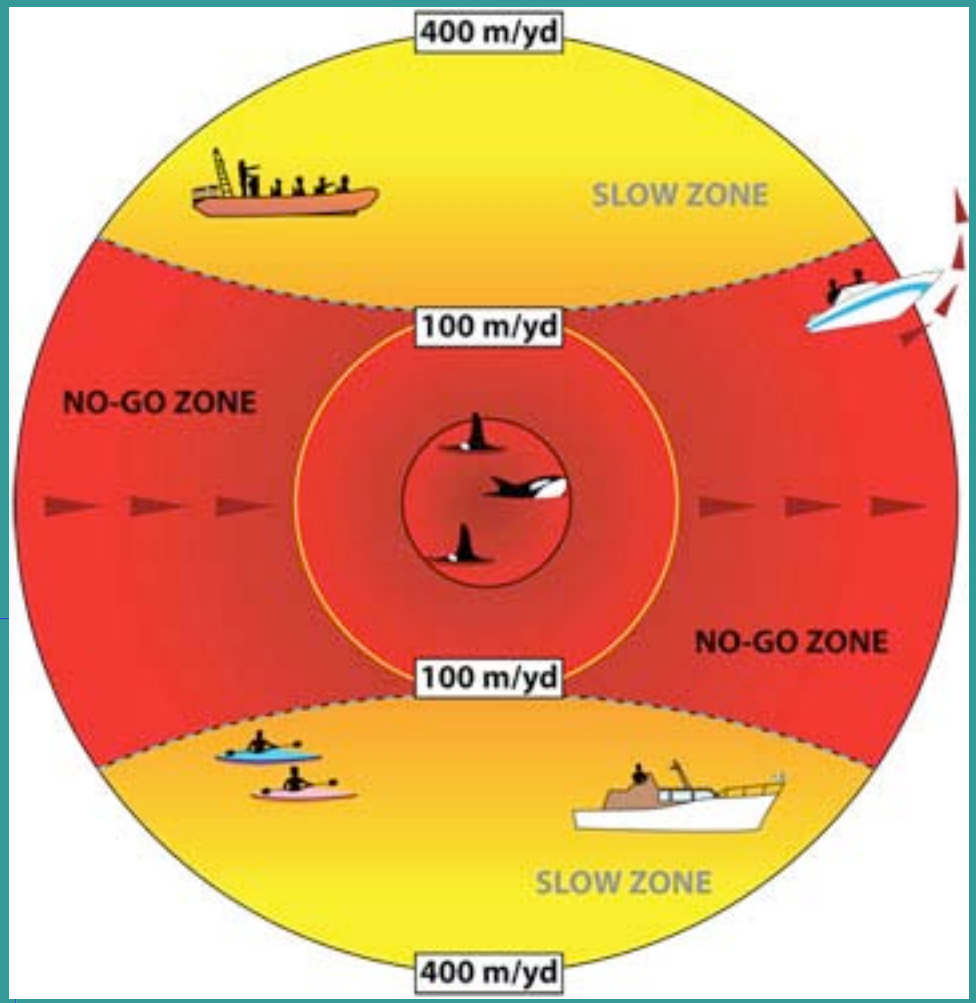
- DNA: species, sex, individual, abundance, distribution
- Hormones: stress, reproduction, nutrition, endocrine disruption
- Pathogens: parasites, diseases
- Immunoglobulins: immunosuppression and/or activation
- Diet: habitat requirements
- Toxins: persistent organic pollutants (PCB, DDT, DDE, PBDE)

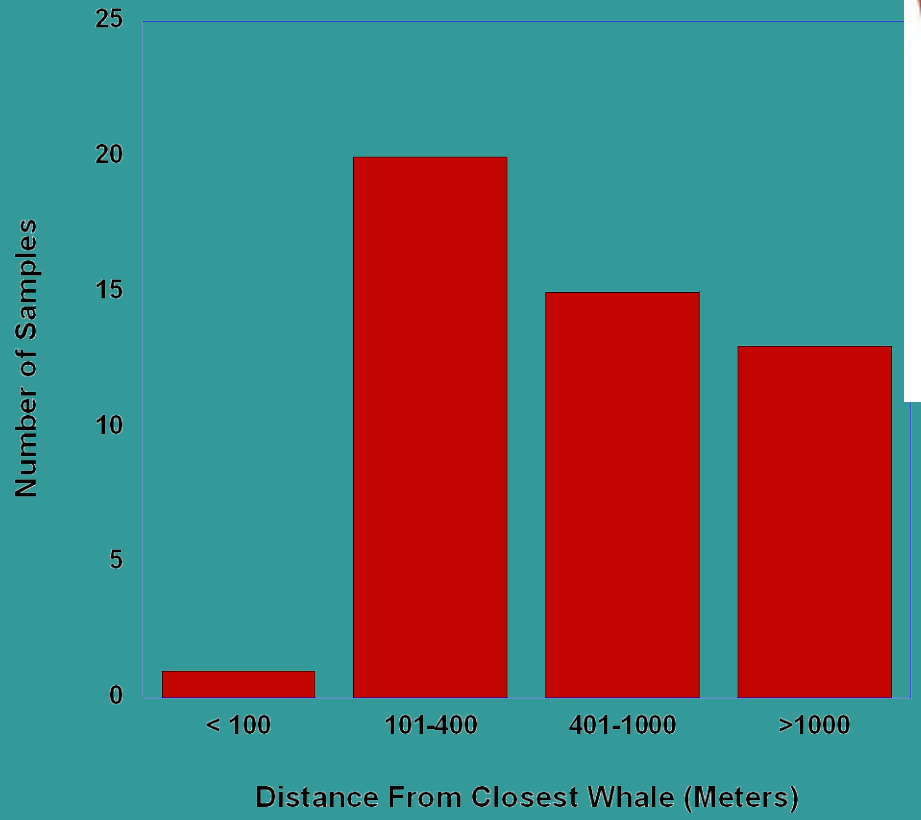
Analogous to a health panel, without having to see the patient

