foothills
MODEL FOREST
research growing into practice.

Grizzly bear habitat and mortality risk: Models for resource management



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Linking habitats & resources to animals

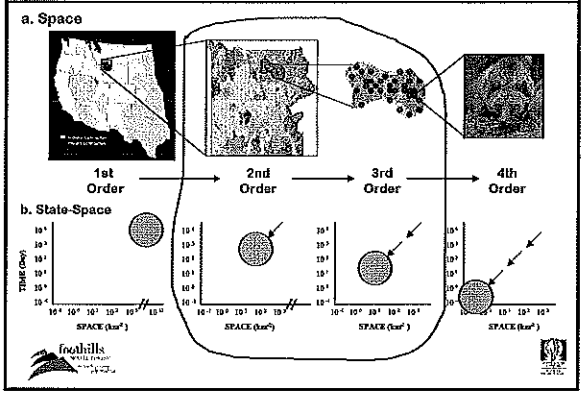
The concept of resource selection

1. Adequate resources are necessary to sustain animal populations
2. Resource items are typically non-random and non-uniform in their spatial-temporal distribution
3. Resources can be anything from food items to habitats
4. When resources are used disproportionately to their availability, use is said to be selective

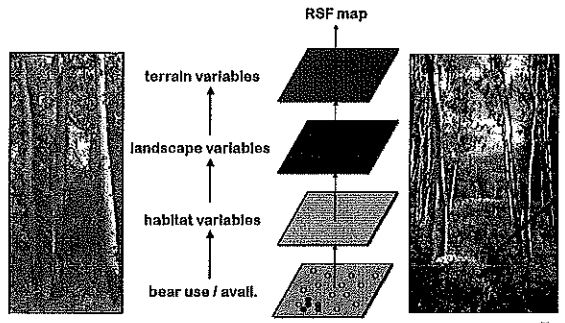


An RSF is any function that is relative to the probability of use for resource units

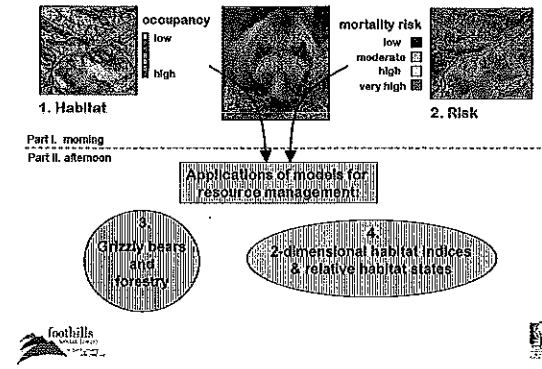
Hierarchical Scales of Resource Selection

