EVALUATION OF OAK DECLINE RISK RATING USING THE CISC DATABASE ON THE CHEROKEE NATIONAL FOREST, TN

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Evaluation of Oak Decline Risk Rating Using the CISC Database on the Cherokee National Forest, TN

by

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Abstract

The Continuous Inventory of Stand Conditions (CISC) database for Southern Region National Forests was used to evaluate oak decline conditions in separate analysis areas on the Hiwassee and Nolichucky Ranger Districts of the Cherokee National Forest. Field sampling of stands representative of oak decline risk classes confirmed the predicted oak decline hazard rating in 44 percent of the cases. Differentiation of Decline-Vulnerable and Decline-Damaged stands from each other was the primary source of unconfirmed rating. Grouping these classes together improves validation to 80 percent, comparable to the validation rates achieved in previous applications. Oak decline risk rating using CISC databases is recommended for landscape-scale analysis for the Cherokee National Forest and other National Forests in the Southern Appalachians in compartments where oak decline is a known or suspected forest health issue. Successful application of the method is limited by the accuracy of inventory, imprecision and subjectivity of some attributes, and potential difficulty in describing variable or complex stand structures.

Introduction

Oak decline is the most widespread and damaging disease of upland hardwood forests in the southeastern United States. Summaries of data from Forest Inventory and Analysis work units of the Southern Research Station have shown that over 3.9 million acres are affected in 12 states of the Southern Region (Kentucky excluded; Starkey and others 1992). This area comprised 10 percent of the vulnerable host type. Bottomland oak forest types were also affected by decline, but at a lower incidence. Geographically, incidence was not uniform across the Region. The states of Virginia, North Carolina, and Tennessee accounted for 67 percent of the total decline-affected area, with concentrations occurring in

the Southern Appalachian Mountains. Virginia had the largest number of affected acres (1.1 million) and the highest incidence (19 percent; Starkey and others 1992).

More detailed analysis of Virginia data showed a high degree of association between oak decline and certain stand and site factors (Oak and others 1991). These factors included site index, stand age, forest type, and physiographic class and tended to confirm earlier findings from other surveys of decline areas (Starkey and others 1989). Further, Virginia National Forests had the highest oak decline incidence of all ownerships due to the frequent co-occurrence of these factors.

