Sonoma Creek Watershed
Historic Salmonid Habitat and Abundance
GIS Mapping Project

Final Report

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Sonoma Ecology Center
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CONTENTS

OVERVIEW

Data from several historical sources was mapped in Arcview/GIS to track changes in steelhead trout population and habitat in the Sonoma Valley watershed between the 1920s and 2002. Maps and tables were created from the data to inform current restoration efforts underway in the watershed.

METHODS

Information from California Department of Fish and Game Stream Surveys between 1946 and 1977 was mapped using Arcview/GIS. This data included fish population, spawning and rearing habitat, flow, temperature, passage barriers, cover, land-use and other aspects. As the level of detail was low, and the area covered by early DFG surveys (1946 – 1961) was a small fraction of the watershed, maps were not created from this data. Data from the 1960s and '70s was substantial enough to allow comparison between those two periods, as well as with the most recent fish census done by the SEC in 2002.

Fish catch numbers from Jordan Basileu's "Fishin' and Huntin'" column in the Sonoma Index-Tribune (1948 – 1978) as well as information from the SEC's Oral History Report (2002) was also mapped using Arcview/GIS. This information supplements the DFG data and extends the picture back to the 1920s. To map the information from the Oral History Report, the comments of the elders were given numerical values. Enthusiastic responses, such as "that creek always had fish," received high scores, while less enthusiastic answers scored lower. First-hand observation was scored higher than second-hand information.

In some cases, information from several sources was combined into one map, as in first-hand observations of redds, which were made by both elders and DFG stream surveyors. In DFG surveys from the 1960s and '70s, some areas rated high as nursery habitat had low trout populations, suggesting that some aspect(s) of habitat were not being accounted for. It was decided to combine nursery habitat data with fish population data to create a more accurate picture of nursery habitat at those times.

INTERPRETATION & FINDINGS

Two major difficulties arose when comparing the historical data with modern data:

- Timing of the surveys: DFG surveys were made from spring through fall. Spring fish counts should yield higher numbers than fall counts. The 2002 census was done in October and November, at the very end of the dry season and thus representing the lowest numbers of the year. Thus a lower population in 2002 may not represent a true decline in numbers; it may just reflect seasonal variability.

- Sampling techniques: DFG surveys used visual, above-the-surface fish counts, the surveyors usually walking an entire tributary in a day. The 2002 census was done using both underwater snorkel counts and electrofishing. Electrofishing yielded counts as much as 4 times higher than snorkel counts (Pier, 2005). It's likely that snorkel counts yield higher numbers than visual counts. Thus DFG surveys probably should be multiplied by some factor to accurately compare them with recent surveys.

Keeping the above limitations in mind, the following assessments can be made:

Habitat Stability: Some reaches and tributaries have apparently maintained habitat quality and population better than others (see Table 1 and maps). These include:

Bear Creek
Calabazas Creek
Graham Creek
Carriger Creek, middle reach
Sonoma Creek, Reach 4—Graham to Yulupa
Reach 5—Yulupa upstream 4564 feet
Reach 7—Fisher to Felton

Population Decline: Within the area covered in the 2002 census, population shows an apparent decrease 5-25%, since 1966. Using only those reaches with specific counts from 1966 yields a 20% decline. Because of the limitations delineated above, the actual drop may be greater than this (see Table 2).

Lack of current data for reaches and tributaries below Madrone Road in Glen Ellen, make it impossible to evaluate population changes in the middle and lower watershed.

Data from oral histories and newspaper reports tends to corroborate DFG surveys and extends the picture back to the 1920s and '30s. For example, the reach of Sonoma Creek between Graham and Yulupa Creeks rates high in "Fishing popularity" according to oral histories, "Steelhead caught" according to newspaper accounts, and a high fish count in the DFG survey of the area.

Causes of population decline: A variety of possible causes for decreases in population have occurred on those streams showing a drop in steelhead trout numbers. These include: passage barriers created by culverts themselves and/or erosion below culverts, passage barriers created by dams, summer dewatering caused by diversion of springs or well drilling, human-caused channel changes, habitat degradation caused by sediment, landslides and floods, and spawning habitat degradation due to unknown causes.

One of the most significant causes was likely a dam constructed at the Sonoma Developmental Center. According to local elders, this created a complete passage barrier for several years in the early 1970s, cutting off steelhead from much of the watershed's prime spawning and rearing habitat. Another dam on the main stem was constructed in the 1950s near the site of present-day Larson Park. While it is believed to have been a summer flashboard dam and not a complete barrier, its remaining concrete base still poses a partial barrier to upstream migration.

Timing of population decline: Anecdotal evidence indicates 1955 to 1977 as a period of decline for steelhead trout populations in Sonoma Valley streams. Rodgers Creek is said to have begun its decline in the 1950s, three other tributaries in the 1960s, three more in the 1970s, and the main stem of Sonoma Creek declined substantially between 1961 and 1971.

Rearing habitat: Some decline in rearing habitat is evident. The most obvious loss is the lower ¾ mile of Yulupa Creek, listed as fair to good summer rearing habitat in the 1960s and '70s. With the exception of a few isolated pools, this reach of Yulupa Creek is now a dry channel at that season. Further analysis of other reaches could be done with the historic data already input into Arcview/GIS and compared with recent habitat surveys.

Spawning habitat: Because there was little comparative data, no analysis was made directly from Stream Surveys. Oral histories suggest that small streams which were "off the radar" for DFG surveys, may have held some importance as spawning habitat. Specifically, Pythian Creek, at the very upstream end of the watershed, and a small unnamed tributary in Kenwood both were reported as spawning streams in the 1930s by local elders. These and other small streams (some probably ephemeral), may have been an important component of spawning habitat and may be worth consideration for restoration projects.

Temperature—no analysis made

RESTORATION GOALS SUGGESTED BY THE HISTORIC DATA

- **Monitoring.** Several tributaries and reaches appear to have maintained population levels and habitat quality since 1966. These may be close to their potential and thus may not respond as much as more degraded streams. Monitoring may be the best approach for these streams, which include:

    *most of Sonoma Creek above Glen Ellen
    *Calabazas Creek—above passage barrier
    *Graham Creek—lower reach
    *Carriger Creek—middle reach (see census suggestion below)
    *Sonoma Creek in Agua Caliente area
    *Bear Creek

- **Evaluate** small and even ephemeral streams for spawning habitat restoration, especially if this is believed to be a limiting factor.

- Look into the possibility of "**rewatering**" lower Yulupa Creek.

- Stuart Creek—removal of **passage barrier**

- Graham Creek—removal of **passage barrier**(s)

- Rodgers Creek—removal of **passage barrier**

- Dowdall Creek—removal of **passage barrier**

- Conduct a **fish census** on Carriger Creek's middle reach to see if its fish population has changed since the 1970s.