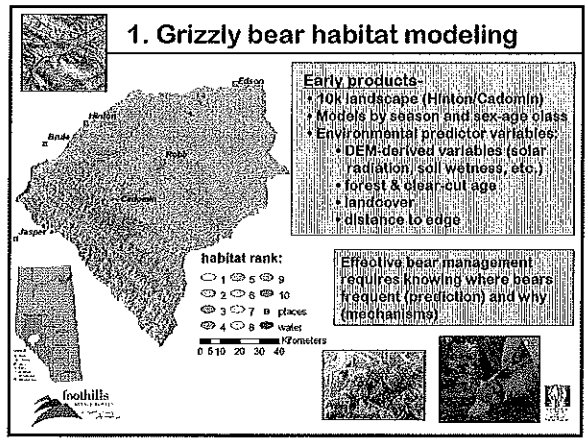


The Resource Selection Modeling Process



Modeling framework and outline




1. Grizzly bear habitat modeling
Early products-
• 10k landscape (Hinton/Cadomin)
• Models by season and sex-age class
• Environmental predictor variables:
• DEM-derived variables (solar radiation, soil wetness, etc.)
• forest & clear-cut age
• landcover
• distance to edge
habitat rank:
places
water
Effective bear management requires knowing where bears frequent (prediction) and why (mechanisms)
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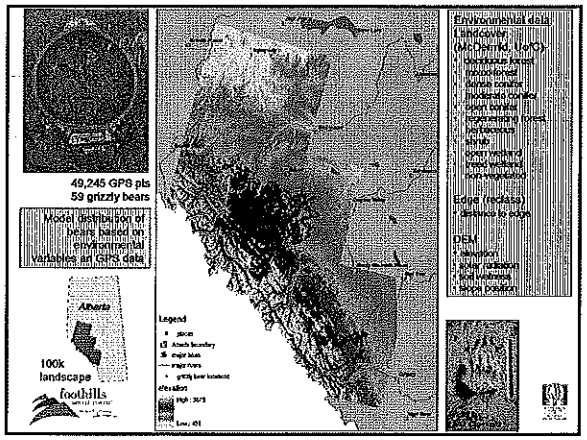
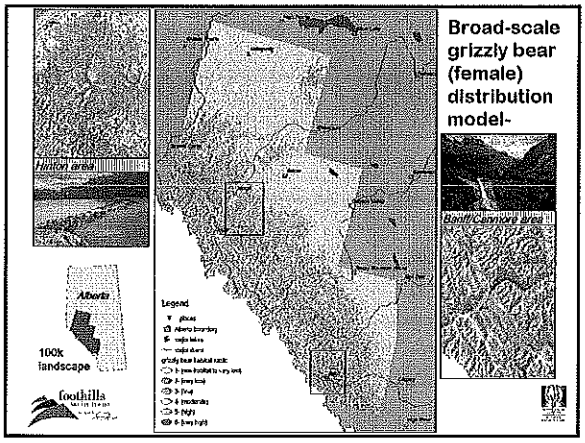
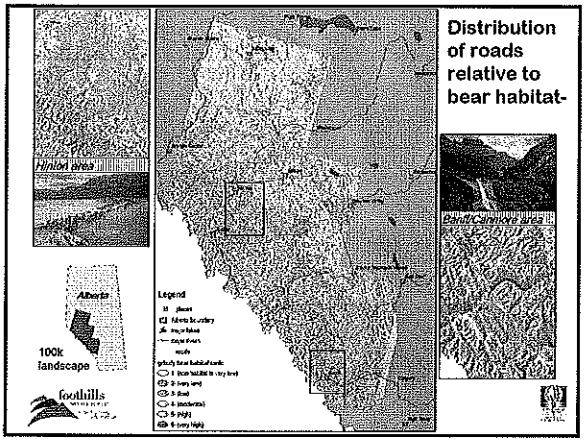
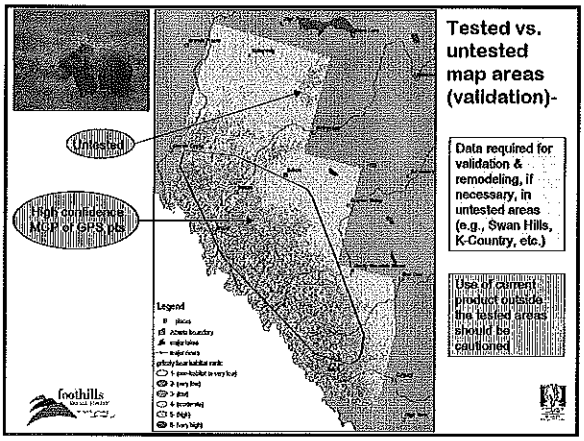

49,245 GPS pts
59 grizzly bears
Model distribution of bears based on environmental variables an GPS data
Alberta
100k landscape
foothills
Environmental data
(Landcover, (McDermid, U of C):
Edge (reclass)
DEM:
Legend


Broad-scale grizzly bear (female) distribution model-
Alberta
100k landscape
foothills
Legend