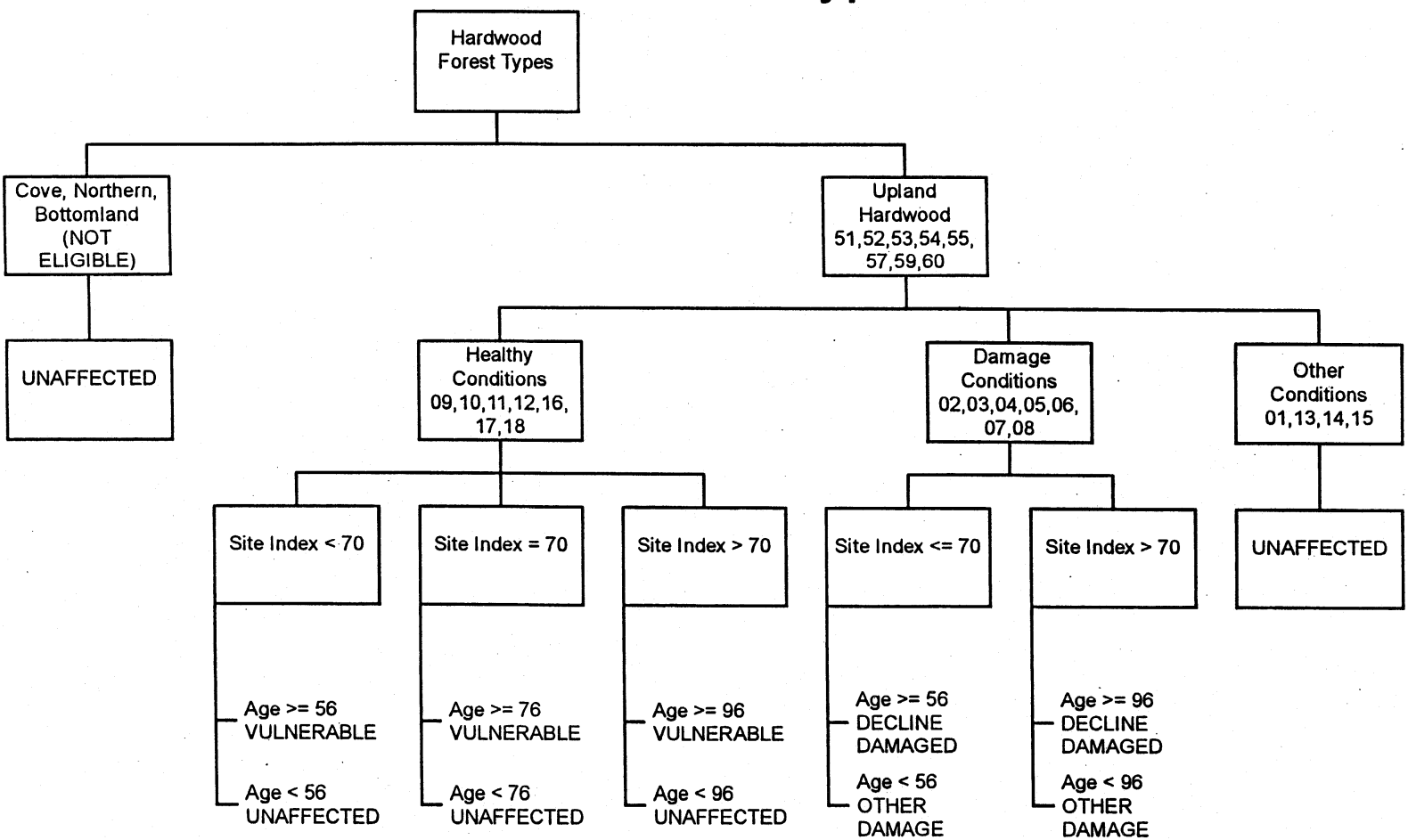
Oak decline can have adverse effects on multiple forest resources including recreation, wildlife habitat, and timber (Oak and others 1988, Starkey and others 1989). National Forests are especially at risk due to multiple resource objectives and high oak decline incidence. Systems for classifying oak decline risk would be helpful for assessing forest health, formulating management plans, and comparing responses for different alternatives. While quantitative risk rating models are being developed (Oak and others, in press), intuitive approaches have been used with some success. One such approach has utilized the Southern Region timber inventory database (CISC). It was first applied in a forest health analysis in the Grassy Gap-Wesser Timber Sale EIS on the Cheoah Ranger District, Nantahala National Forest, NC. Actual ground conditions were correctly predicted for 71 percent of a sample of stands representing the full range of possible classifications (USDA Forest Service 1989). Prediction success was higher when the same system was applied in another analysis on the Wayah Ranger District, Nantahala National Forest. In that case, ground conditions were correctly predicted for 87 percent of the stands (Huber 1990). Climate, physiography, and species mixtures may differ significantly between the Nantahala and Cherokee National Forests. This evaluation was conducted to test CISC-based oak decline risk rating on the Cherokee National Forest, TN before being recommended for operational use.

Methods

The Cherokee National Forest is divided into northern and southern sections by the Great Smoky Mountains National Park. One analysis area from each section was selected in order to sample the potential variation in climate, physiography, and vegetation across the Forest. Other criteria for selection were an active Environmental Analysis in progress and the possibility that oak decline would be a forest health issue. National Forest personnel were responsible for selecting the analysis areas.