WN 3930 NW



3930 NW

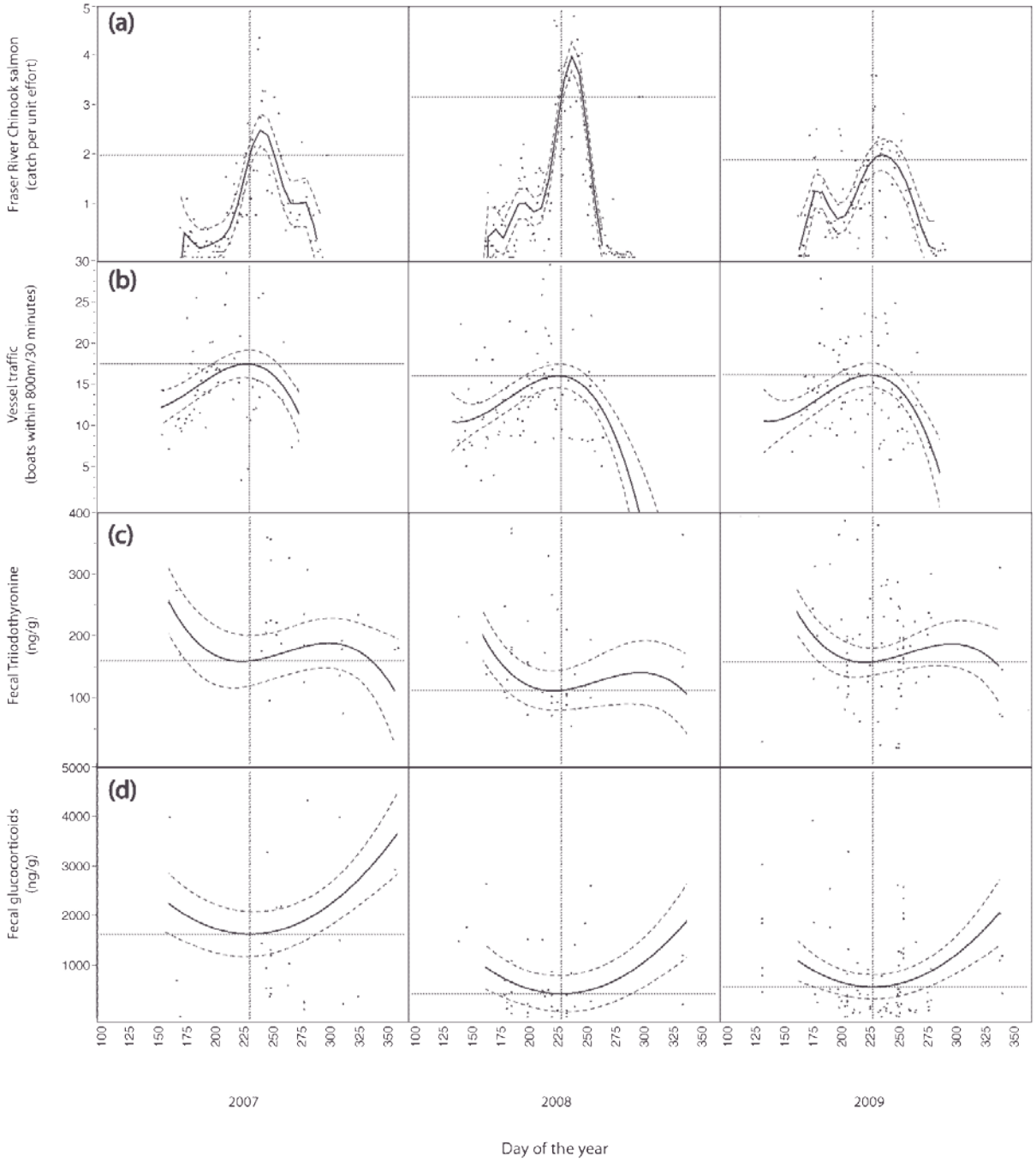

400 m/yd
SLOW ZONE
100 m/yd
NO-GO ZONE
NO-GO ZONE
100 m/yd
SLOW ZONE
400 m/yd

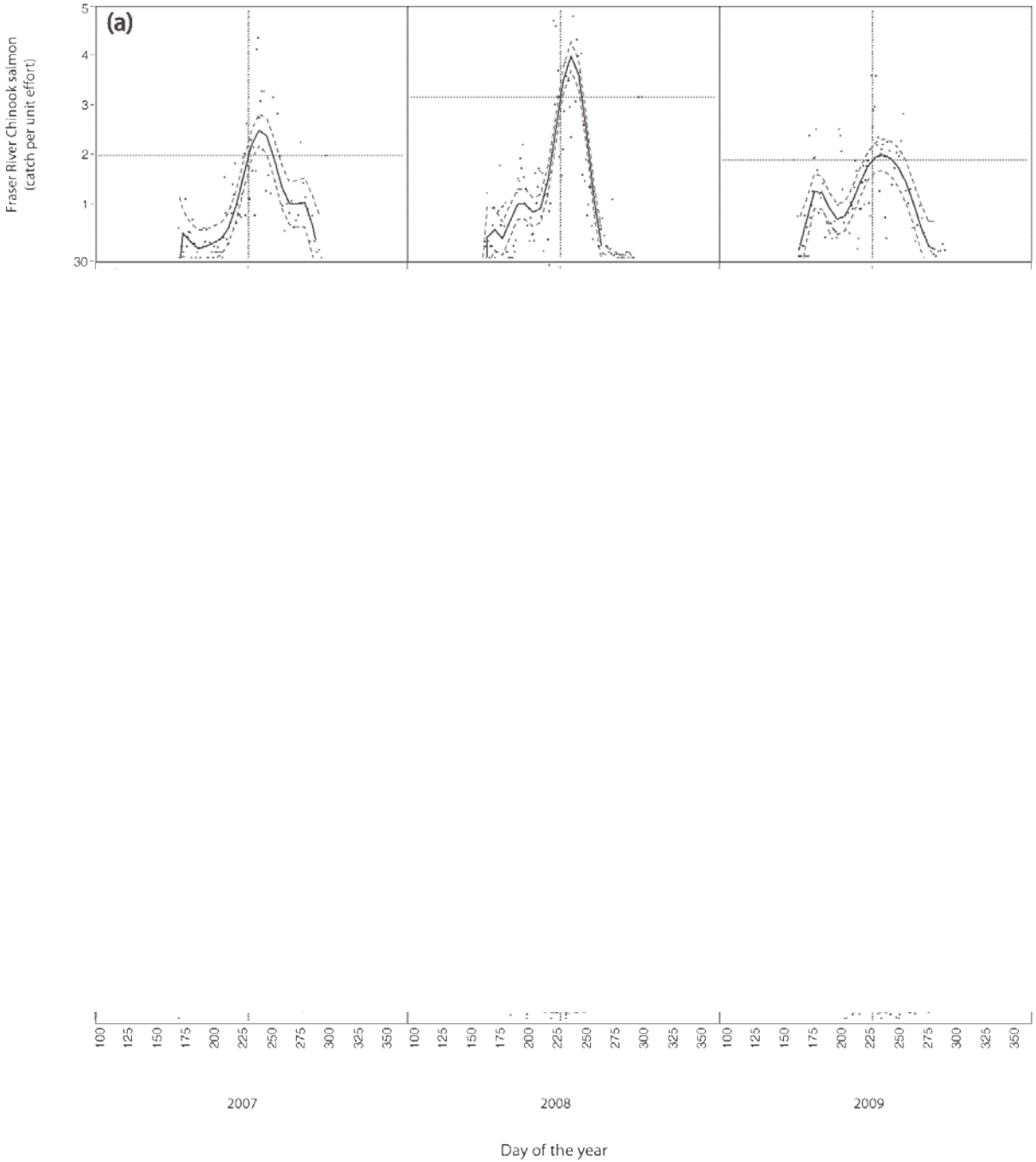

25
20
15
10
5
0
Number of Samples
< 100
101-400
401-1000
>1000
Distance From Closest Whale (Meters)

Glucocorticoid (GC) and Triiodothyronine (T3) hormones

- GC concentrations increase in response to acute psychological and nutritional stress:
  - mobilizing glucose to provide quick energy

- T3 concentrations decrease in response to longer-term nutritional stress, but are unaffected by psychological stress:
  - lowering metabolism to conserve energy


