CWHR Level II Model Prototype

Design and Data Development by

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The Goal of a New CWHR Model Paradigm

Improve the ability of CWHR to project species presence.

Attributes of a New CWHR Model

• What are now called "habitat stages" and "special habitat elements" will both be used to predict suitability and thus project species presence. Collectively they will be called "habitat attributes".

• Spatial and temporal scales will be explicit in habitat attribute definitions. For example, slope and gradient values and the presence of habitat "inclusions" are relative to the spatial extent being considered.

• Threshold values for habitat attributes will be defined for each species.

• Spatial extent levels for querying the model will be explicit.

• Individual species models will be built from the finest scale up. However, GIS data representing range will still be the first "cut" in projecting species presence.

Sample Species Model: Siskiyou Mountains Salamander
Plethodon stormi

Level	Threshold Value (s)	Potential Data Sets to Support
Biogeographic or Ecoregional	Klamath Mountains Subregion (M261A) Below treeline	USDA Ecological Subregions Elevation
Landscape or Ecosystem	Forested	Life form dominance from vegetation data sets
Macro-habitat or Stand Level	Hardwood/conifer dominated Given tree size and canopy cover	Fine-scale vegetation data sets containing CWHR habitats and structural attributes
Meso-habitat	Rocky, organic substrate 3 or more rocks	
Micro-habitat	Decomposed hardwood vegetation, which leads to rich invertebrate presence Given soil temperature and moisture	

Level of Spatial Extent	Options from CWHR Now	What Level II Modeling Effort will Add
Biogeographic or Ecoregional	Range and distribution maps captured at 1:1,000,000 scale Species list predictions derived by selecting locations and habitats only	
Landscape or Ecosystem	Single and two-condition habitat value comparisons for multiple species based on habitat and stage Bioview output – suitability mapping for an individual species across a landscape	A flexible way of defining and redefining patches of suitable habitat stages with fine-scale pixel data Elements at the same level as habitat stage in determining suitability
Macro-habitat or Stand Level	"	Same habitat attribute defined at multiple scalar levels
Meso-habitat Micro-habitat	Option to delete elements not present at the appropriate scalar level for all of the species of interest, and thus delete those species finding the element essential for a life requisite	Spatial explicitness within and between patches of suitable habitat One size does not fit all!

DFG Contract in 2000/2001 with
US Forest Service Pacific Southwest
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Using these guidelines and the sample species model, develop models for 32 selected species representing a range of regions and habitats. For each species, identify:

- key habitat attributes to predict habitat suitability;

- key spatially (e.g. lineal distance, slope) and temporally (e.g. time of day, time of year) explicit variables;

- threshold values for predicting suitability along each of these continua.

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Develop components for a desktop software application for Level II Models and provide documentation of the programming logic.

Accomplishments

Accomplishments

Spatial model parameters for 32 species.

Pinyon Mouse

Most of these attributes add quality to habitat but they are not necessarily additive.

Timing - include timing of use if appropriate into each of these variables - timing is important for predators - animal is generally nocturnal; in warmer climates (lower elevation) these mice are active pretty much year-round but in colder climates is generally in dens in winter

Water

presence of water enhances the value of the habitat but is not necessary for this mouse generally found in rather xeric conditions water is acquired through its prey, metabolic water, and free water such as dew

Within Patch Characteristics:

Vegetation Elements:
pines, firs, hardwoods - no particular species seem to be critical to presence of this mouse

Layers:
Tree Layer - desirable (M) (Preferred Attribute)
Shrub Layer - very important (H) (Secondarily Essential Attribute)
Herb Layer - very important (H) (Secondarily Essential Attribute)
Layer Charac - species needs a mixture of layers especially of shrubs and herbs - relatively continuous cover of **herbaceous and shrubs** within a habitat patch is desirable 25% - L; 50% - H

Efficiency of habitat structure for foraging or shelter from predation (e.g., logs/rocks for mice)

- favors rocky areas with thick shrubs or coniferous woodland with mixed shrubs
- LITHIC & ROCK enhance the reproductive and cover value of a habitat
- All RES from 3-7 regardless of condition enhance the reproductive & cover value of a habitat
- SNAGS enhance the value of all three life history requirements