Distribution of roads relative to bear habitat-
Alberta
100k landscape
foothills


Tested vs. untested map areas (validation)-
Untested
High confidence MCP or GPS pts
Data required for validation & remodeling, if necessary, in untested areas (e.g., Swan Hills, K-Country, etc.)
Use of current product outside the tested areas should be cautioned
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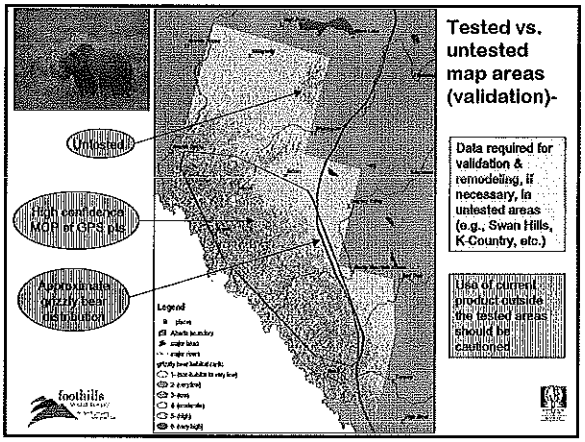
Tested vs. untested map areas (validation)-
Untested
High confidence MCP or GPS pts
Approximate grizzly bear habitat
Data required for validation & remodeling, if necessary, in untested areas (e.g., Swan Hills, K-Country, etc.)
Use of current product outside the tested areas should be cautioned
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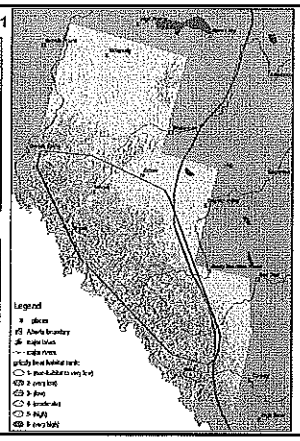
100k RSF-version 1

Some limitations:

- interpretations of habitat outside tested areas
- forest stand management
- sub-adult males
- habitat 'quality'

We are updating forest stand GIS data allowing for more specific 100k RSF models



Intended use & limitations

Useful for:

- regional grizzly bear distribution questions
- regional special management questions

100k landscape

2. Human-caused mortality risk

Where are bears at risk? Where are bears safe?

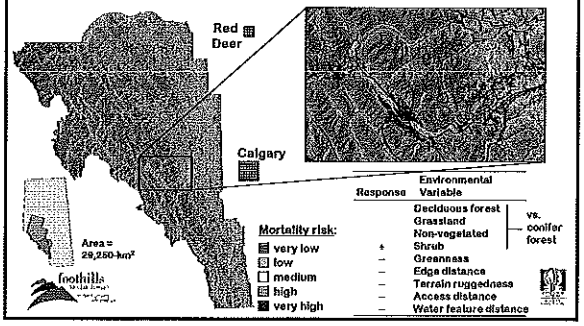
- Knowing the likelihood of a species being present does not dictate habitat 'quality'
- Reproduction and survival (especially for grizzly bears) may be better in some habitats than others (e.g., attractive sinks/ecological traps)
- Risk-based adjustments to the habitat (RSF) map

G-24, male

ecological trap
(lack the evolutionary cues to the low quality risk)

2. Mortality risk (Central Rockies)

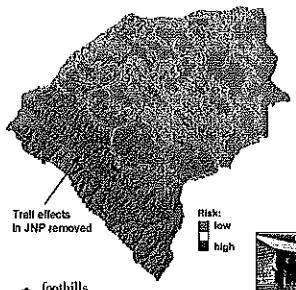
- 279 human-caused mortalities (1971-2002, ESGBP-Herrero)
- Modeled with common human & habitat variables
- Very good predictive accuracy from 41 withheld mortalities



Response	Environmental Variable	
+	Deciduous forest Grassland Non-vegetated Shrub	vs. conifer forest
–	Greenness	
–	Edge distance	
–	Terrain ruggedness	
–	Access distance	
–	Water feature distance	

2. Mortality risk (applying to FMF)

- 10 of 13 animal mortalities were located in high risk sites
- 6 of 6 female mortalities were located in high risk sites



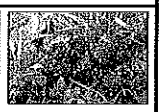
G-24, male

Summary of habitat and risk models

Habitat (RSFs)

10k models from thesis:
- relevant to stand-level & local assessments
- seasonal & sex-age specific models
- limited in extent (10k & limited # animals), but based on highly accurate GIS/environmental data

100k models:
- regional-level assessments of bear distribution
- not for specific seasons/sex-age groups
- large area & number of animals, but with decreasing confidence in data and predictions

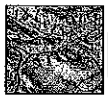


Risk

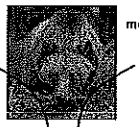
10k models from thesis:
- extrapolations from Central Rockies
- good accuracy in foothills, less so in JNP (w/o adjustment)

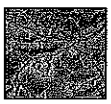
20k models from CRE:
- original area of model development (271 mortalities/32 yrs)
- very good predictive capacity