(a)
(b)
(c)
(d)
Fraser River Chinook salmon (catch per unit effort)
Vessel traffic (boats within 800m/30 minutes)
Fecal Triiodothyronine (ng/g)
Fecal glucocorticoids (ng/g)
2007
2008
2009
Day of the year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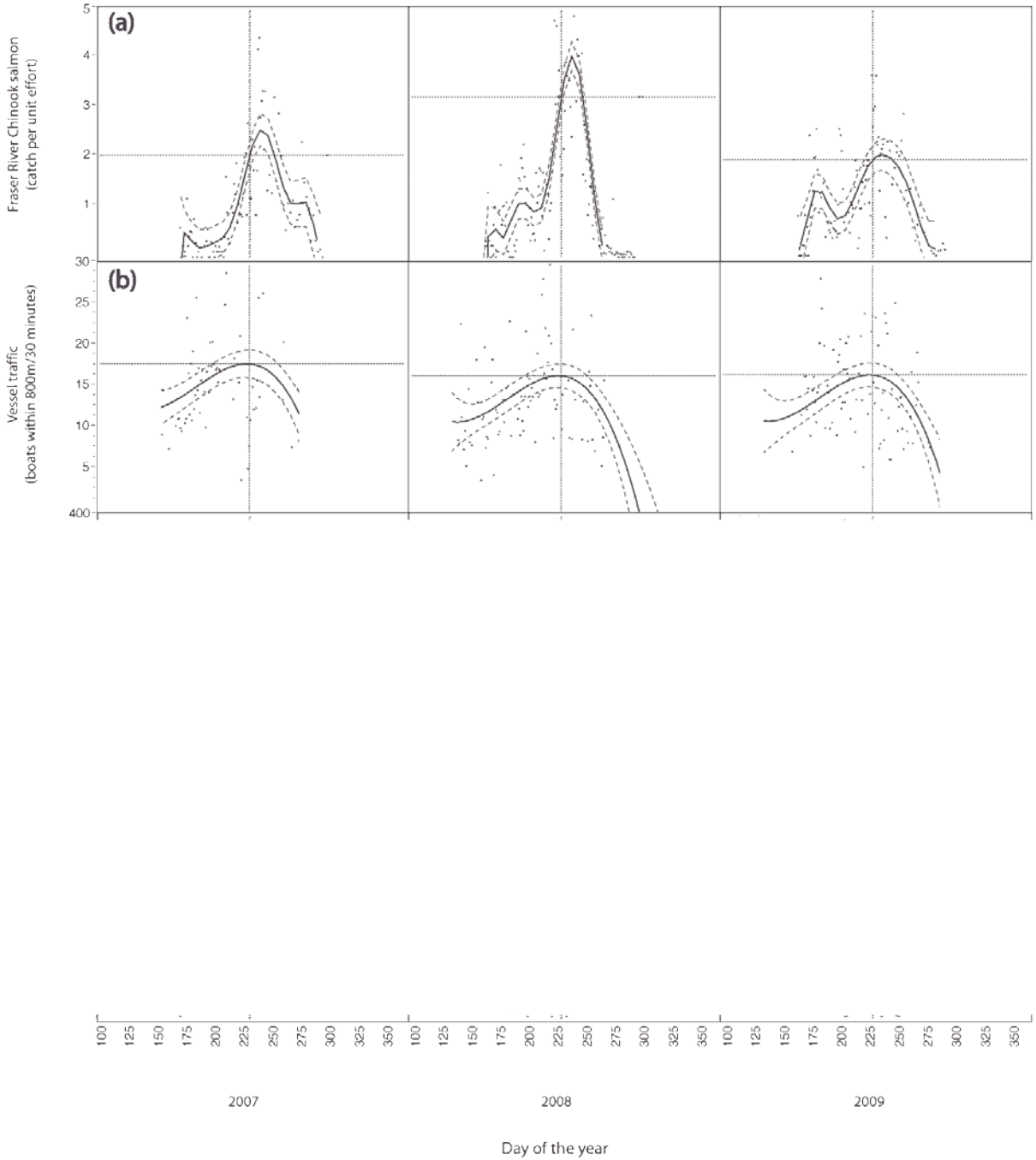
Fraser River Chinook salmon
(catch per unit effort)
5
4
3
2
1
30
100
125
150
175
200
225
250
275
300
325
350
2007
2008
2009
Day of the year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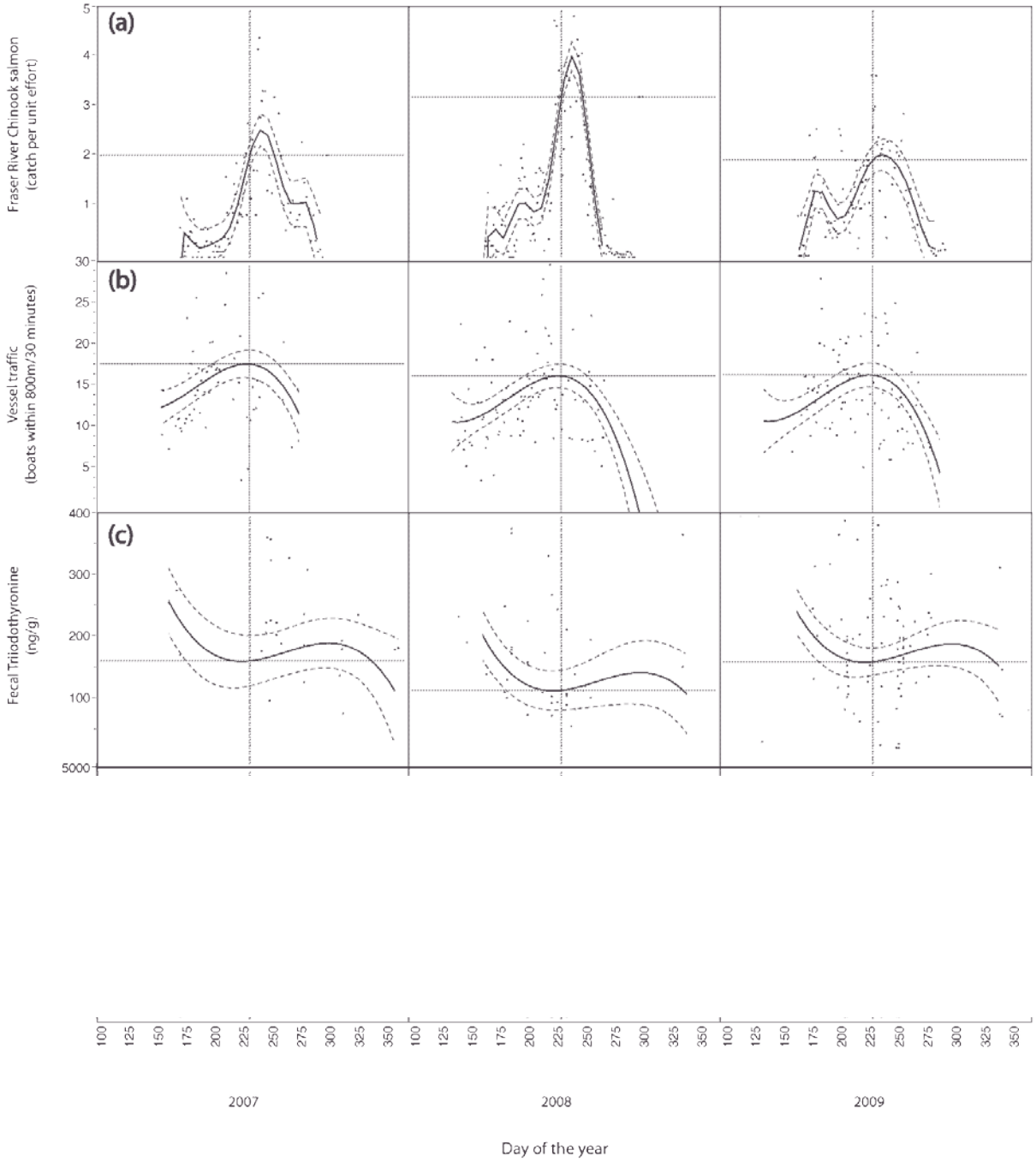
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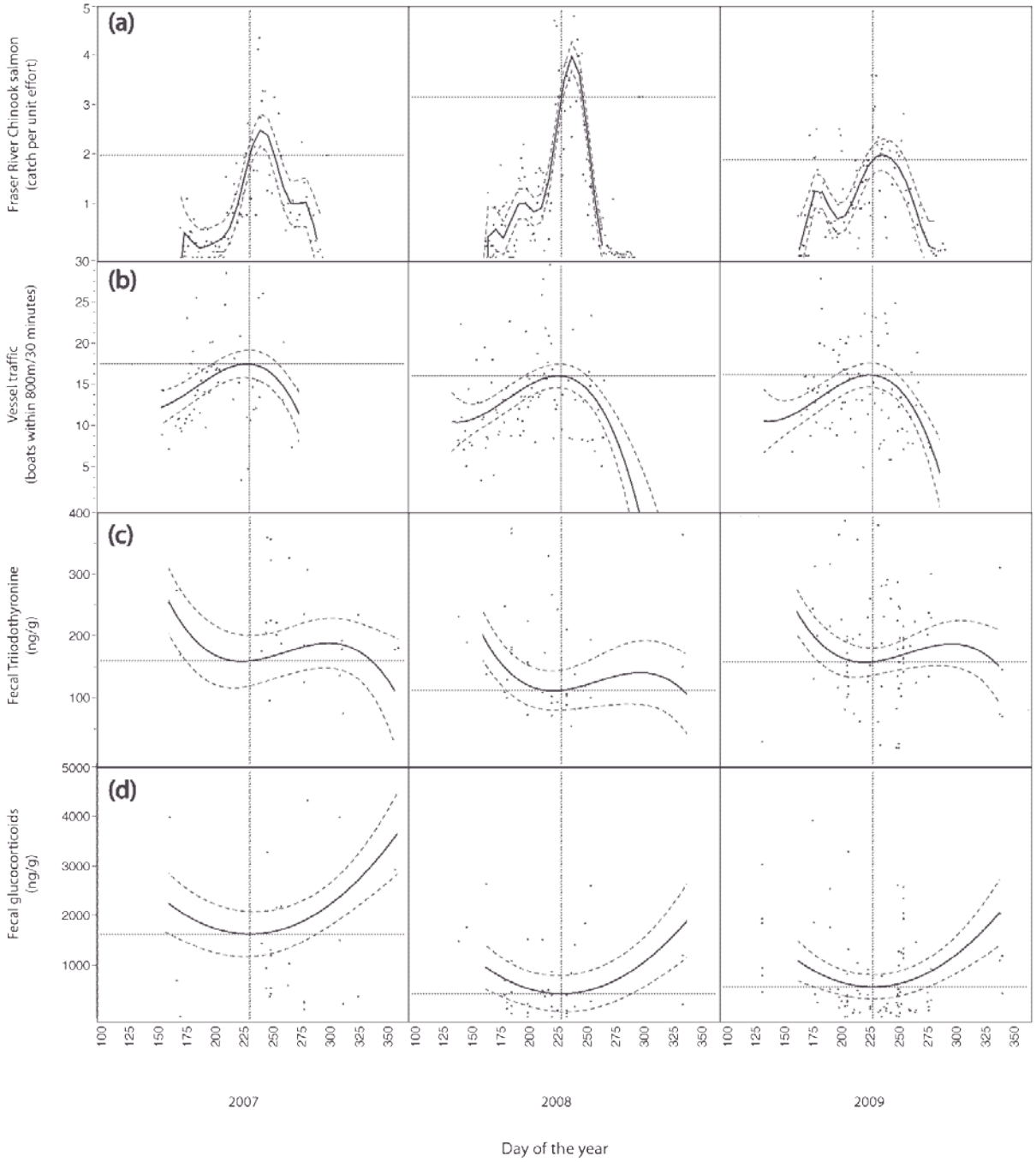
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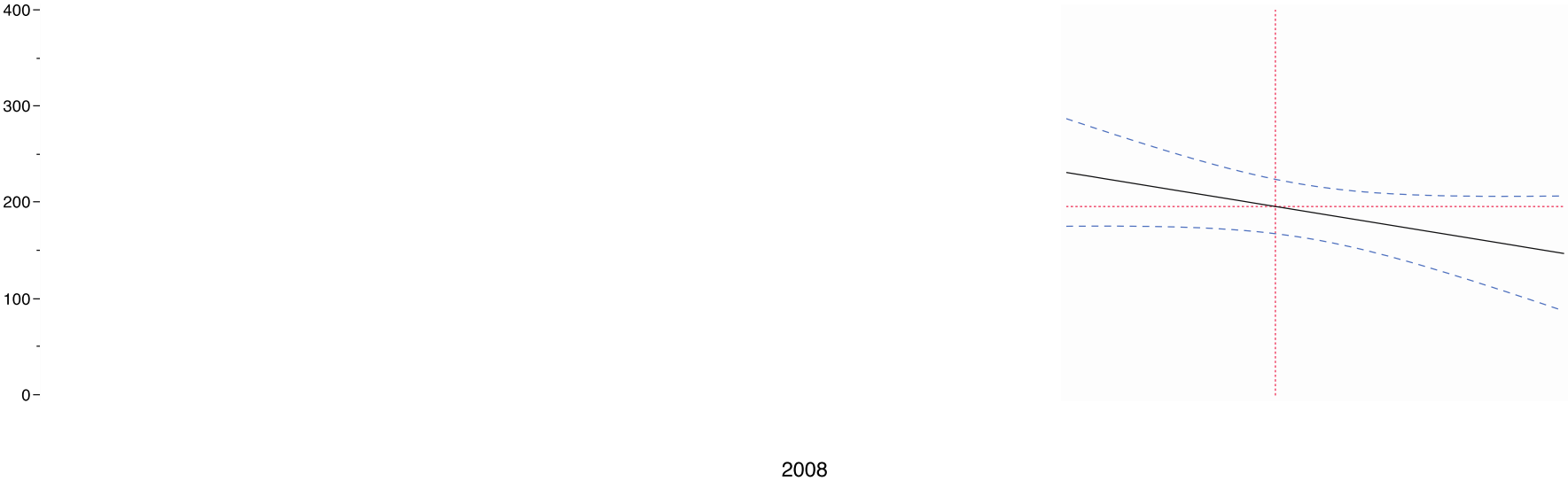
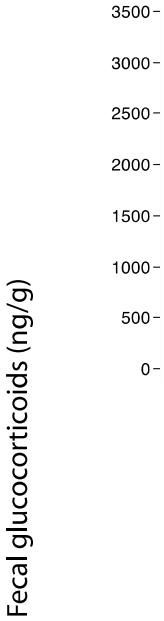