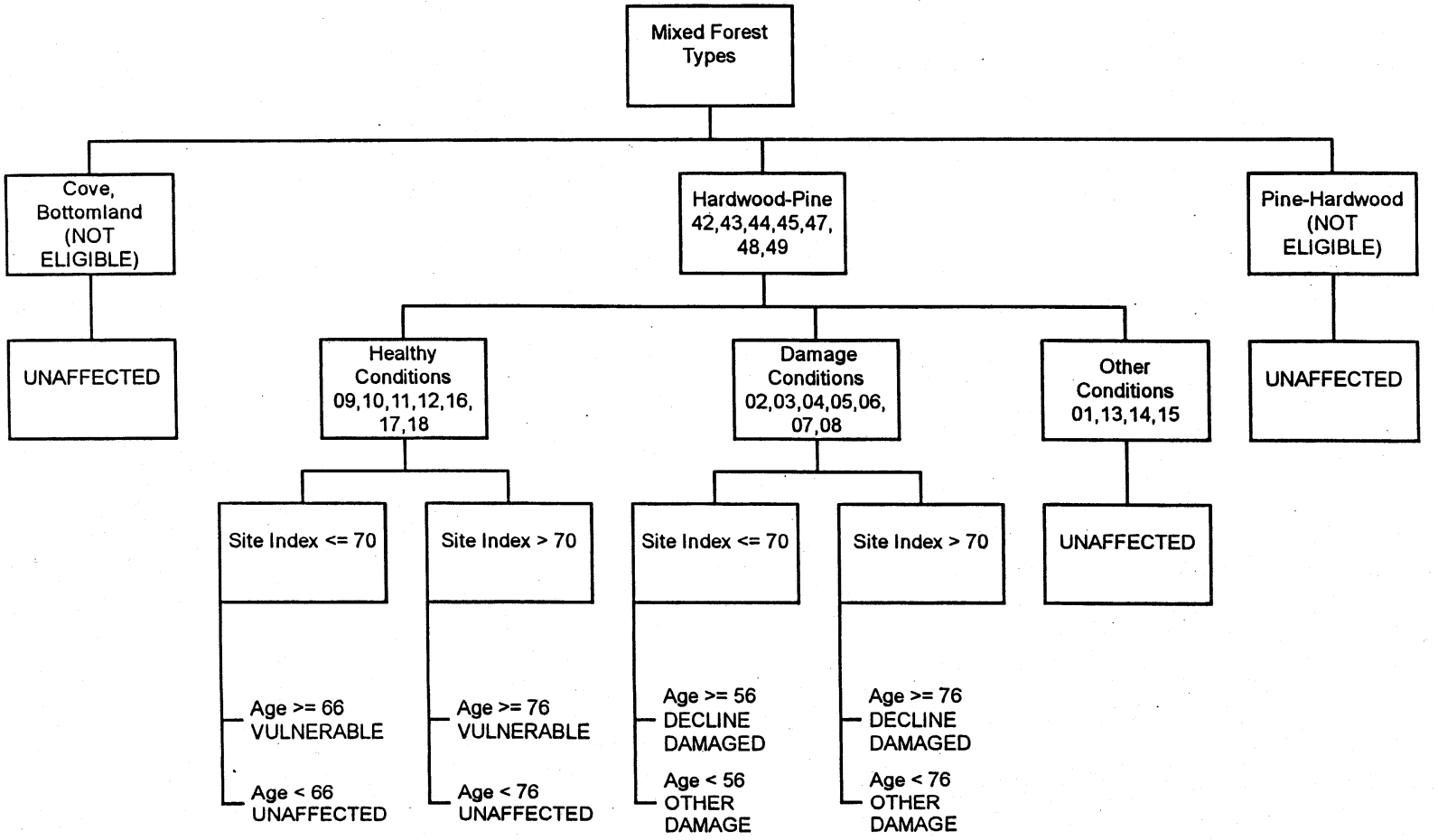
Compartments 205, 206, and 207 on the Nolichucky Ranger District (north section) and compartments 160 and 162 on the Hiwassee Ranger District (south section) were selected. CISC data were acquired and subjected to the decision tree detailed in the Grassy Gap-Wesser EIS (USDA Forest Service 1989; figures 1a and b). Briefly, the hazard rating utilizes 4 data fields from CISC. These are forest type, stand age, oak site index and condition class (a measure of predominate size class, density, stem quality, and damage