A framework for resource management



1. Habitat





2. Risk

Part I. morning

Part II. afternoon

Applications of models for resource management

3. Grizzly bears and forestry

4. 2-dimensional habitat indices & relative habitat states

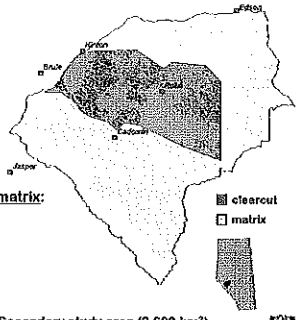
3. Grizzly bears and forestry

Selection *for* clearcuts (clearcut vs. matrix)

Grizzly bear GPS locations

Season:
1-hypophagia (spring)
2-early hyperphagia (summer)
3-late hyperphagia (fall)

→ In clearcut or not?



Selection for clearcuts compared to matrix:

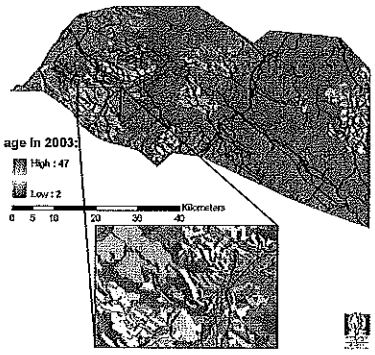
Season	Odds Ratio	Signif
1	1.14	no
2	1.56	yes
3	0.85	no

Secondary study area (2,600-km²)
21 bears (10,127 GPS locations)

3. Grizzly bears and forestry

Habitat selection *of* clearcuts

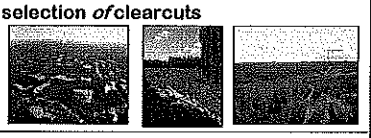
Grizzly bear predictors:
age of cut-block
scarified or non-scarified
area of cut-block
area to perimeter ratio
distance to edge
elevation
soil wetness
solar radiation
silviculture/site preparation



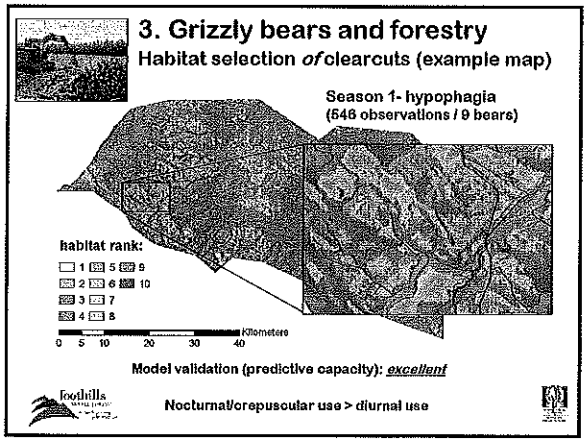
3. Grizzly bears and forestry

Habitat selection *of* clearcuts

Responses to non-silvicultural variables:



Variable	Spring	Summer	Fall
Age	intermediate	intermediate	young & old
Soil	dry & wet	dry & wet	intermediate
Solar	low (NE slopes)	high (SW slopes)	*no difference*
Dist-edge	near edges	near edges	near edges
Area:Perim	natural shape	*no difference*	natural shape