400
300
200
100
0
2008


Fecal glucocorticoids (ng/g)
3500
3000
2500
2000
1500
1000
500
0

Fecal glucocorticoids (ng/g)

3500
3000
2500
2000
1500
1000
500
0

10
15
20
25
30
35
40

Conclusions

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- Fish > boats, although boats appear to have cumulative physiological impacts when fish abundance is low

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- NRKW
- Winter reproductive failure

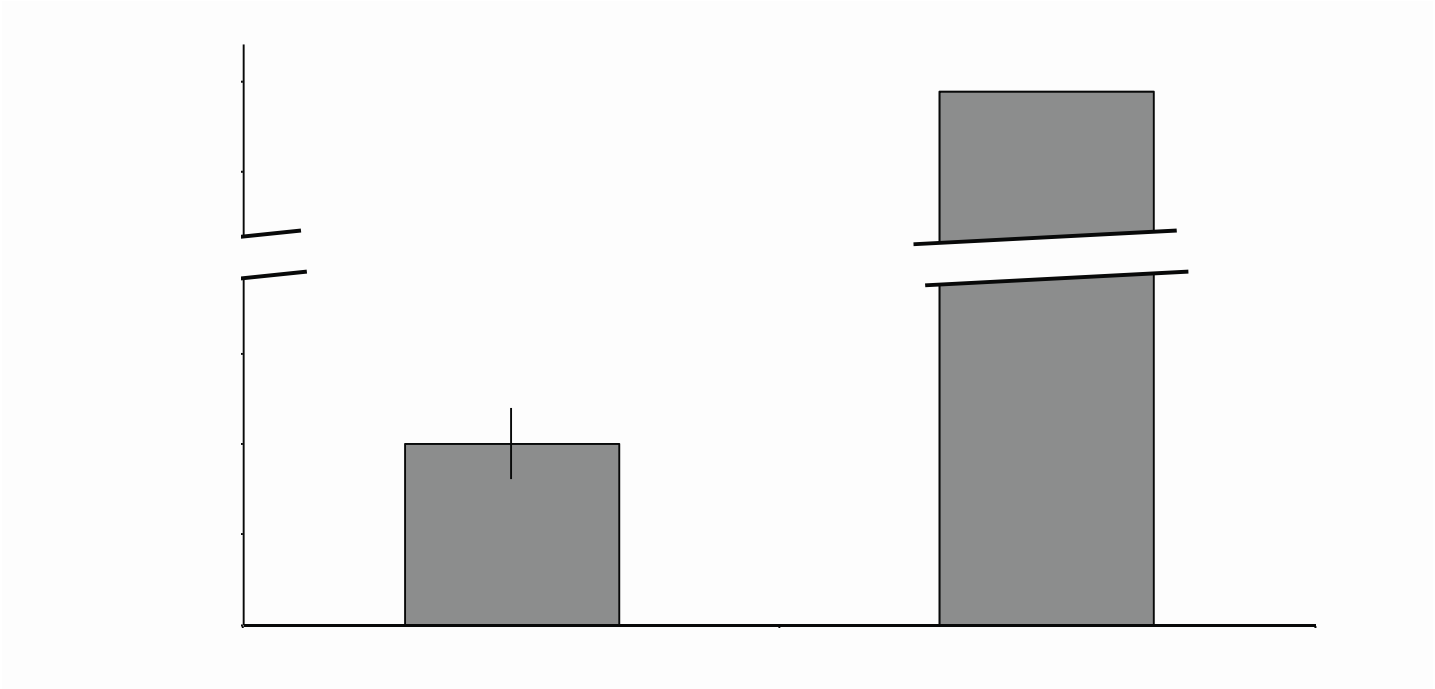
Fecal hormones can confirm pregnancy providing an index of winter reproductive failure

Estimated Reproductive State[1]	Reproductive State Criteria	n	Progestins (ng/g) +/- SE[2]	Testosterone (ng/g) +/- SE[3]
Juvenile[2]	0.5 to 12 years.	7	718 +/- 141a	19.2 +/- 14.4a
No calf[2]	13 to 40 years old, but no observed calf within 17 months of sampling.	11	14,036 +/- 11,090ab	86.4 +/- 37.6a
Pregnant	Observed with calf within 18 months of sampling.	4	25,370 +/- 10,459b	230.9 +/- 86.1b
Lactating[2]	Observed with calf estimated to be younger than two years.	2	740 +/- 441ab	18.127a
Post-reproductive[2]	Older than 40 years with no observed calf in the previous 3 years.	10	1200 +/- 323a	12.6 +/- 4.7a

Thanks to:
NMFS
Washington Sea Grant
JISAO
Soundwatch
Center for Whale Research
Center for Conservation Biology

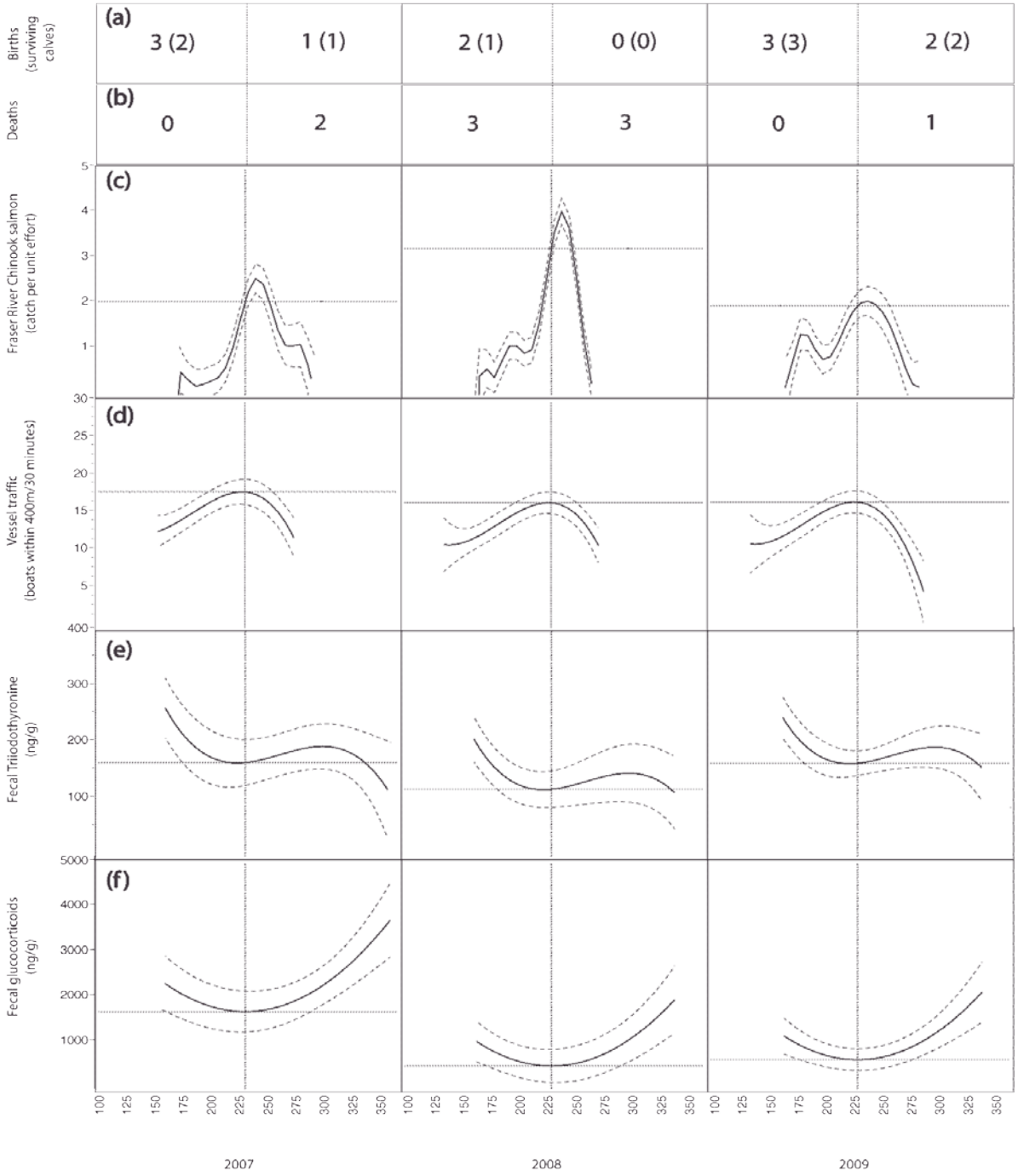
Photo Dave Ellifrit

ACTH Challenge



Toxicants in scat

- Does this increase as prey decline?
- Does in lead to greater T3 declines?
- Cumulative impacts