- On the upper mainstem, generally considered some of the best habitat in the watershed, Adobe Canyon has shown the highest population decline since 1966. **Explore** the possible causes and potential restoration projects.

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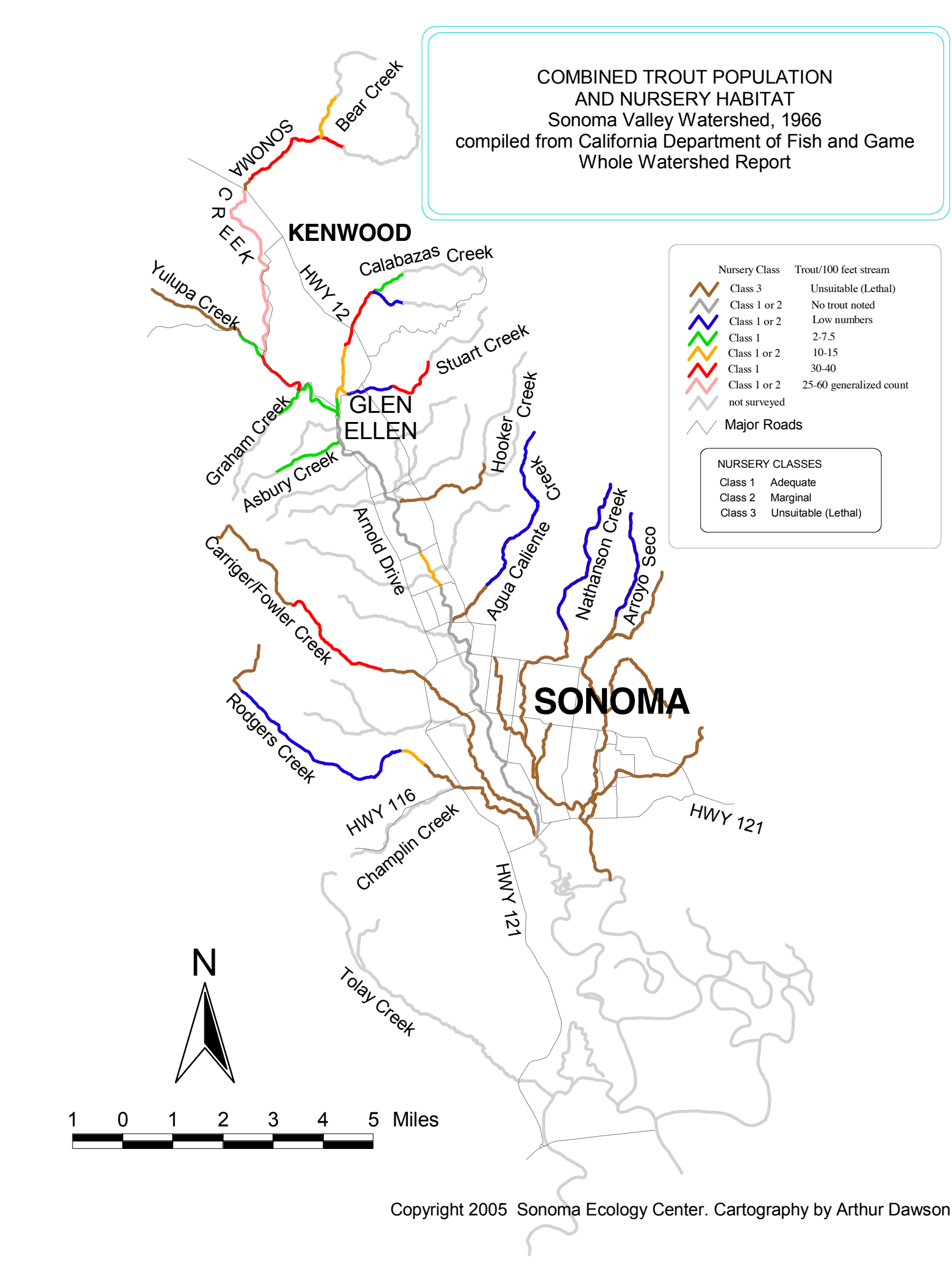
Table 1: Comparison of Steelhead Trout Population Densities, 1966- 2002

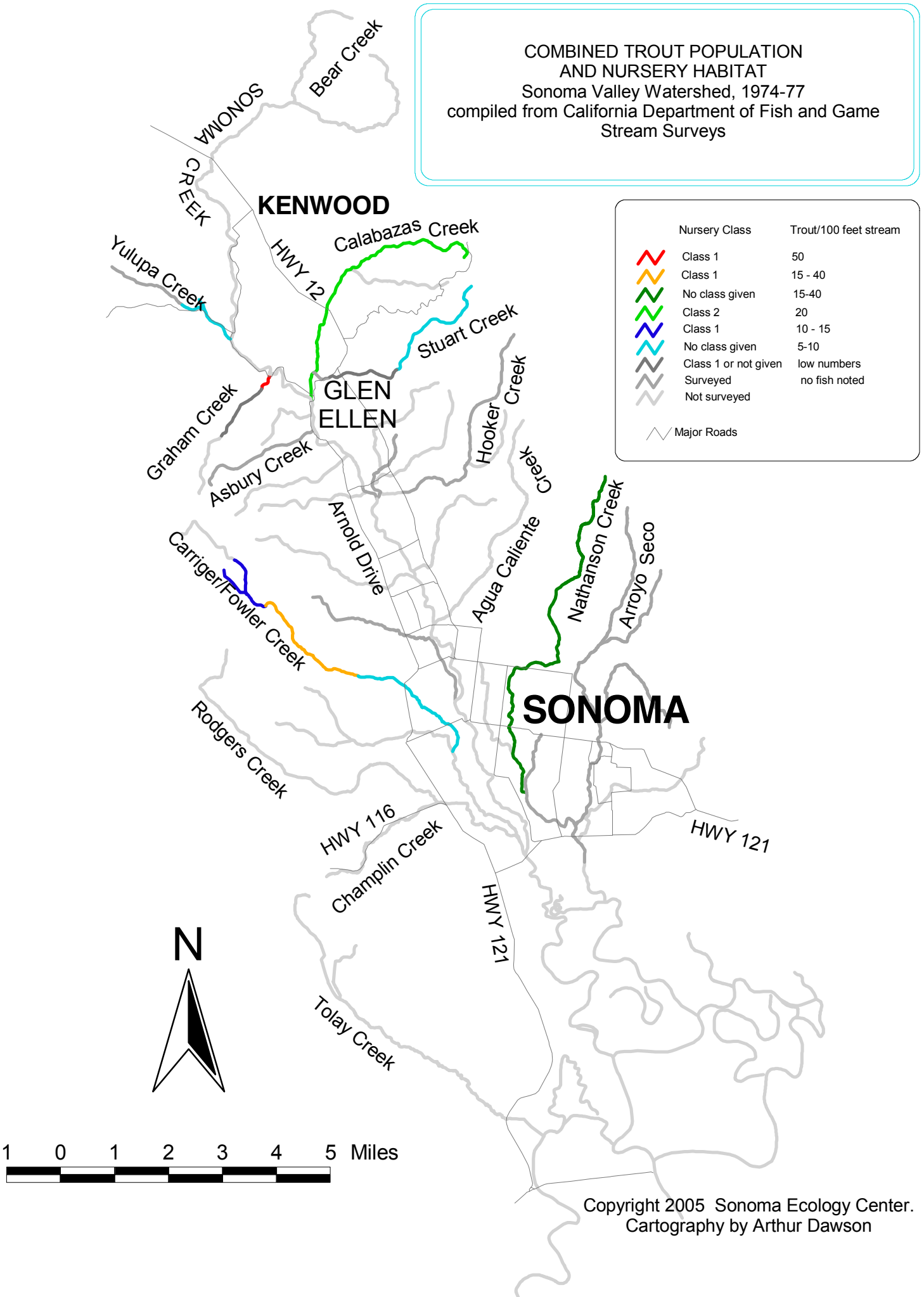
*general estimate for whole Glen Ellen to Kenwood reach **interpreted from table