3. Grizzly bears and forestry
Habitat selection *of* clearcuts (example map)
Season 1- hypophagia
(546 observations / 9 bears)
habitat rank:
1 5 9
2 6 10
3 7
4 8
0 5 10 20 30 40 Kilometers
Model validation (predictive capacity): excellent
Nocturnal/crepuscular use > diurnal use
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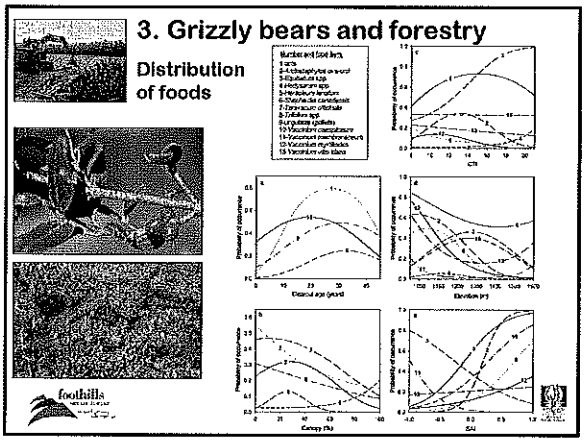
3. Grizzly bears and forestry
Distribution
of foods
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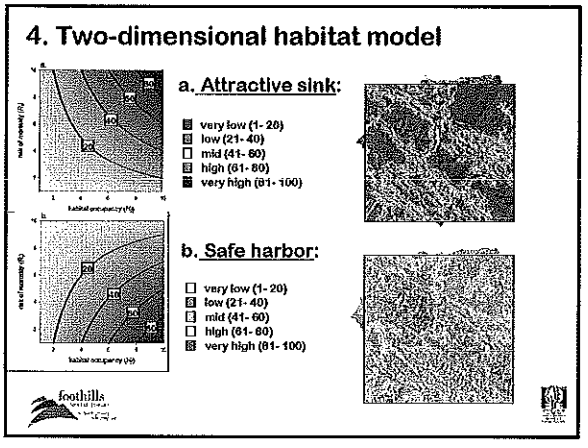
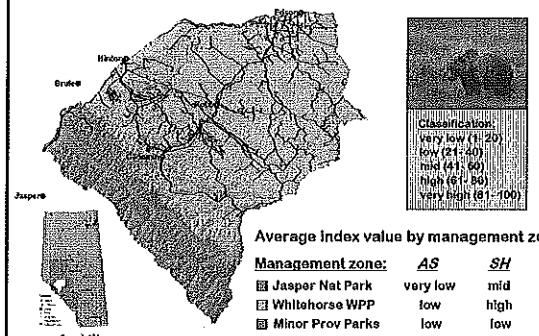

4. Two-dimensional habitat model
a. Attractive sink:
very low (1- 20)
low (21- 40)
mid (41- 60)
high (61- 80)
very high (81- 100)
b. Safe harbor:
very low (1- 20)
low (21- 40)
mid (41- 60)
high (61- 80)
very high (81- 100)
foothills

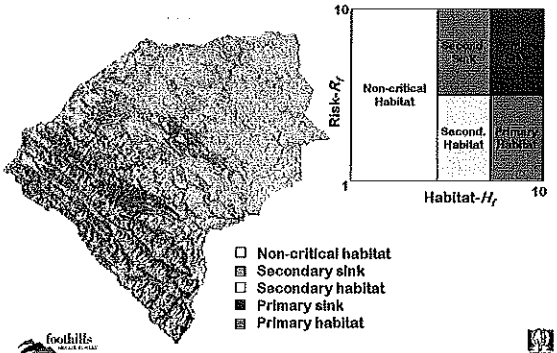
4. Two-dimensional habitat model



Average index value by management zone:

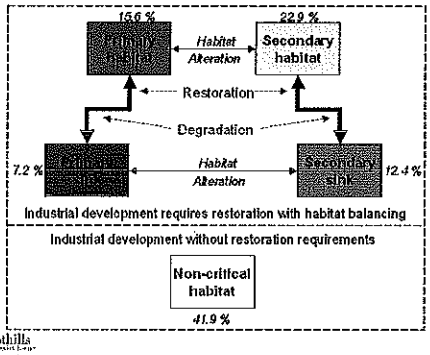
Management zone:	*AS*	*SH*
Jasper Nat Park	very low	mid
Whitehorse WPP	low	high
Minor Prov Parks	low	low
Crown lands	low	low
White zone	low	very low

4. Two-dimensional habitat model



- Non-critical habitat
- Secondary sink
- Secondary habitat
- Primary sink
- Primary habitat

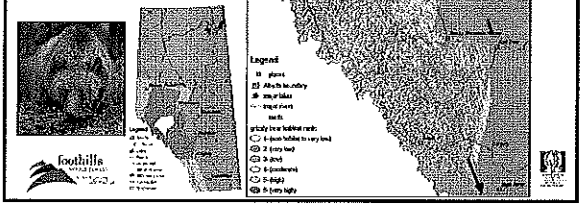
4. Two-dimensional habitat model



Current research activities-

Expanded products

1. Update existing habitat models w/ new data
2. Expand habitat models to USA border & north
3. Update risk models for expanded study area



Current research activities-

Landscape-level food modeling

1. Update existing food models
2. Integrate into a single, temporally varying index (% of diet and/or kcal)
3. Test predictive capacity for grizzly bear occurrence
4. Temporal dynamics of buffaloberry