Births (surviving calves)
(a)
3 (2)
1 (1)
2 (1)
0 (0)
3 (3)
2 (2)
Deaths
(b)
0
2
3
3
0
1
Fraser River Chinook salmon (catch per unit effort)
(c)
Vessel traffic (boats within 400m/30 minutes)
(d)
Fecal Triiodothyronine (ng/g)
(e)
Fecal glucocorticoids (ng/g)
(f)
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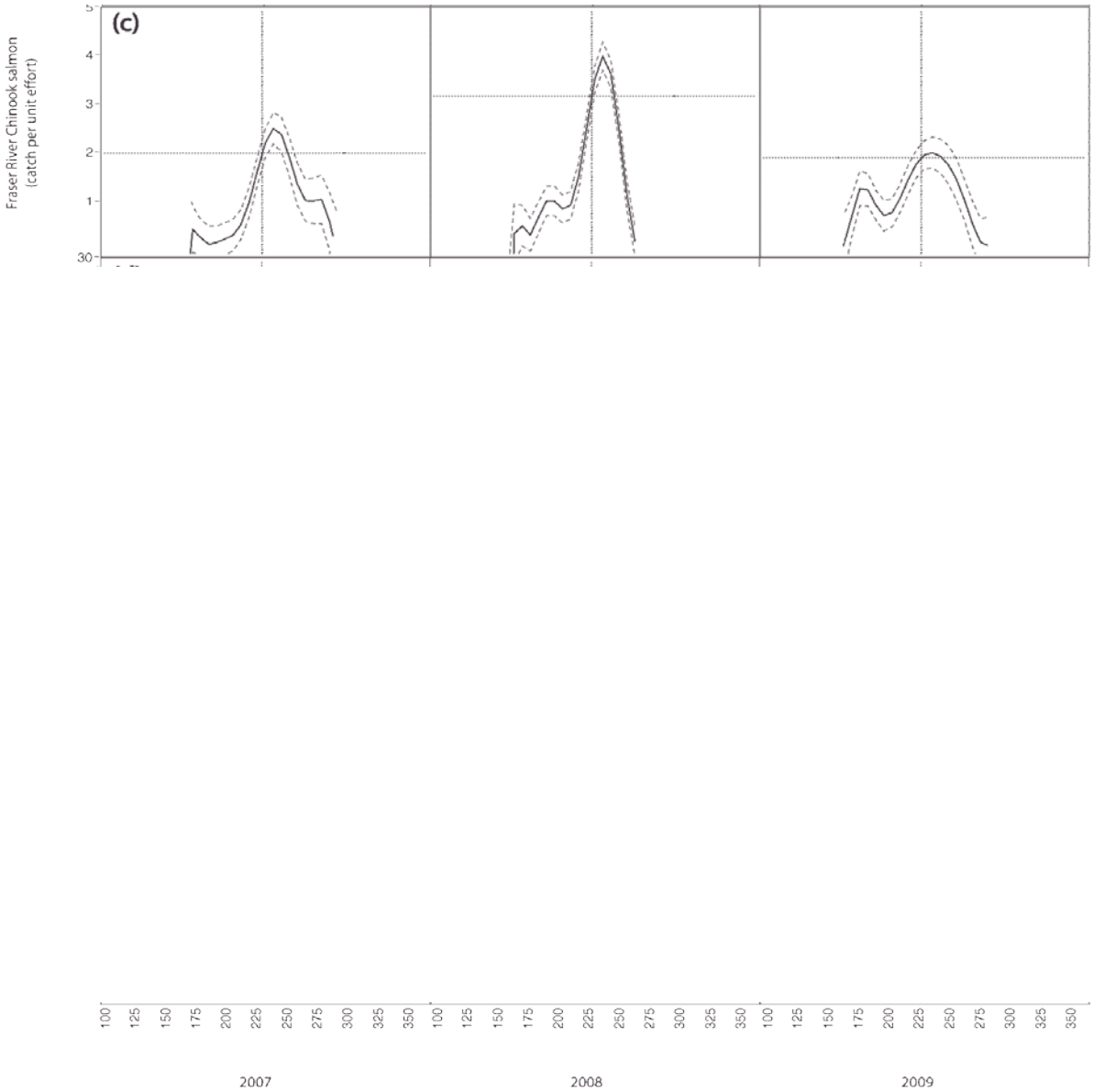
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5
4