Patch size

minimum patch for persistence of an animal (bounded by habitat with 0 value)-
0.25 acre (L)
5 acres (H)

distance between - patches (across habitat with 0 value) -
< 5 m (H)
10 m (L)

patch for "population"
above configuration within 200 acres

Edge Elements

edges between habitats don't seem to be as important as within habitat patch variability

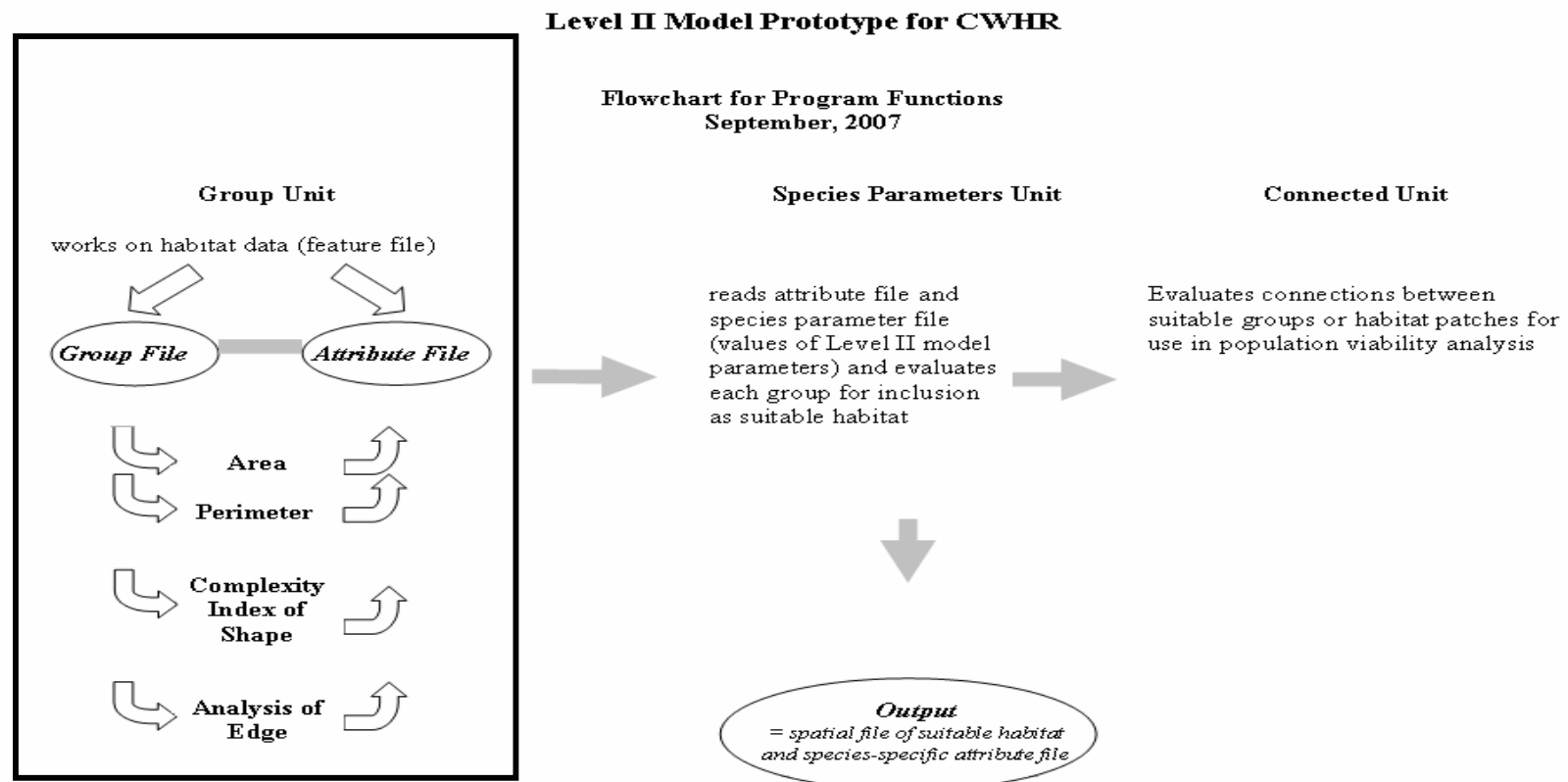### Spatial Relations of Essential Habitats