FIGURE 1a
CISC RISK RATING FOR OAK DECLINE
Hardwood Forest Types Branch



Numbers in forest type and condition class boxes indicate CISC codes

FIGURE 1b
CISC RISK RATING FOR OAK DECLINE
Mixed Forest Types Branch



Numbers in forest type and condition class boxes indicate CISC codes

conditions limiting management opportunities). These data fields are related to attributes derived from quantitative analysis of oak decline survey data for the development of mathematical risk rating models (Oak and others, in press). The result of this screening was a predicted rating in one of 4 risk classes-- Decline-Vulnerable, Decline-Damaged, Unaffected, or Other Damage. Vulnerable stands have a high proportion of oak (upland hardwood or hardwood-pine forest types), a relatively low ratio of site index/stand age (a measure of physiologic maturity), and lack limiting damage conditions. Decline-Damaged stands have the same attributes as Vulnerable stands except that limiting damage conditions are present i.e. sparse, damaged, or low quality. Stands classified as Other Damage have the same limiting damage conditions as stands classified as Decline-Damaged but have a relatively high site index/age ratio. Typically, the damage is caused by fire, top breakage by ice or snow loading, wind, or other mechanical damage. Unaffected stands lack damage conditions and have a relatively high site index/age ratio or are non-oak forest types.

The accuracy of the rating was assessed by prism sampling (BAF = 10) in stands selected according to accessibility and representing the range of forest types, site indices, stand ages, and predicted outcomes. The accessibility criterion was necessary to ensure accurate navigation and sampling within the forest condition classified and mapped. Five plots were evenly spaced along a compass line originating from a known landmark and plotted on a 1:24,000 scale map to traverse the physiographic variation of the sample stand. Data collected at each plot for each sampled tree were species, D.B.H. (5 inches minimum), crown position (dominant, codominant, intermediate, suppressed), and dieback class (healthy, trace {<10% crown dieback}, slight {10-33%}, moderate {34-67%}, severe {>67%}, and dead). Snags (dead trees without crown structure due to advanced decay) were ignored. Site index was determined for a dominant or codominant oak in the red oak group according to Schnur (1937; in USDA Forest Service 1992). If stand conditions seemed variable with respect to site index or age, two or three measurements representing the range of conditions were made. Validation of the predicted rating was determined by the results of the field sampling according to the criteria shown in table 1.

Table 1. Field survey validation criteria for oak decline risk classes.

	Field Survey Results[1]		
Class	**Incidence**		**Severity**
Decline-Vulnerable	<50%	**AND**	Most w/ ≤33%dieback
Decline-Damaged	>50%	**OR**	Dead oaks w/ evidence of decline present
Other Damage		Non-decline damages predominate	
Unaffected	<25%	**AND**	Few w/ >trace dieback

[1]Incidence and severity based on dominant and codominant oaks with >10% crown dieback.

Results and Discussion

The five compartments selected for validation contained 209 stands of which 92 were upland hardwood or hardwood-pine forest types (table 2). A majority of these (58 percent) had predicted ratings of Vulnerable or Decline-Damaged.

Table 2. Predicted oak decline risk ratings for stands in compartments selected for validation . Hiwassee and Nolichucky RDs, Cherokee NF[1]

	Number of Stands					
Compartment No.	Total	UH+HP	V	DD	OD	U
160	40	10	6	2	0	2
162	30	11	4	1	0	6
205	46	21	1	14	0	6
206	42	24	3	15	1	5
207	51	26	2	6	5	13
Total	209	92	16	38	6	32

[1] UH+HP = Upland hardwood + hardwood-pine forest types
V = Decline-Vulnerable; DD = Decline-Damaged; OD = Other Damage; U = Unaffected