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2
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325
350
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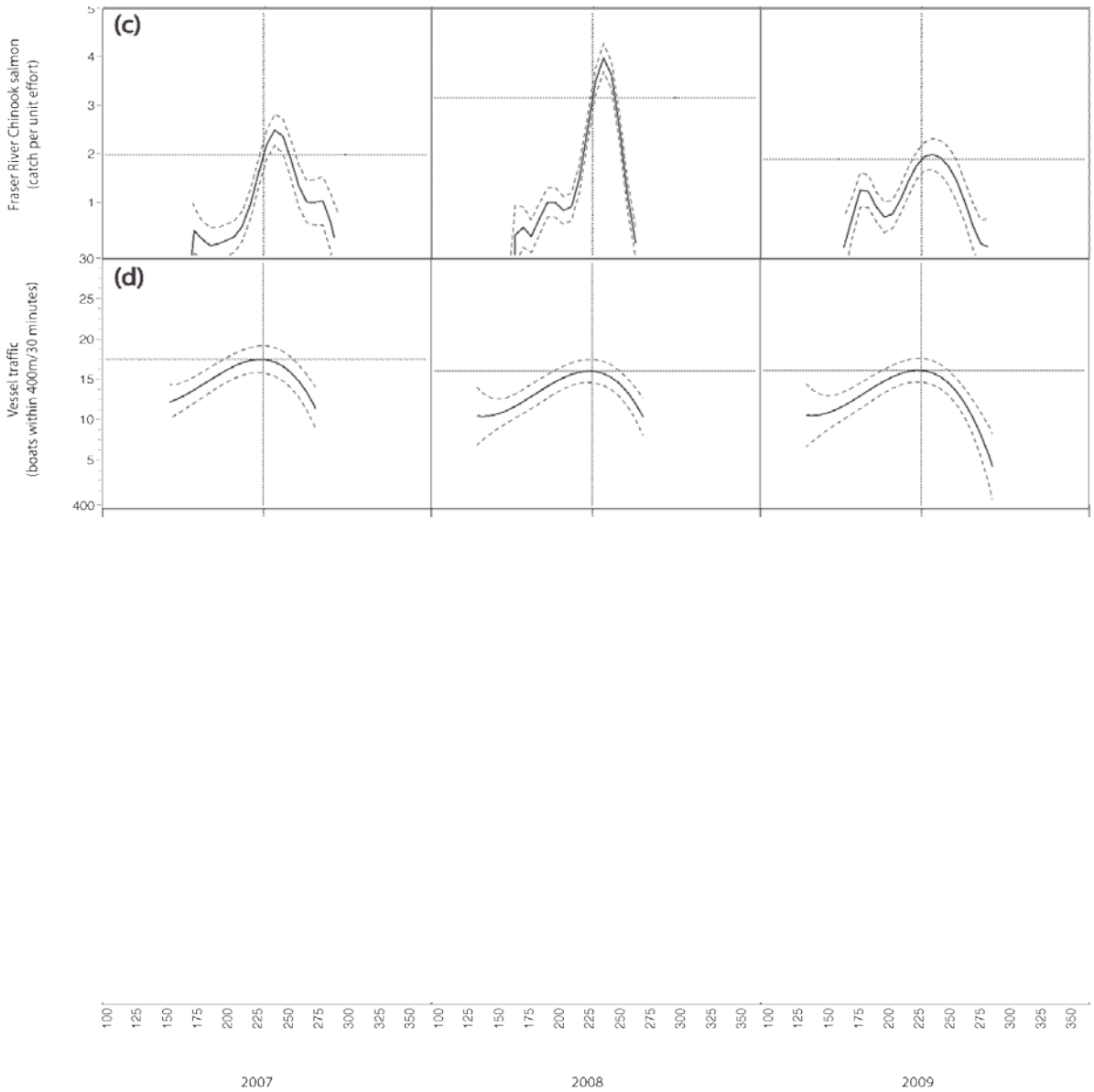
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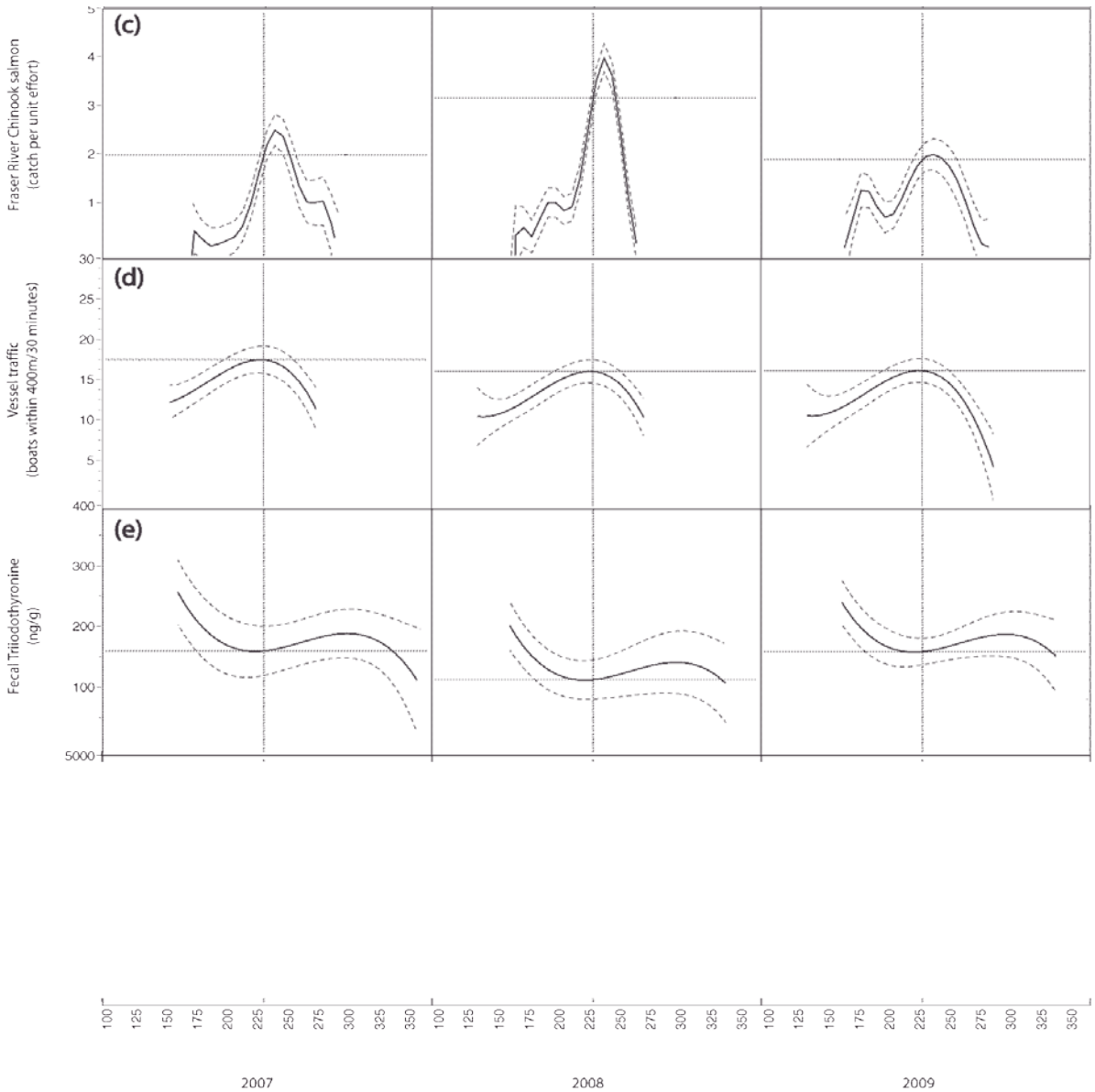
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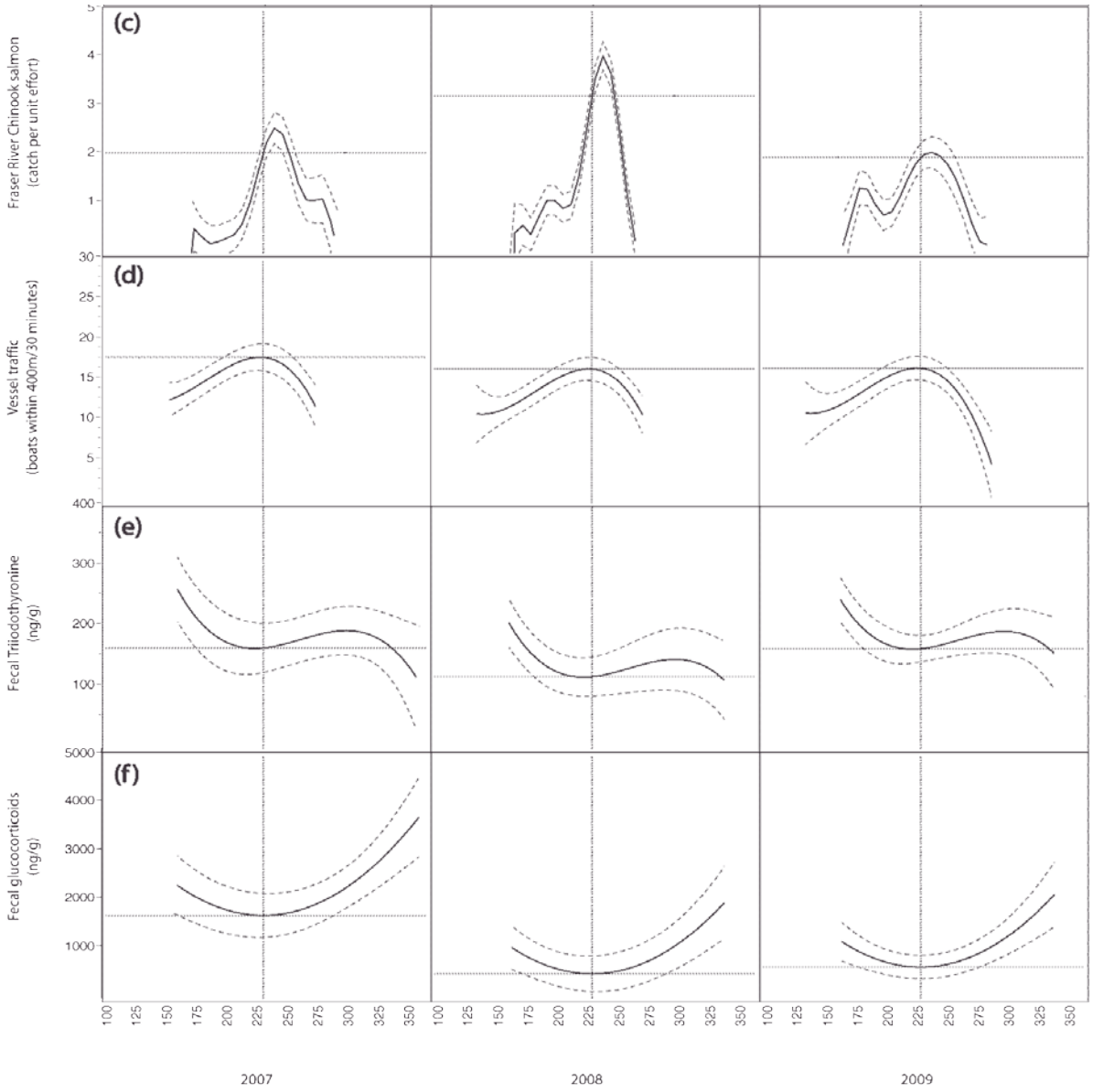
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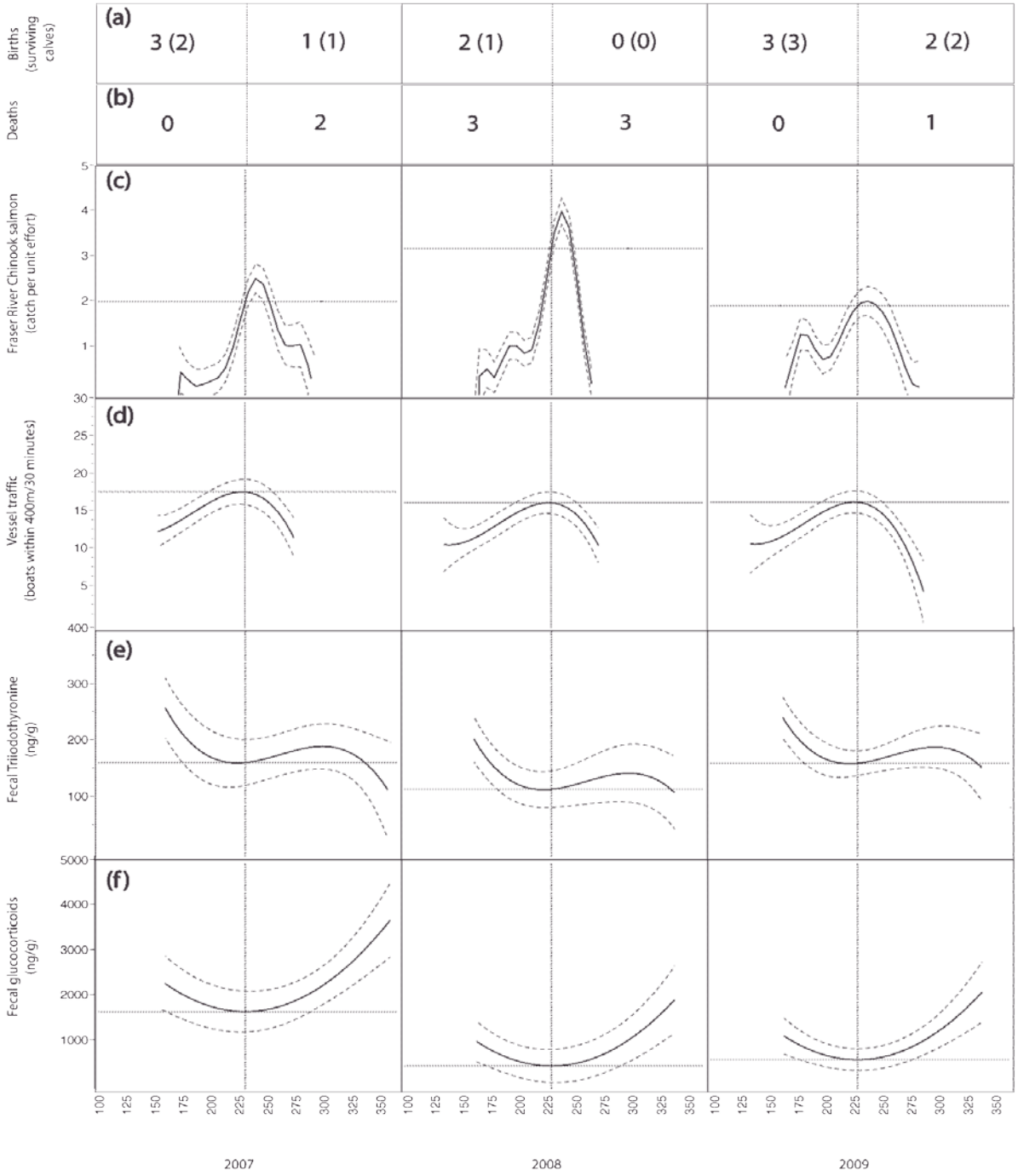