small scale animal with pattern of shrub and herbaceous cover in habitat patches more important than pattern of habitats
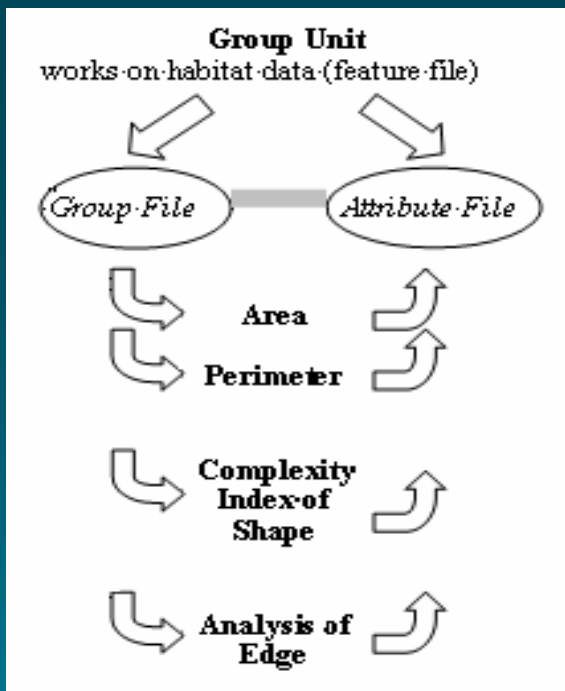
Accomplishments

A concept for how the units of the Level II Model will fit together. The first of these units – the Group Unit – is available as a stand-alone program known as "GRABS". "GRABS" stands for "Grouping Resources Algorithm for Biological Systems". The "Group Unit" or "GRABS" acts on habitat data.

Level II Model Prototype for CWHR

Flowchart for Program Functions
September, 2007

Group Unit

works on habitat data (feature file)

Group File — *Attribute File*

Area
Perimeter

Complexity
Index of
Shape

Analysis of
Edge

Species Parameters Unit

reads attribute file and
species parameter file
(values of Level II model
parameters) and evaluates
each group for inclusion
as suitable habitat

Connected Unit

Evaluates connections between
suitable groups or habitat patches for
use in population viability analysis

Output
= spatial file of suitable habitat
and species-specific attribute file

Group Unit
works on habitat data (feature file)