Twenty-five stands were selected for field sampling. Sampling intensity among predicted risk classes varied from 69 percent for stands classified Vulnerable to 13 percent of those classified Unaffected. Predicted ratings from CISC were confirmed by field sampling for 11 of 25 stands (44 percent; table 3). This rate of validation is lower than for either of two

Table 3. Validation of oak decline risk rating for 25 stands on the Hiwassee and Nolichucky RDs, Cherokee NF[1]

		Predicted (CISC)				
		V	DD	OD	U	Total
Actual (Field Survey)	V	4	4	0	0	8
	DD	6	5	0	3	14
	OD	0	0	1	0	1
	U	1	0	0	1	2
	Total	11	9	1	4	25

= Validated Stands

[1] V = Decline-Vulnerable; DD = Decline-Damaged; OD = Other Damage; U= Unaffected

previous applications on the Wayah and Cheoah Ranger Districts on the adjacent Nantahala National Forest. Of 14 cases where ratings were unconfirmed, 10 were due to a lack of

resolution between Vulnerable and Decline-Damaged conditions. The difference between these two predicted outcomes is the presence of sparse, damaged, or low quality condition classes. Condition class is the most subjective attribute of the CISC data fields used. If Vulnerable and Decline-Damaged stands are grouped, then validation improves to 80 percent, which is comparable to grouped validation rates for the earlier applications (87 and 93 percent; USDA Forest Service 1989 and Huber 1990, respectively).

The remaining four unconfirmed cases were due to differences between CISC attributes and field results for forest type, age, or site index (tables 4 and 5). The predicted rating for Hiwassee 162-18 was Vulnerable but the stand proved to be composed primarily of yellow poplar (forest type 50), a type unaffected by oak decline. The actual age of Hiwassee 160-16 was determined to be 20 years older (85 years vs. 65 years) than indicated by CISC, while the site index for Nolichucky 207-43 was measured 10 feet less than indicated by CISC (60 feet vs. 70 feet). The predicted rating for both stands was Unaffected, but the rating would be Vulnerable using our field measures of these attributes. The fourth unconfirmed case was Hiwassee 160-40. This stand was highly variable for both site index (measured range 60-80 feet) and age (68-83 years). The SI/age ratio for this stand could range between 0.72 and 1.18, depending on whether the mean values or range extremes for site index and age were used in calculations. The rating for this stand could be either Unaffected or Vulnerable under these circumstances.

The differences in CISC attributes as found in the database and our field measurements are probably due to differences in sampling design and/or intensity between our survey and that of the prescriber initially responsible for the inventory. It is impossible after the fact to determine with certainty which estimate best describes stand conditions, but sampling intensity in the validation process was probably greater. These discrepancies point out the need for accurate inventory and characterization of stand attributes in the CISC database.

Conclusions

CISC oak decline risk rating was less accurate for assessment of oak decline conditions in individual stands than in two previous applications on the adjacent Nantahala National Forest. This drawback can be overcome by grouping Vulnerable and Declined stands into a single category. The ability to analyze the oak decline status of landscapes is retained by this grouping, but at the cost of site-specific characterization of individual stands. Additional field inventory would be necessary to determine the oak decline status of individual stands.

Oak decline is involved in profound ecosystem changes that are reshaping the composition and structure of forested landscapes throughout the National Forests of the Southern Appalachian Mountains. These changes could be positive or negative depending on ecosystem management objectives. Responsible land managers should disclose these effects during Environmental Assessments. These methods provide land mangers with a useful tool for landscape-scale analysis using easily collected standard inventory data. CISC risk rating

Table 4. CISC Attributes and Field Survey Results for Validation of Oak Decline Risk Rating, Hiwassee RD, Cherokee, NF