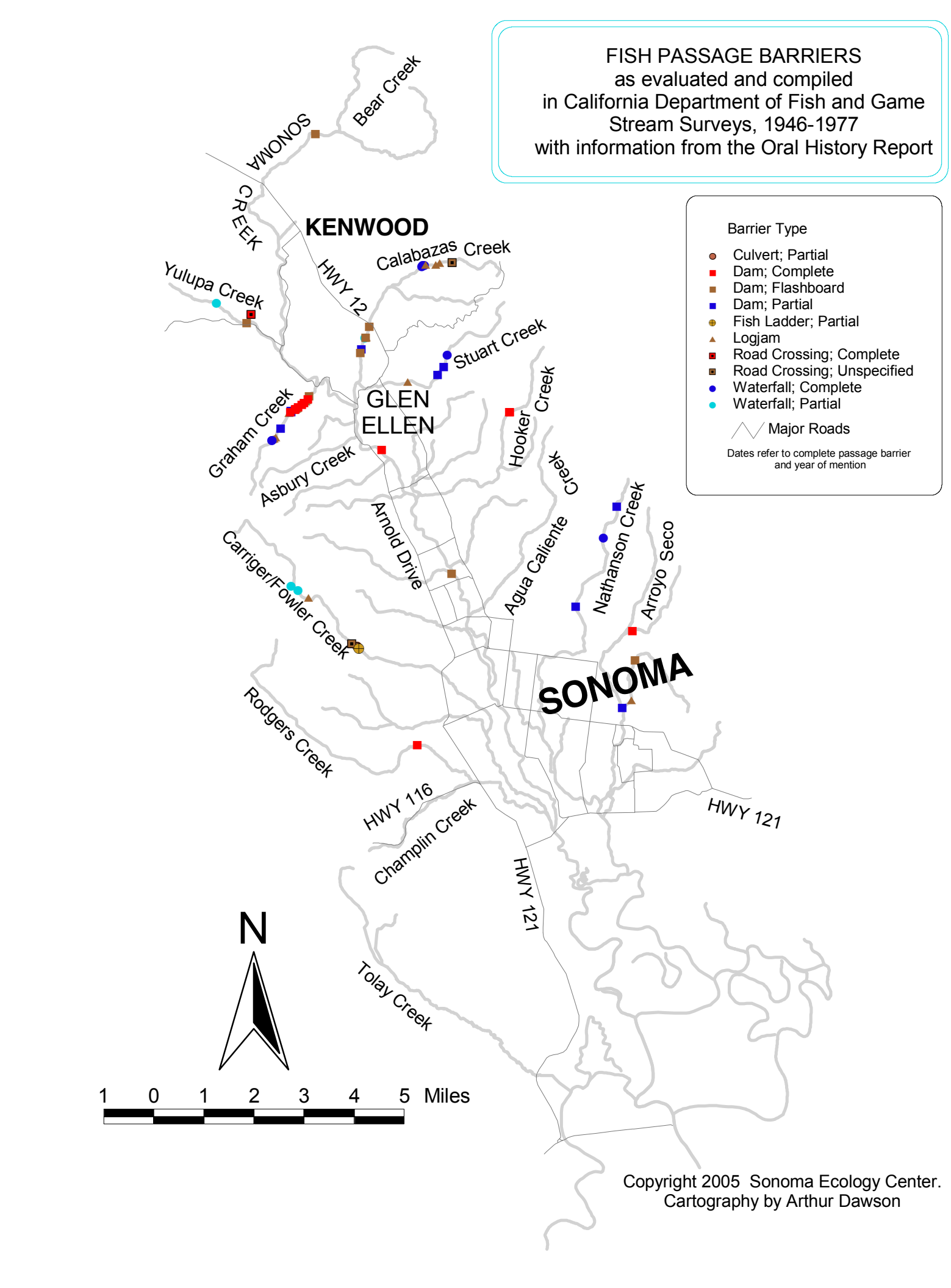
CREEK or REACH **Bold** = little change	**1966** **DFG**	**1974-77** **DFG**	**2002** **SEC**	**Possible Cause for decline**
	Average Trout/foot stream			
Agua Caliente—lower	0	--	--	
Agua Caliente—upper	present	--	--	
Arroyo Seco—lower	0	0	--	
Arroyo Seco—upper	present	0	--	Low summer flows—DFG report
Asbury	0.03	0	--	Arnold Drive culvert
BEAR	0.15	--	0.14	
CALABAZAS average	0.19	0.2	0.15	
Calabazas--lower	0.1	(0.2)	(0.15)	
Calabazas--middle	0.35	(0.2)	(0.15)	
Calabazas--upper	0.02	(0.2)	(0.15)	
Carriger—lower	0	0.1	--	
CARRIGER—middle	0.3	0.27	--	
Carriger—upper	0	0.1	--	
Dowdall	present	0	--	Diversion/passage
GRAHAM--lower	0.08	0.5	0.15	
GRAHAM—upper	--	present	0.15	
Hooker--lower	present	0	--	???
Nathanson—lower	0	0.27	--	
Nathanson—upper	present	0.27	--	
Redwood	present	--	--	
Rodgers—lower	0	--	--	
Rodgers—lower middle	0.15	--	--	Barrier—old dam
Rodgers—upper	0	--	--	
Rodgers—upper middle	present	--	--	Barrier—old dam
Sonoma 1	0.25**	--	0.14	
Sonoma 2	0.25**	--	0.11	
Sonoma 3	0.075	--	0.04	Sediment/landslides, 1986 flood
SONOMA 4	0.3	--	0.26	
SONOMA 5	0.25 – 0.6*	--	0.32	
Sonoma 6	0.25 – 0.6*	--	--	
SONOMA 7	0.25 – 0.6*	--	0.5	
Sonoma 8	0.25 – 0.6*	--	0	???
Sonoma 9 Adobe Canyon	0.4	--	0.21	
Sonoma—Boyes Blvd to Agua Caliente Road	0.125	--	--	
Stuart—lower	present	0.013	--	Barrier—Picchinini Bridge
Stuart—upper	0.32	0.1	--	Barrier—Picchinini Bridge
Wilson	--	0	--	
Yulupa—lower	0.075	<0.1	0	Summer dewatering
Yulupa—upper	0	0	0	Summer dewatering