Group File — Attribute File
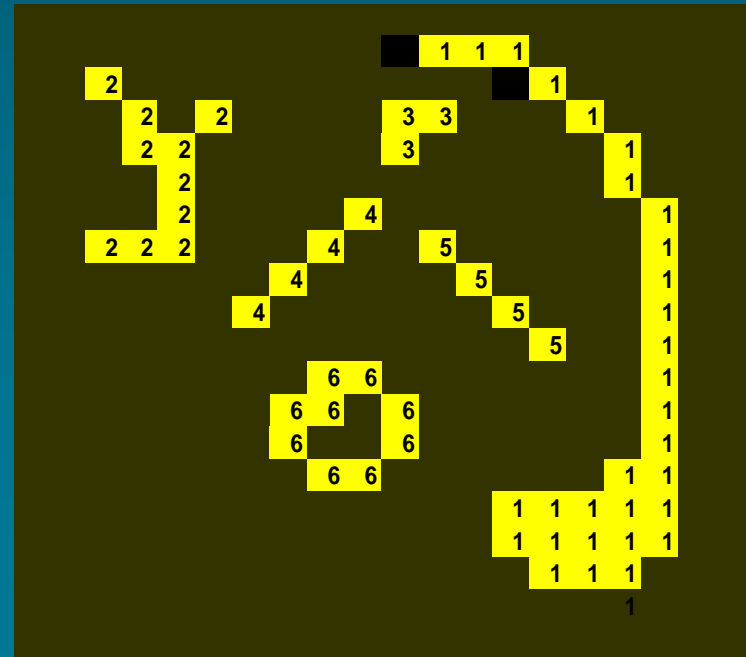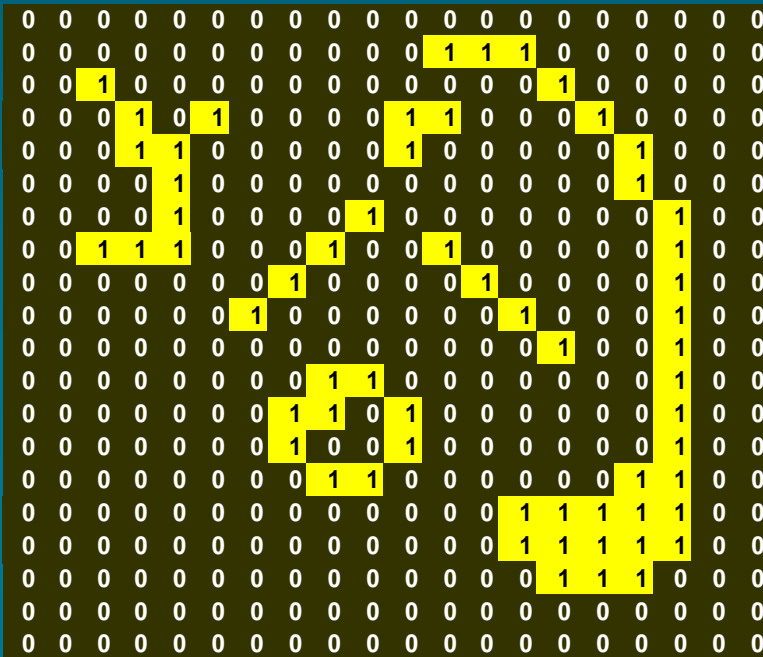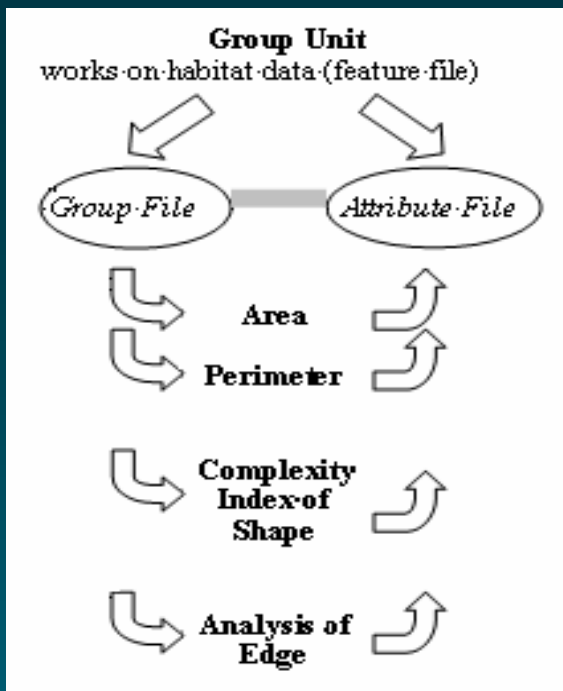
Area
Perimeter
Complexity Index of Shape
Analysis of Edge