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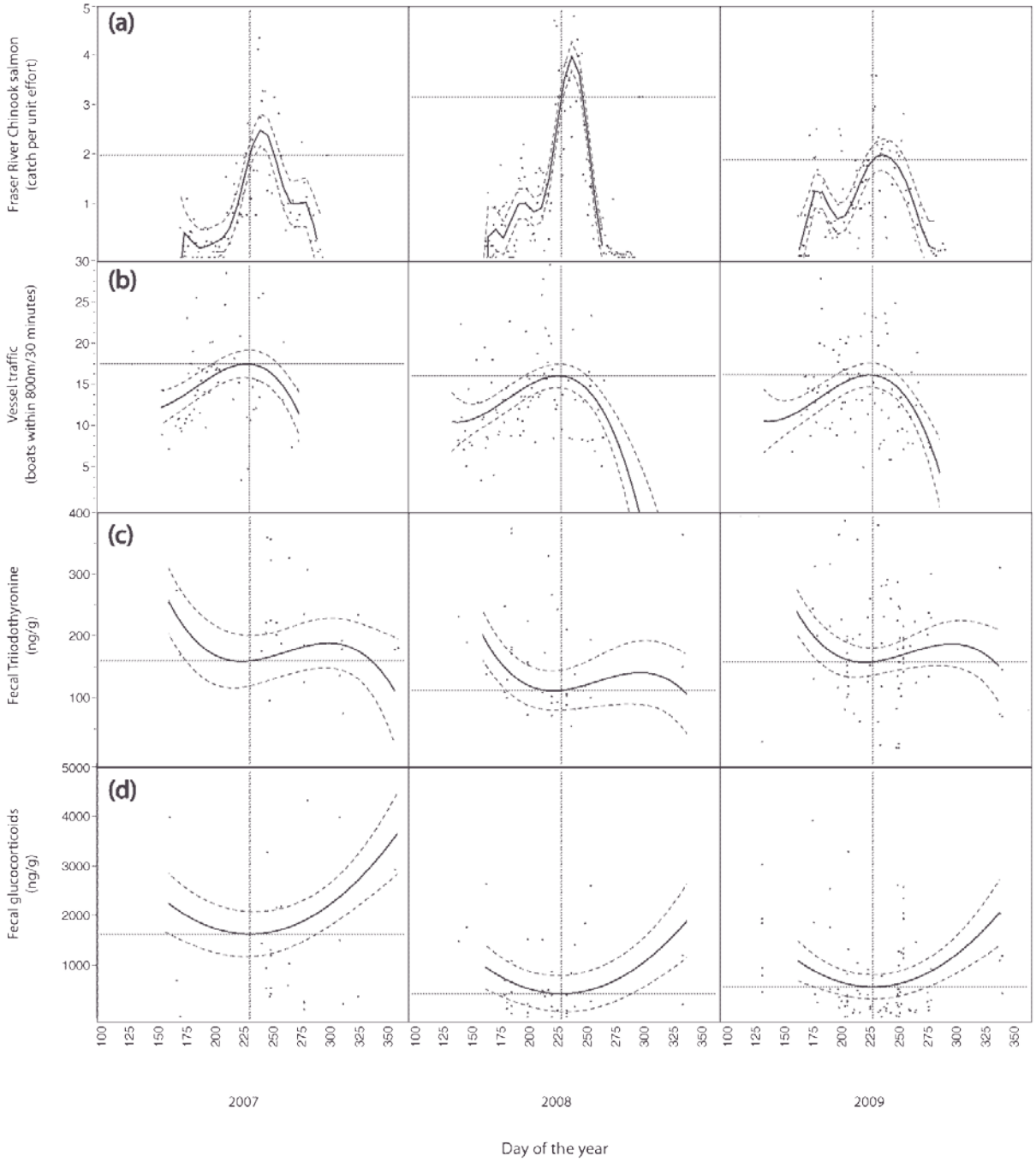
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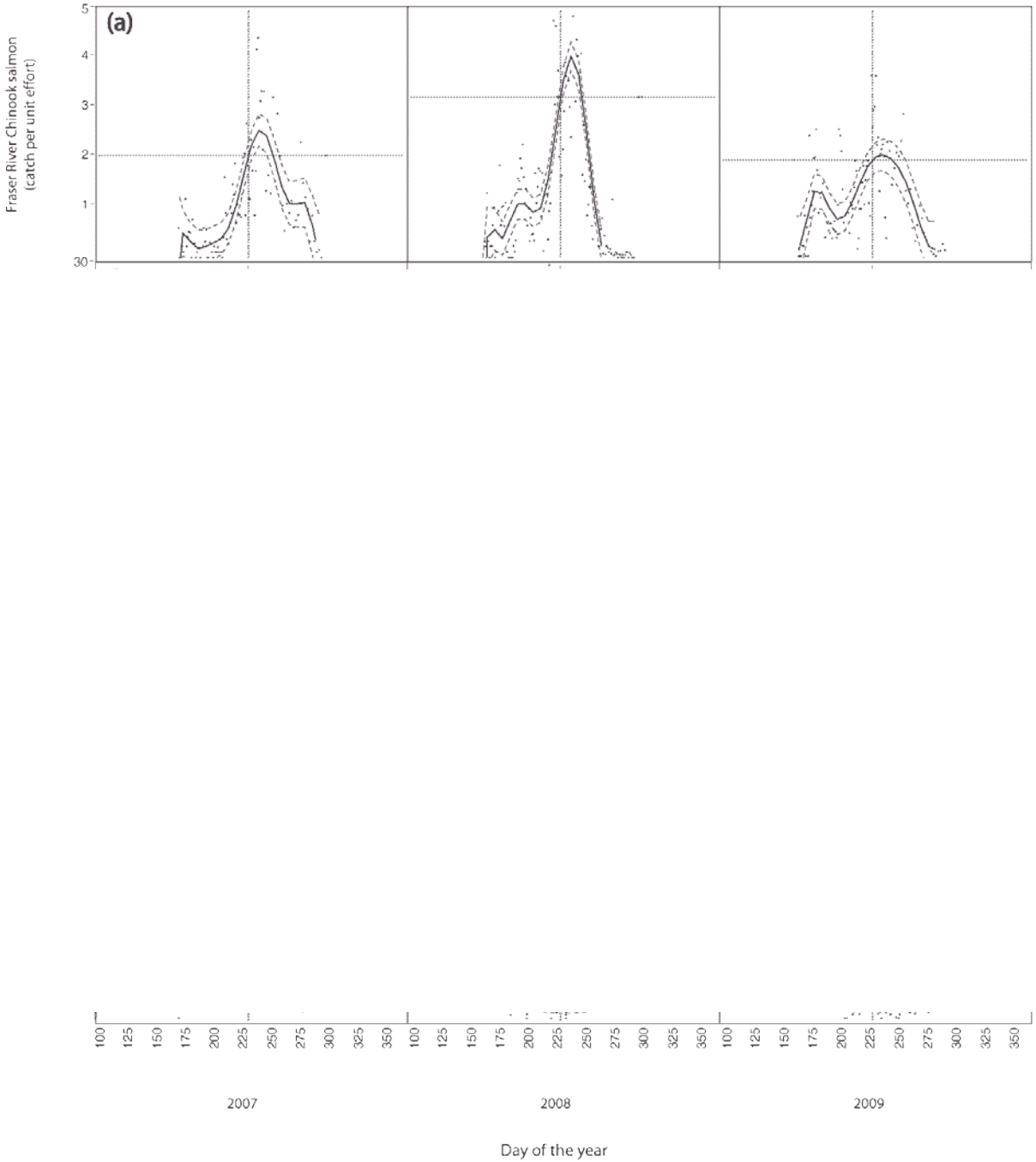
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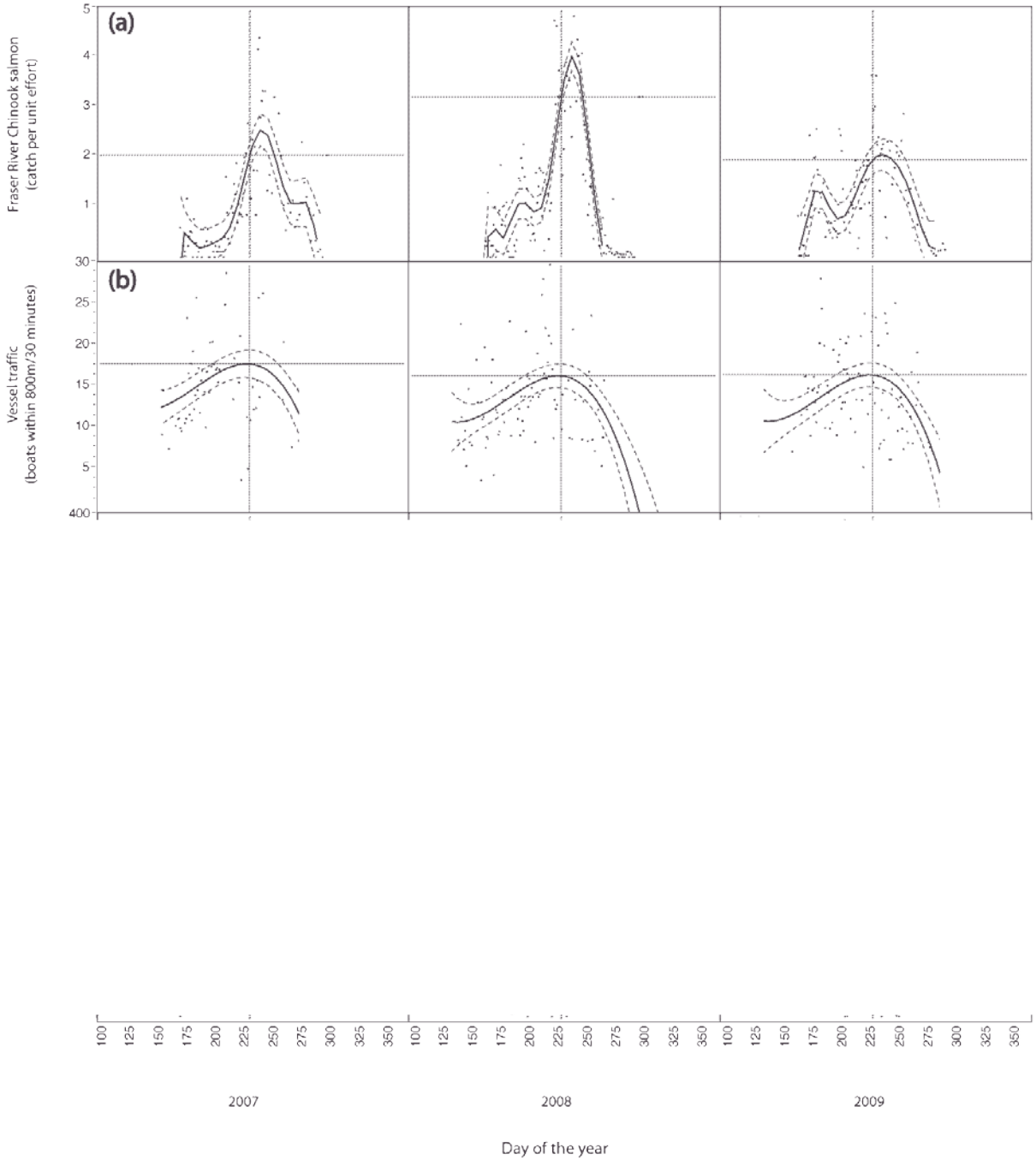
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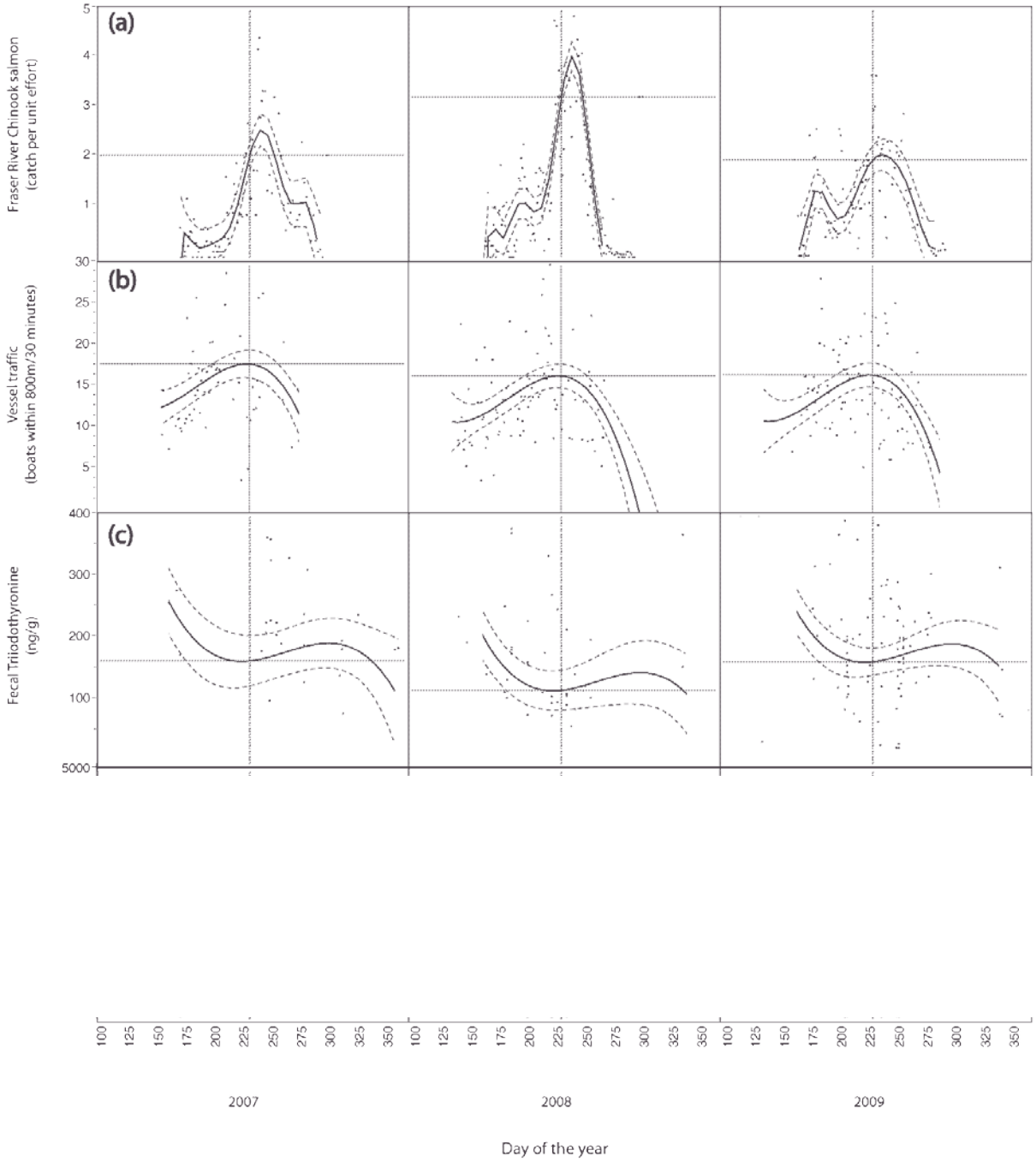