Table 2: Comparison of Total Steelhead Trout Population, 1966 and 2002

REACH from 2002 census	**Length** (ft)	**Density 2002** (fish/foot)	**Estimated Pop 2002**	**Density 1966** (fish/foot)	**Estimated Pop 1966**	**Comments on 1966 data**
Sonoma 1	4161	0.14	570	.25	1040	interpreted from table
Sonoma 2	7811	0.11	844	.25	1953	interpreted from table
Sonoma 3	6320	0.04	265	.075	474	count
Sonoma 4	6391	0.26	1642	0.3	1917	count
Sonoma 5	4564	0.32	1481	0.25 – 0.6	1140-2736	estimate
Sonoma 6	5763	No data	No data	0.25 – 0.6	(1441-3458)	estimate
Sonoma 7	10725	0.5	5355	0.25 -0.6	2681 - 6435	estimate
Sonoma 8	3709	0.00	0	0.25 – 0.6	(927–2225)	estimate
Sonoma 9	8318	0.21	1731	0.4	3328	count
Calabazas 1	20123	0.15	2978	0.19	3823	count
Bear 1	2801	0.14	400	0.15	420	count
Graham 1	11075	0.15	1629	0.075	831	Count. Was 0.5 in 1976 survey
Totals			16896		17607-22957	5 – 25% decrease
Counting only reaches with counts from 1966:						
Sonoma 3,4,9			3644		5719	35% decrease
Calabazas, Bear & Graham			5007		5074	No change
Totals			8651		10793	20% decrease