When executed, the Group Unit or "GRABS" takes a band-interleaved (*.bil) or raster file containing a habitat feature of interest to an analyst (e.g. a stand of Coastal Oak Woodland 4M). It puts pixels representing that feature into coherent groups, provides each group a number, and creates a group file and an attribute file.
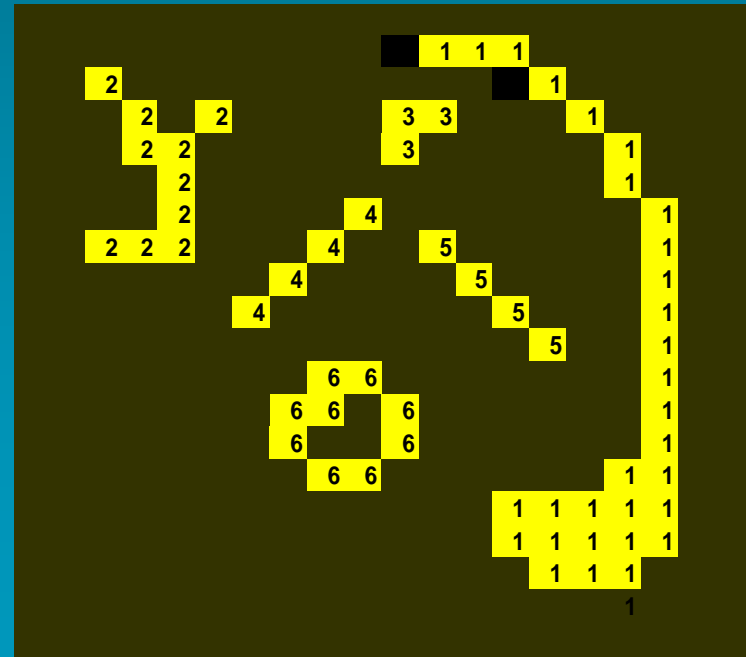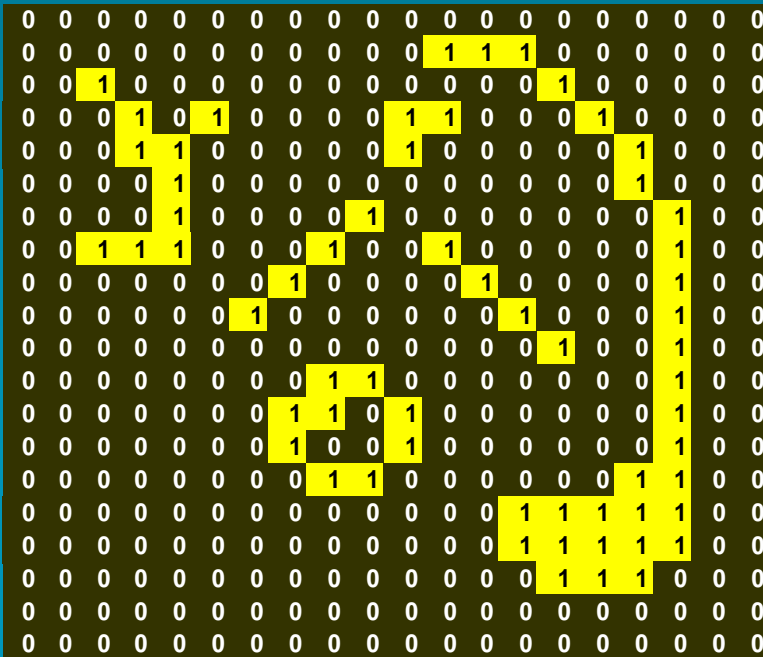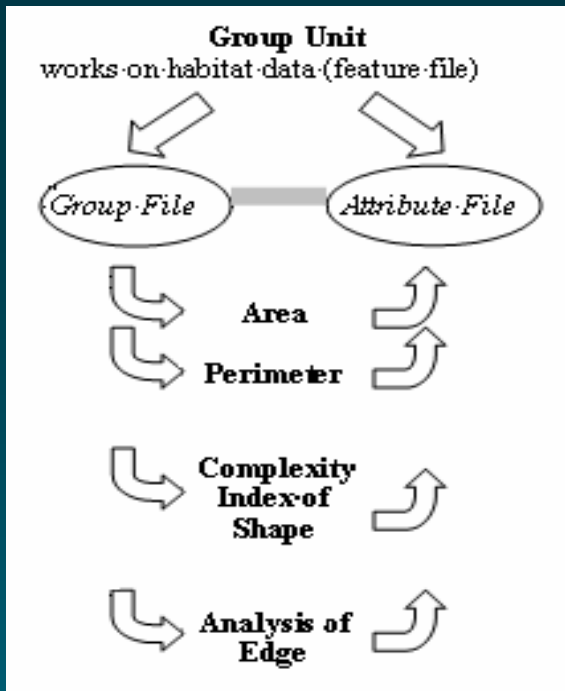
Program routines calculate the area and perimeter of each group and return these values to the attribute file.

A Complexity Index of Shape is calculated for each group and the values returned to the attribute file.