CISC ATTRIBUTES

Compartment	162	160	160	160	160	160	160	162	162	160	160	162
Stand	22	16	40	5	8	11	27	17	18	32	33	21
Forest Type	53	53	53	42	45	53	53	53	53	59	59	53
Condition	12	12	12	12	12	12	12	12	12	7	7	8
Site Index	70	70	70	70	70	70	70	70	70	60	70	70
Age	70	65	73	80	80	80	95	90	90	80	65	58
CISC Rating (1)	U	U	U	V	V	V	V	V	V	DD	DD	DD

FIELD SAMPLING

% Oaks (All trees)	21%	62%	70%	63%	65%	60%	57%	24%	2%	57%	28%	45%
%Oaks (Dom.+Codom.)(2)	26%	78%	82%	80%	86%	60%	65%	30%	0%	67%	37%	50%
<10% Dieback	31%	37%	32%	41%	34%	37%	30%	45%	0%	29%	64%	23%
10-33% Dieback	8%	16%	22%	20%	34%	15%	27%	27%	0%	54%	29%	41%
>33% Dieback	0%	0%	0%	2%	9%	0%	3%	0%	0%	0%	0%	0%
Dead	0%	8%	3%	5%	3%	0%	7%	0%	0%	7%	0%	9%
Sum >10% Dieback+Dead	8%	24%	25%	27%	46%	15%	37%	27%	0%	61%	29%	50%
Field Rating (1)	U	DD	DD	DD	DD	V	DD	V	U	DD	V	DD(3)

(1) U = Unaffected, V = Vulnerable, DD = Decline Damaged, OD = Other Damage
(2) Percentages for classes are expressed as percent of dominant + codominnant oaks
(3) Storm damage also present

Table 5. CISC Attributes and Field Survey Results for Validation of Oak Decline Risk Rating, Nolichucky RD, Cherokee NF

CISC ATTRIBUTES

Compartment	207	207	206	206	206	207	205	205	205	206	206	207	207
Stand	43	41	6	10	18	9	1	7	15	33	35	44	19
Forest Type	53	55	45	53	42	52	45	52	53	53	45	52	53
Condition	12	12	12	9	10	10	7	7	7	8	8	8	5
Site Index	70	70	60	50	80	70	60	60	70	70	60	60	80
Age	62	77	113	100	96	85	60	64	63	67	66	64	69
CISC Rating (1)	U	V	V	V	V	V	DD	DD	DD	DD	DD	DD	OD

FIELD SAMPLING

% Oaks (All Trees)	61%	43%	56%	70%	55%	69%	38%	62%	22%	78%	68%	51%	67%
% Oaks (Dom. + Codom.)(2)	70%	53%	68%	78%	67%	79%	39%	80%	24%	88%	67%	57%	66%
<10% Dieback	77%	52%	40%	31%	39%	62%	67%	38%	73%	45%	45%	43%	22%
10-33% Dieback	0%	12%	20%	25%	19%	3%	11%	5%	9%	34%	24%	10%	4%
>33% Dieback	0%	0%	0%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Dead	4%	4%	0%	3%	3%	0%	0%	3%	0%	3%	0%	10%	4%
Sum >10% Dieback+Dead	4%	16%	20%	31%	25%	3%	11%	8%	9%	37%	24%	20%	8%
Field Rating (1)	DD	DD	V	DD	DD	V	V	DD	V	DD	V	DD	OD (3)

(1) U = Unaffected, V = Vulnerable, DD = Decline Damaged, OD = Other Damage

(2) Percentages for classes are expressed as percent of dominant + codominant oaks

(3) Fire damage

for oak decline has now been validated by a regional mathematical model built from data collected on National Forests in 6 states in the Southern Appalachian and Ozark Mountains (Oak and others in press) and by field testing in 52 stands on 4 Ranger Districts in 2 National Forests (USDA Forest Service 1989, Huber 1990). Oak decline risk rating is recommended for the Cherokee and other National Forests in the Southern Region where oak decline is a forest health issue. The importance of accurate, timely inventory is paramount. Computer programs to facilitate automated CISC data processing for PC and DG platforms are under development.

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