FISH PASSAGE BARRIERS
as evaluated and compiled
in California Department of Fish and Game
Stream Surveys, 1946-1977
with information from the Oral History Report
Barrier Type
Culvert; Partial
Dam; Complete
Dam; Flashboard
Dam; Partial
Fish Ladder; Partial
Logjam
Road Crossing; Complete
Road Crossing; Unspecified
Waterfall; Complete
Waterfall; Partial
Major Roads
Dates refer to complete passage barrier and year of mention
KENWOOD
GLEN ELLEN
SONOMA
Bear Creek
SONOMA CREEK
Calabazas Creek
Yulupa Creek
HWY 12
Stuart Creek
Graham Creek
Asbury Creek
Hooker Creek
Arnold Drive
Agua Caliente Creek
Nathanson Creek
Arroyo Seco
Carriger/Fowler Creek
Rodgers Creek
HWY 116
Champlin Creek
HWY 121
HWY 121
Tolay Creek
N
1 0 1 2 3 4 5 Miles
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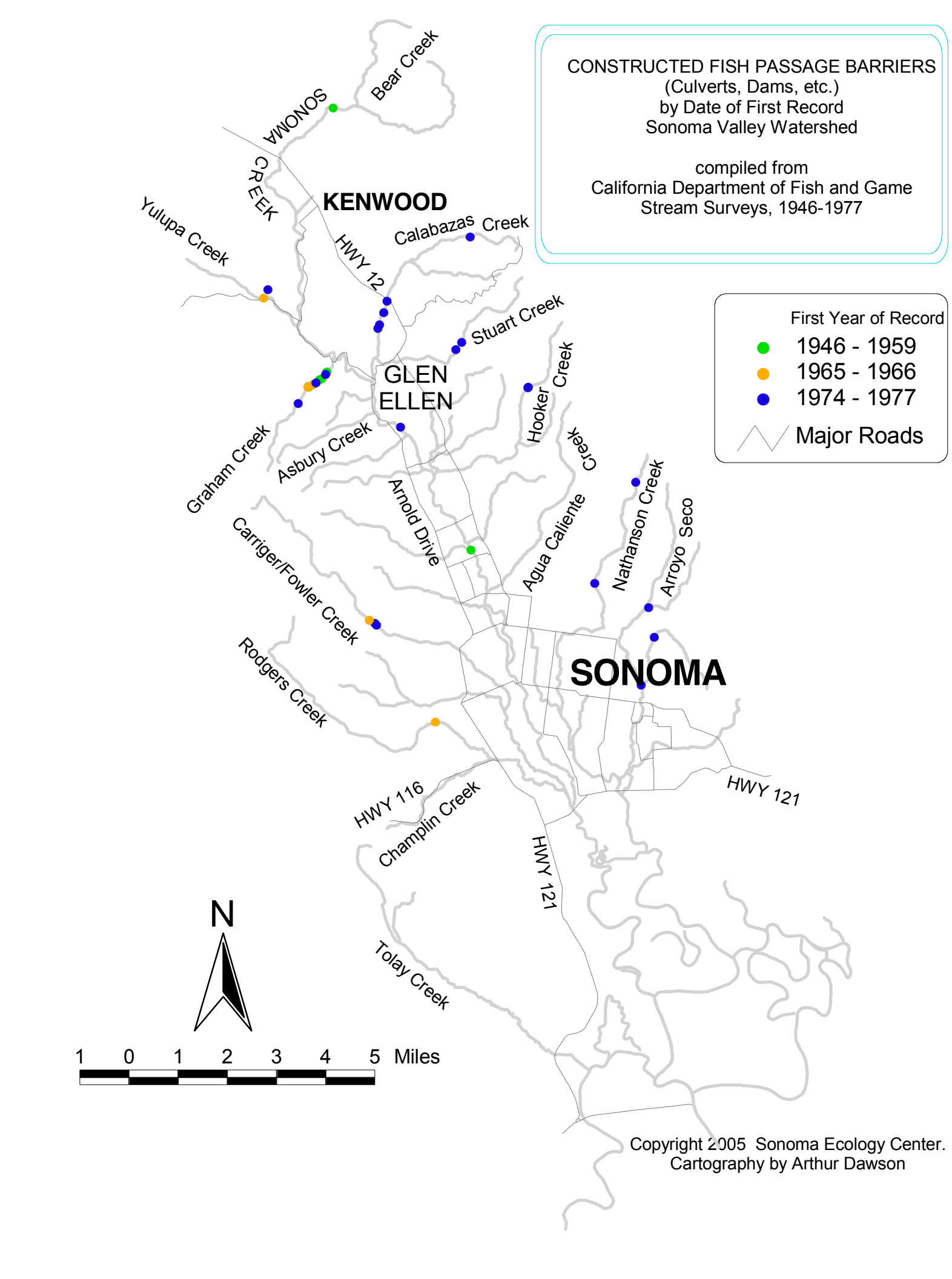
CONSTRUCTED FISH PASSAGE BARRIERS
(Culverts, Dams, etc.)
by Date of First Record
Sonoma Valley Watershed
compiled from
California Department of Fish and Game
Stream Surveys, 1946-1977
First Year of Record
1946 - 1959
1965 - 1966
1974 - 1977