Shape of a feature is considered as important as is its area. A 5-acre patch of foraging habitat can be in a coherent 5-acre piece or strung out in a 5-acre strip only 15 feet wide.
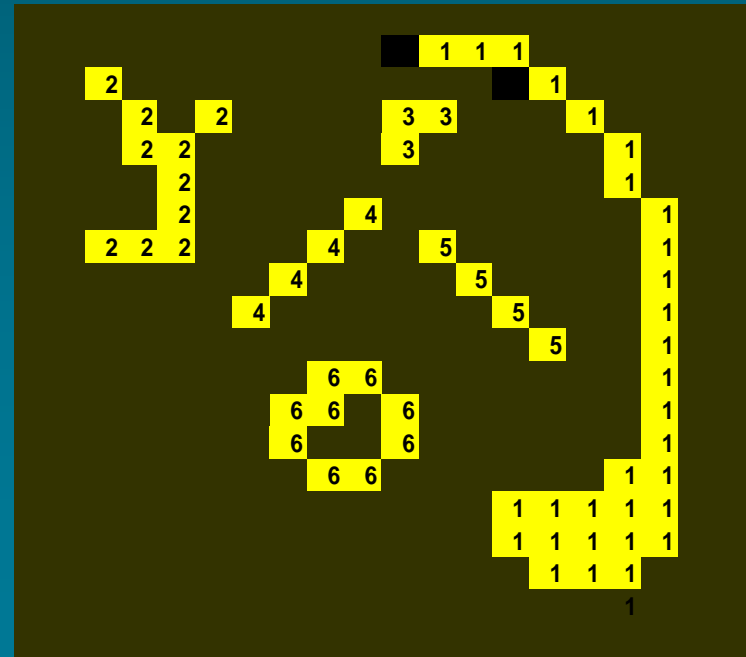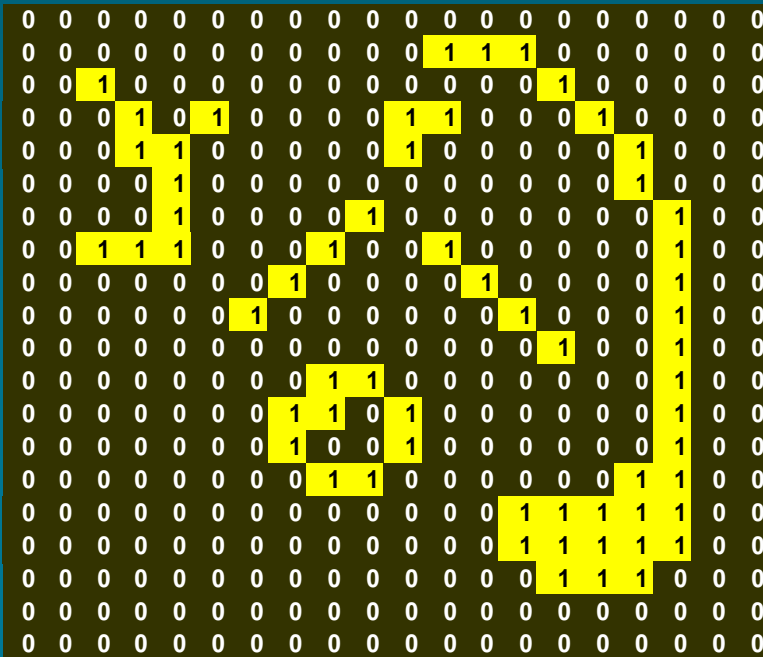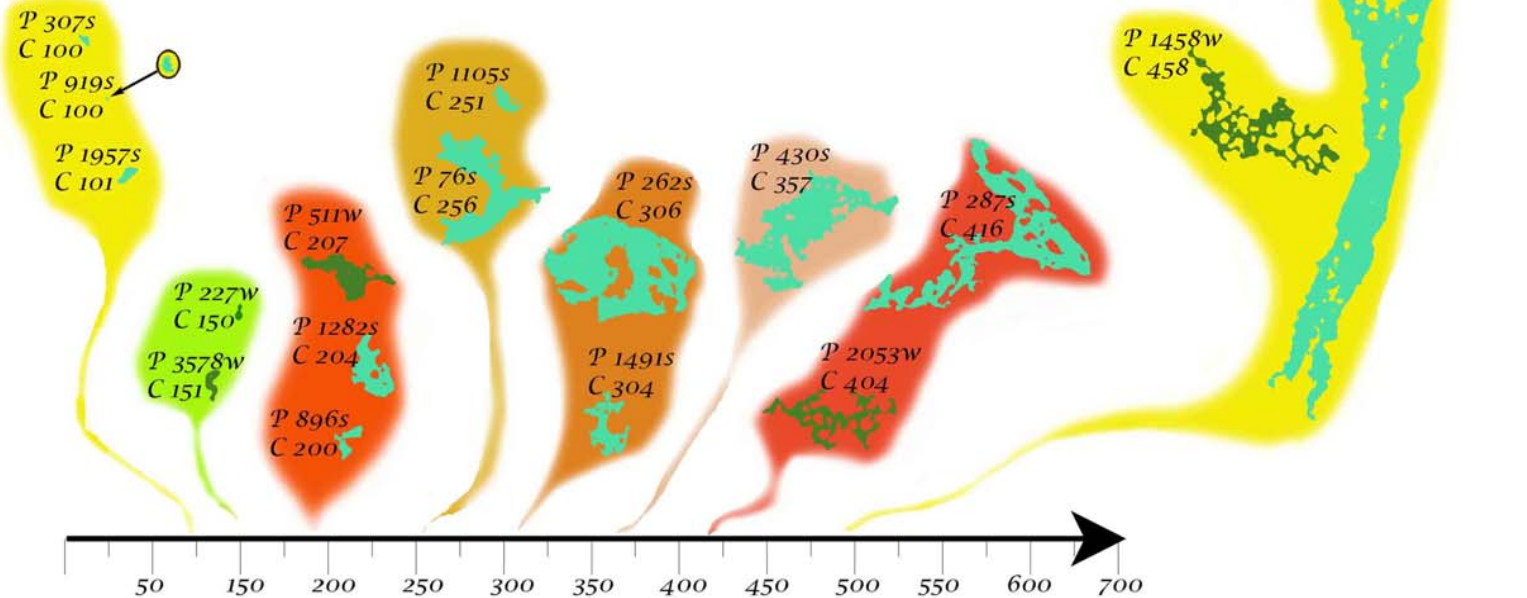
The Complexity Index is a measure of shape independent of scale.