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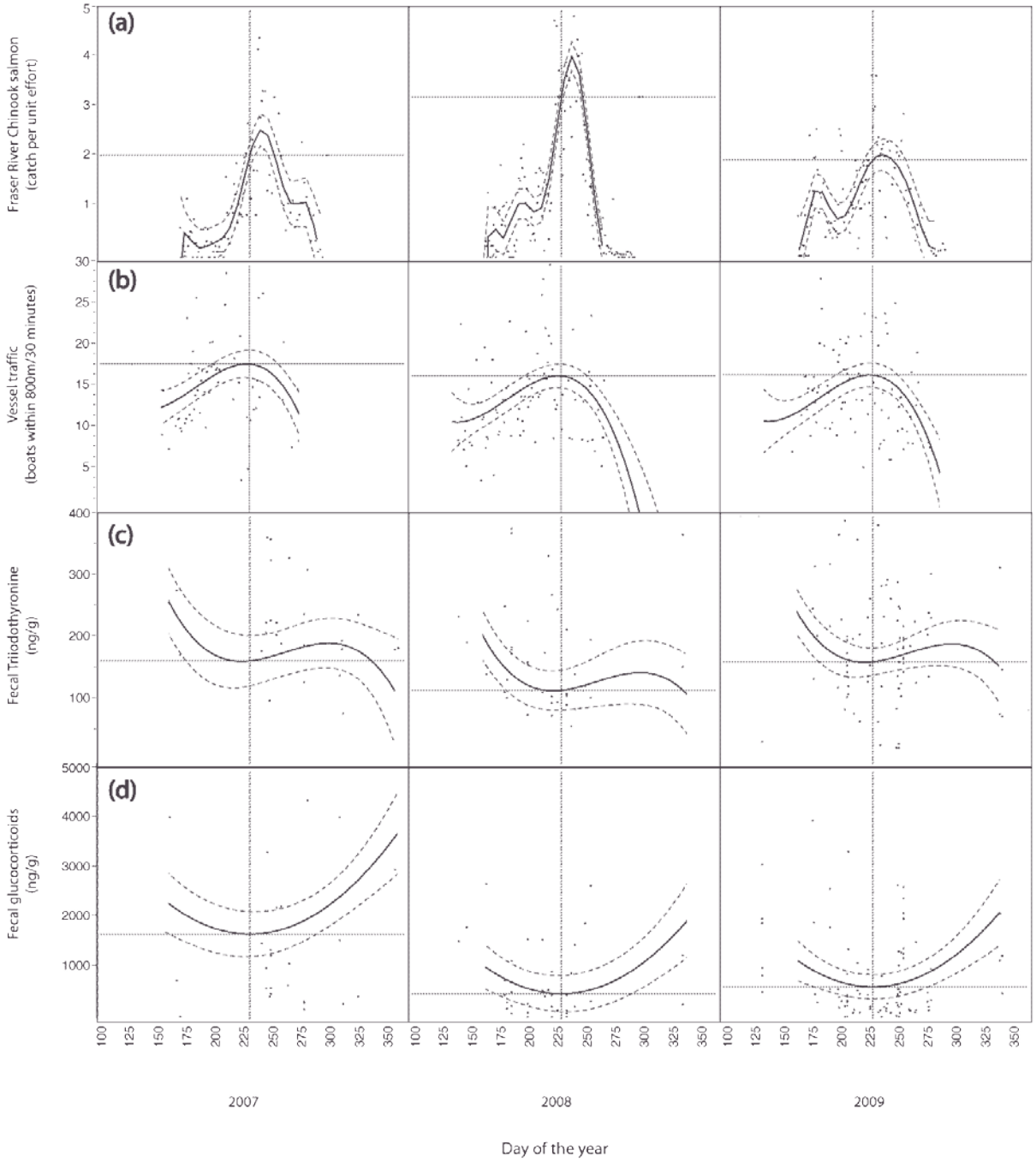
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5

4

3

2

1

Fraser River Chinook salmon
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5

4

3

2

1

Fraser River Chinook salmon
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5

4

3

2

1

Fraser River Chinook salmon
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5
4
3
2
1