Major Roads
KENWOOD
GLEN ELLEN
SONOMA
Bear Creek
SONOMA CREEK
Yulupa Creek
Calabazas Creek
HWY 12
Stuart Creek
Hooker Creek
Graham Creek
Asbury Creek
Arnold Drive
Agua Caliente Creek
Nathanson Creek
Arroyo Seco
Carriger/Fowler Creek
Rodgers Creek
HWY 116
Champlin Creek
HWY 121
HWY 121
Tolay Creek
N
1 0 1 2 3 4 5 Miles
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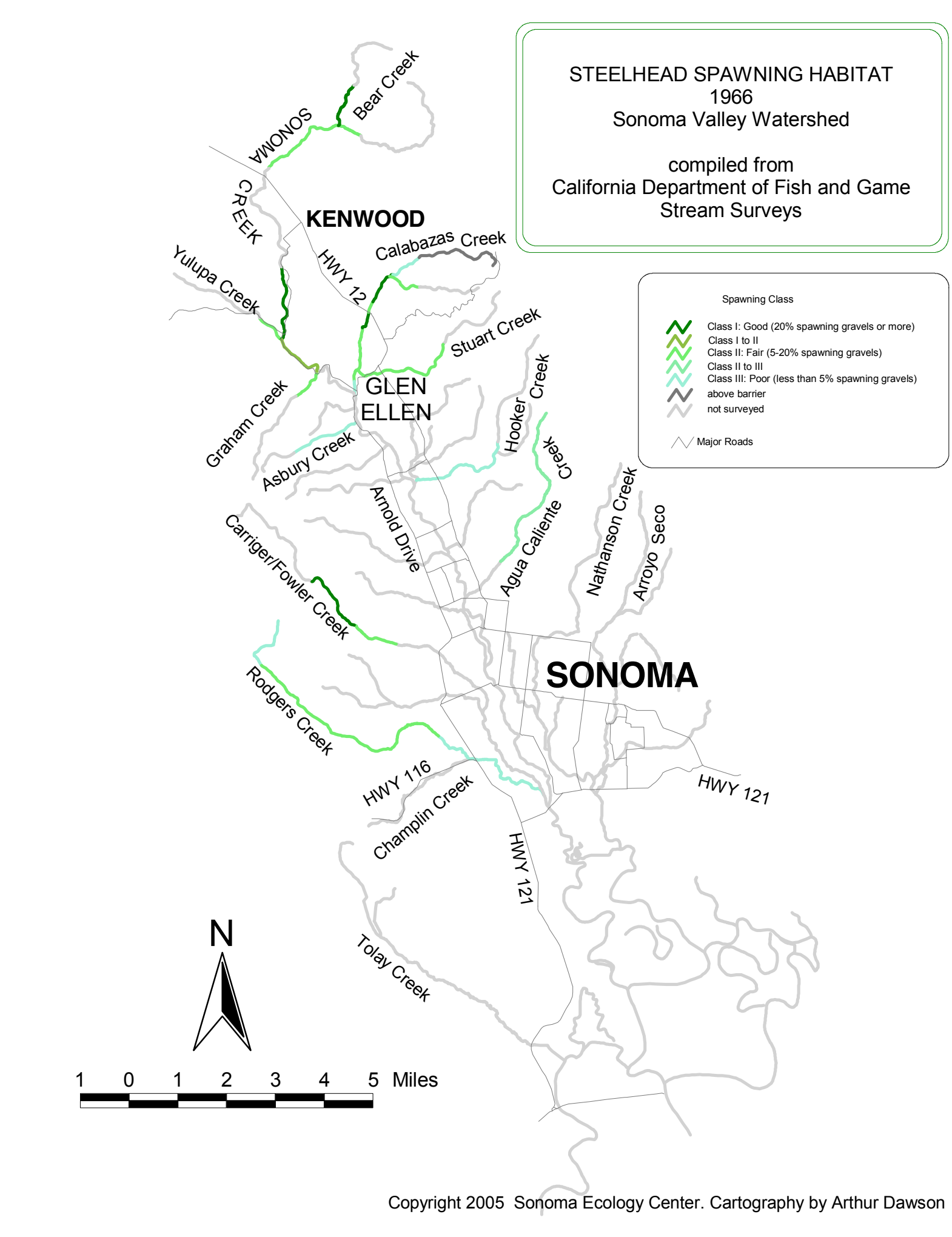
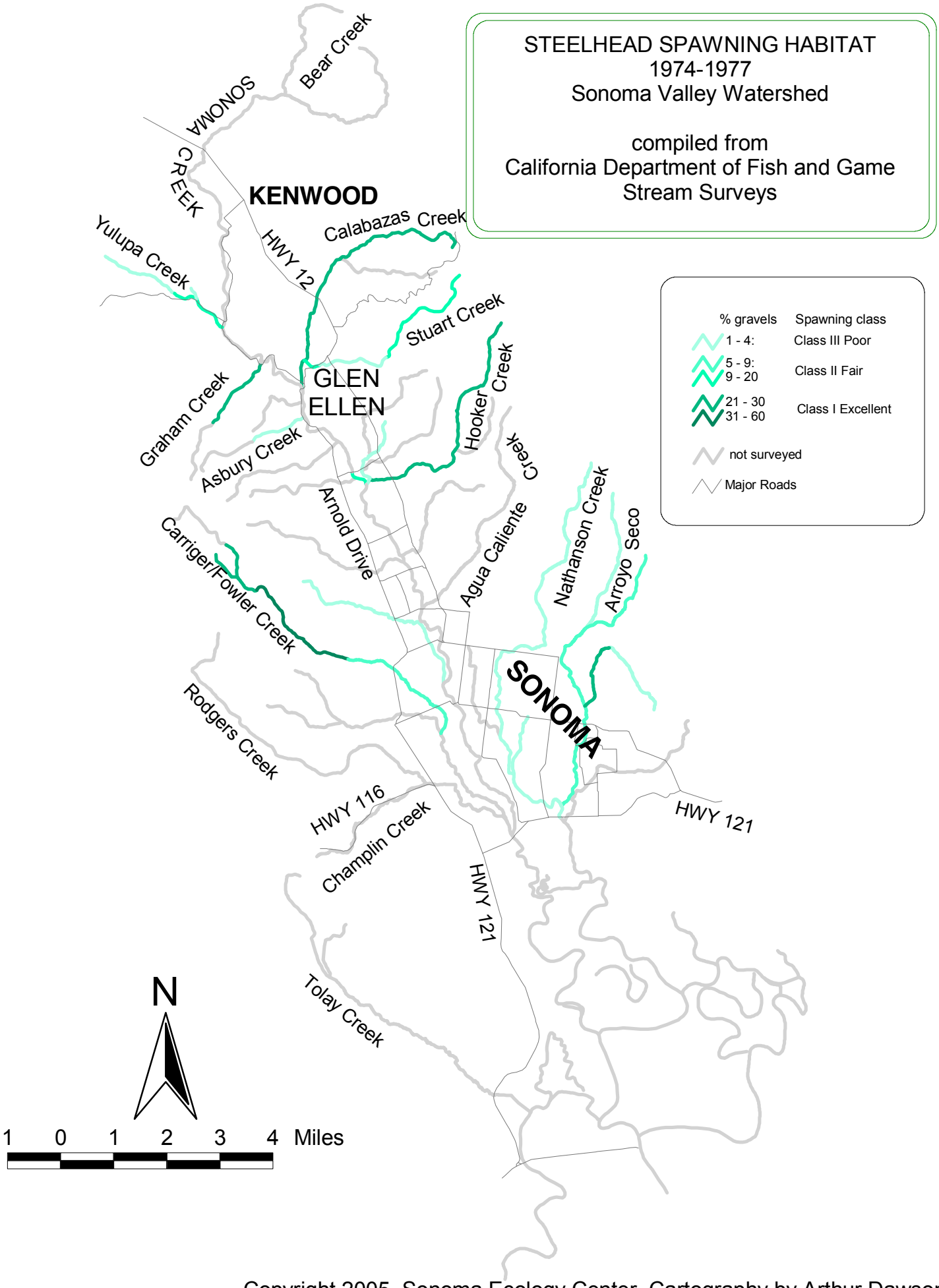
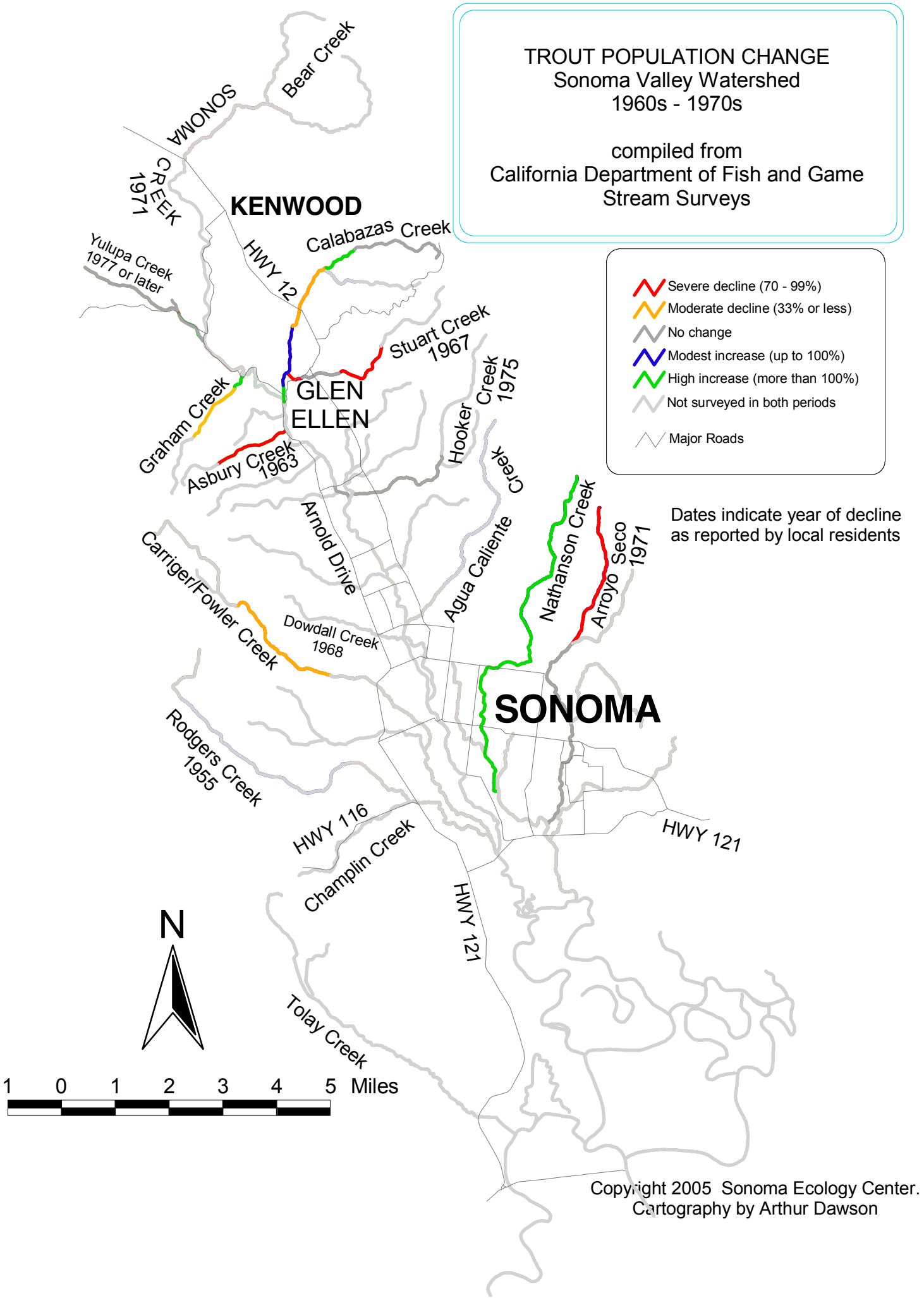
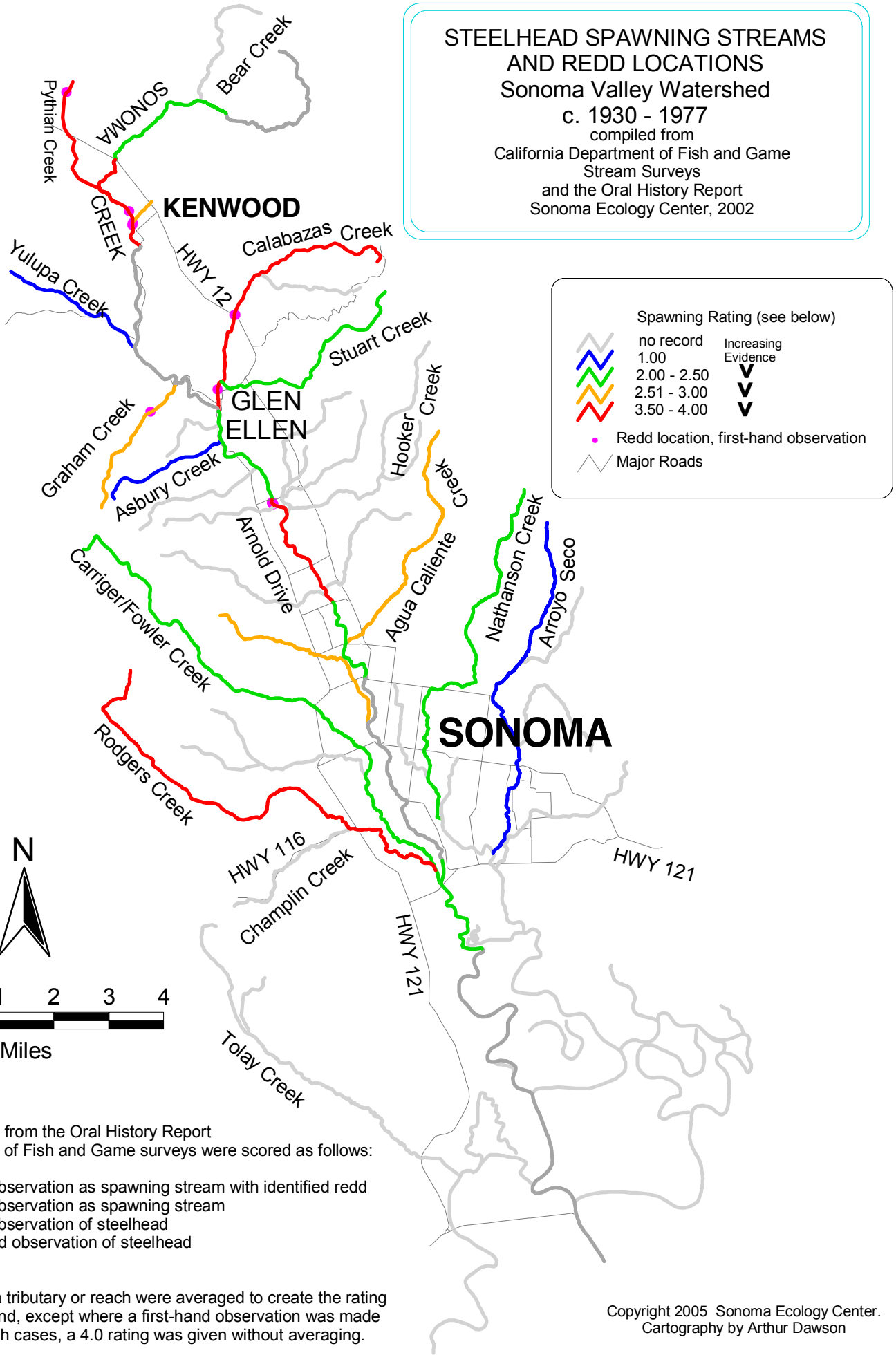