Complexity Value Scale with example natural Polygons
(all polygons same scale)

Complexity of shape is a combination of external convolutions and internal holes. Although the complexity value is independent of scale there is a visible (see below) relationship between size and complexity.

This arises because, in general, the larger a polygon the more complex it CAN be as there are more opportunities for "edge wandering" and holes.

Polygons composed of less than 9 to 13 pixels have little option for complex shapes and complexity values are below 50.

P 307s
C 100
P 919s
C 100
P 1957s
C 101
P 227w
C 150
P 3578w
C 151
P 511w
C 207
P 1282s
C 204
P 896s
C 200
P 1105s
C 251
P 76s
C 256
P 262s
C 306
P 1491s
C 304
P 430s
C 357
P 2875
C 416
P 2053w
C 404
P 795s
C 497
P 1458w
C 458

50   150   200   250   300   350   400   450   500   550   600   700

It uses 3 existing measures of shape.
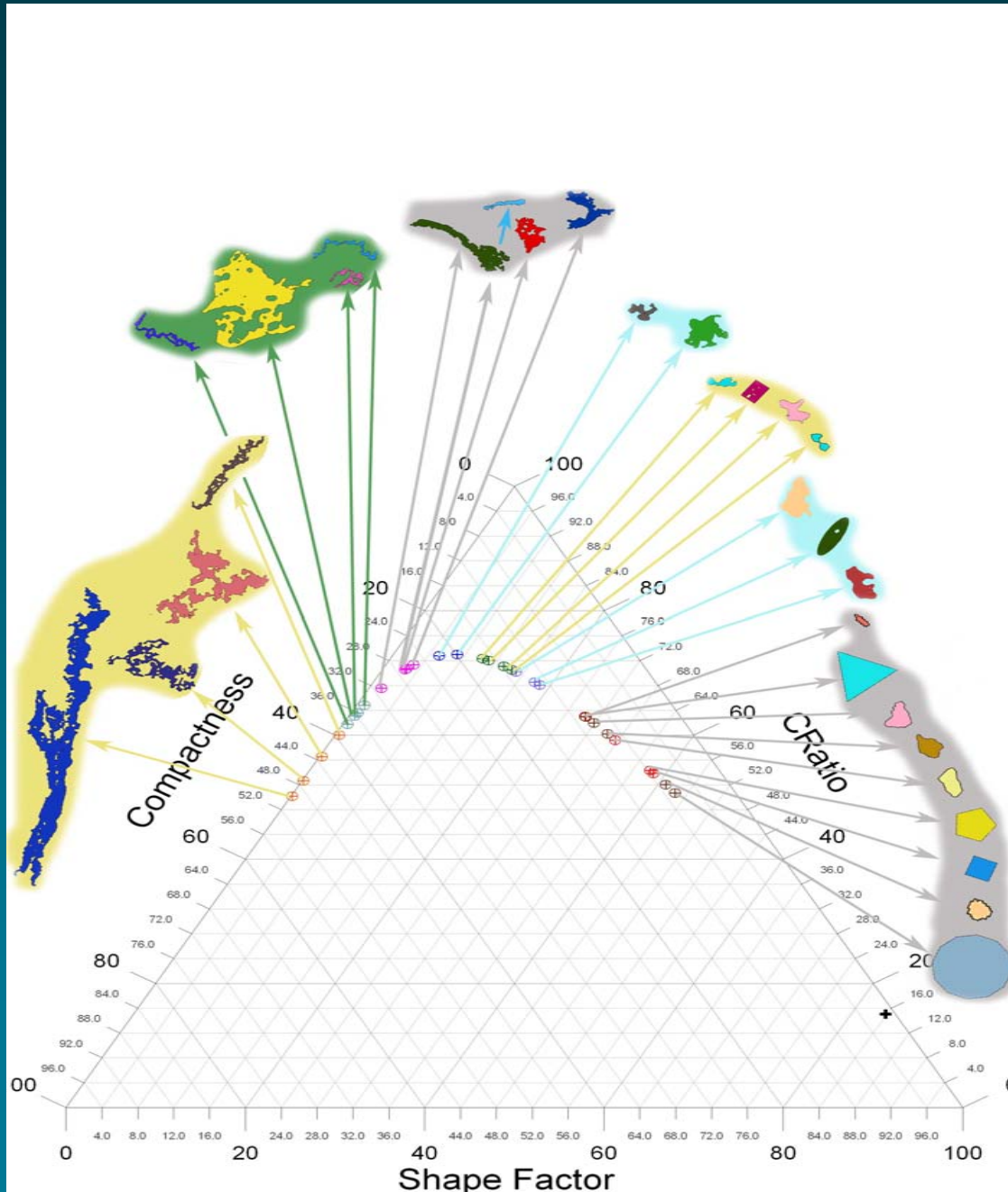
P = perimeter of polygon
A = area of polygon

Compactness = P2/A
The value in the ternary diagram is divided by 100 to bring it in line with the other values. The equation is then (P2/A)/100 or P2/100A.

Shape Factor = (4*Pi*A)/P2

C Ratio = √((P2/4π)/A)
The intent is to get the square root of the ratio of two areas -- a circle (with the same perimeter as the polygon) and the polygon.

The axes on the graphs represent proportional values. Each is divided by the sum of all three. The odd one is compactness, which is divided by 100 to bring the numbers into the same scale as the others thereby avoiding a complete dominance by compactness.

A final program routine analyzes the amount of edge each group shares with up to 5 different life form types and records this data to the attribute file.

Other units are not yet developed. "GRABS" and model parameters for the initial 32 species are available on the CWHR website.

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Flowchart for Program Functions
September, 2007

Group Unit   Species Parameters Unit   Connected Unit

works on habitat data (feature file)

Group File — Attribute File

reads attribute file and species parameter file (values of Level II model parameters) and evaluates each group for inclusion as suitable habitat

Evaluates connections between suitable groups or habitat patches for use in population viability analysis

Area

Perimeter

Complexity Index of Shape

Analysis of Edge

Output = spatial file of suitable habitat and species-specific attribute file