TROUT POPULATION CHANGE
Sonoma Valley Watershed
1960s - 1970s
compiled from
California Department of Fish and Game
Stream Surveys
Severe decline (70 - 99%)
Moderate decline (33% or less)
No change
Modest increase (up to 100%)
High increase (more than 100%)
Not surveyed in both periods
Major Roads
Dates indicate year of decline
as reported by local residents
KENWOOD
GLEN ELLEN
SONOMA
Bear Creek
SONOMA CREEK 1971
Yulupa Creek 1977 or later
HWY 12
Calabazas Creek
Stuart Creek 1967
Graham Creek
Asbury Creek 1963
Hooker Creek 1975
Arnold Drive
Agua Caliente Creek
Nathanson Creek
Arroyo Seco 1971
Carriger/Fowler Creek
Dowdall Creek 1968
Rodgers Creek 1955
HWY 116
Champlin Creek
HWY 121
HWY 121
Tolay Creek
N
1 0 1 2 3 4 5 Miles
Copyright 2005 Sonoma Ecology Center.
Cartography by Arthur Dawson

STEELHEAD SPAWNING STREAMS AND REDD LOCATIONS
Sonoma Valley Watershed
c. 1930 - 1977

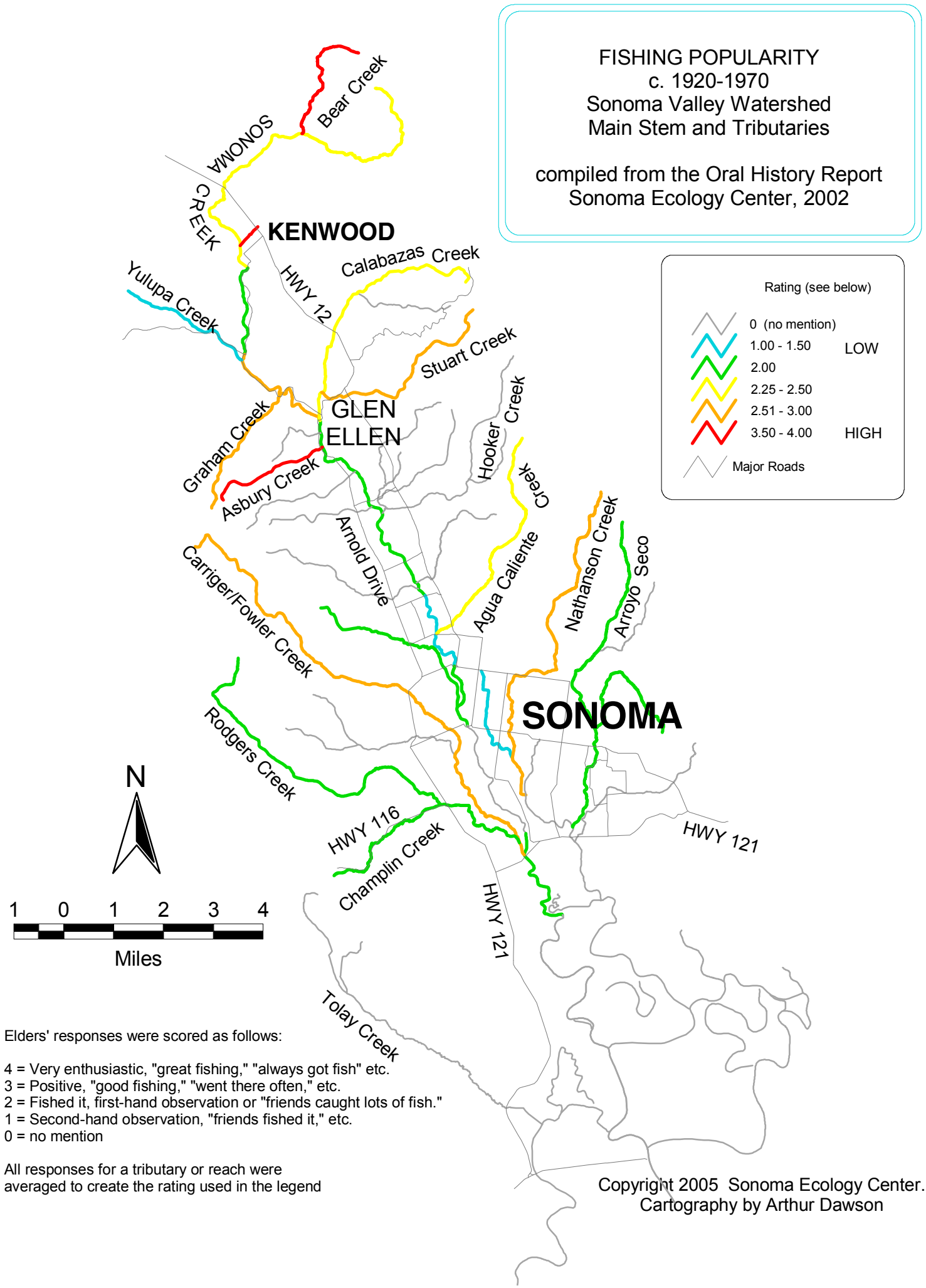
compiled from
California Department of Fish and Game
Stream Surveys
and the Oral History Report
Sonoma Ecology Center, 2002



Data from the Oral History Report
and Department of Fish and Game surveys were scored as follows:

4 = First-hand observation as spawning stream with identified redd
3 = First-hand observation as spawning stream
2 = First-hand observation of steelhead
1 = Second-hand observation of steelhead

Responses for a tributary or reach were averaged to create the rating used in the legend, except where a first-hand observation was made of a redd. In such cases, a 4.0 rating was given without averaging.



Elders' responses were scored as follows:

4 = Very enthusiastic, "great fishing," "always got fish" etc.
3 = Positive, "good fishing," "went there often," etc.
2 = Fished it, first-hand observation or "friends caught lots of fish."
1 = Second-hand observation, "friends fished it," etc.
0 = no mention

All responses for a tributary or reach were averaged to create the rating used in the legend

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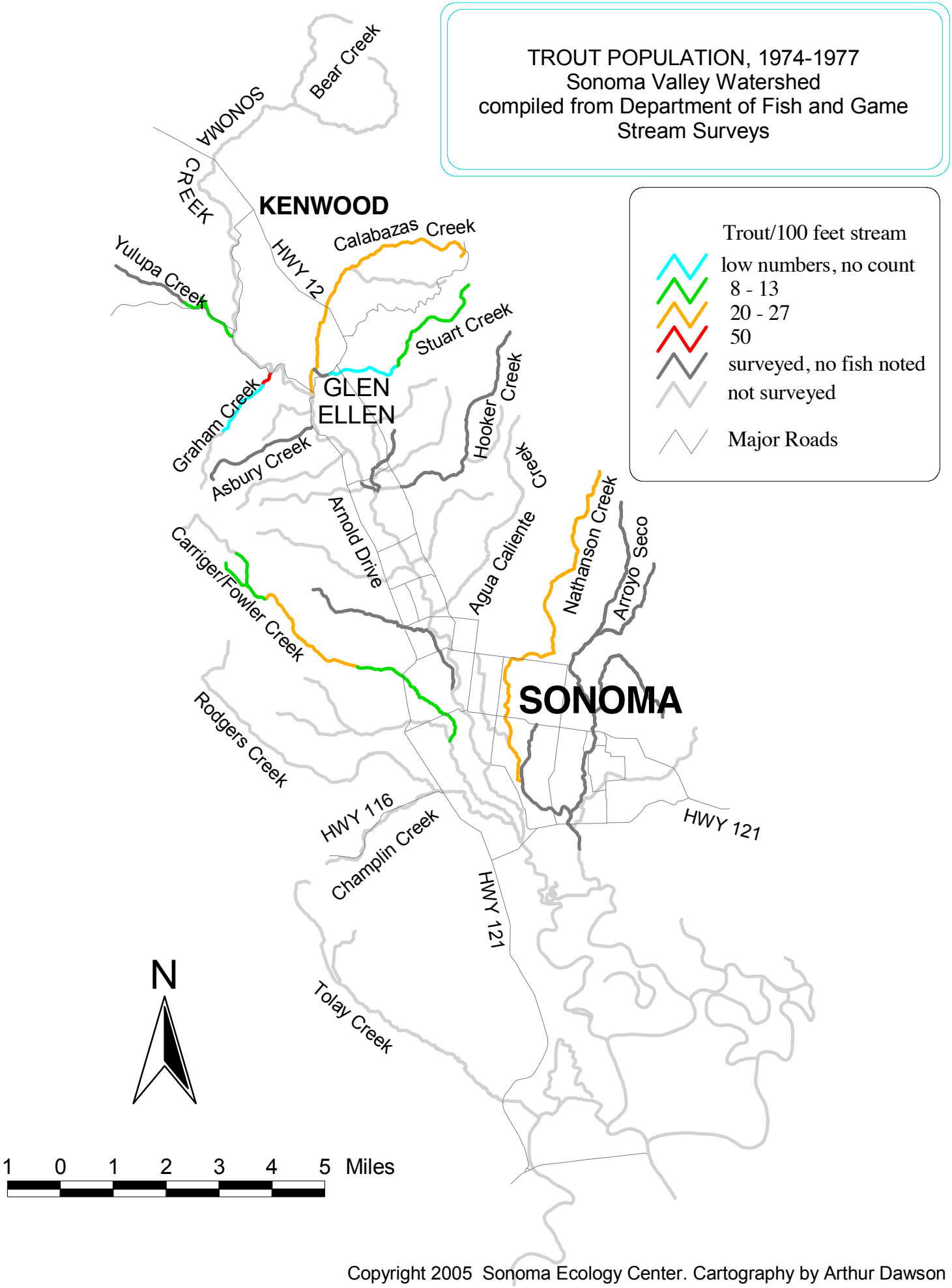

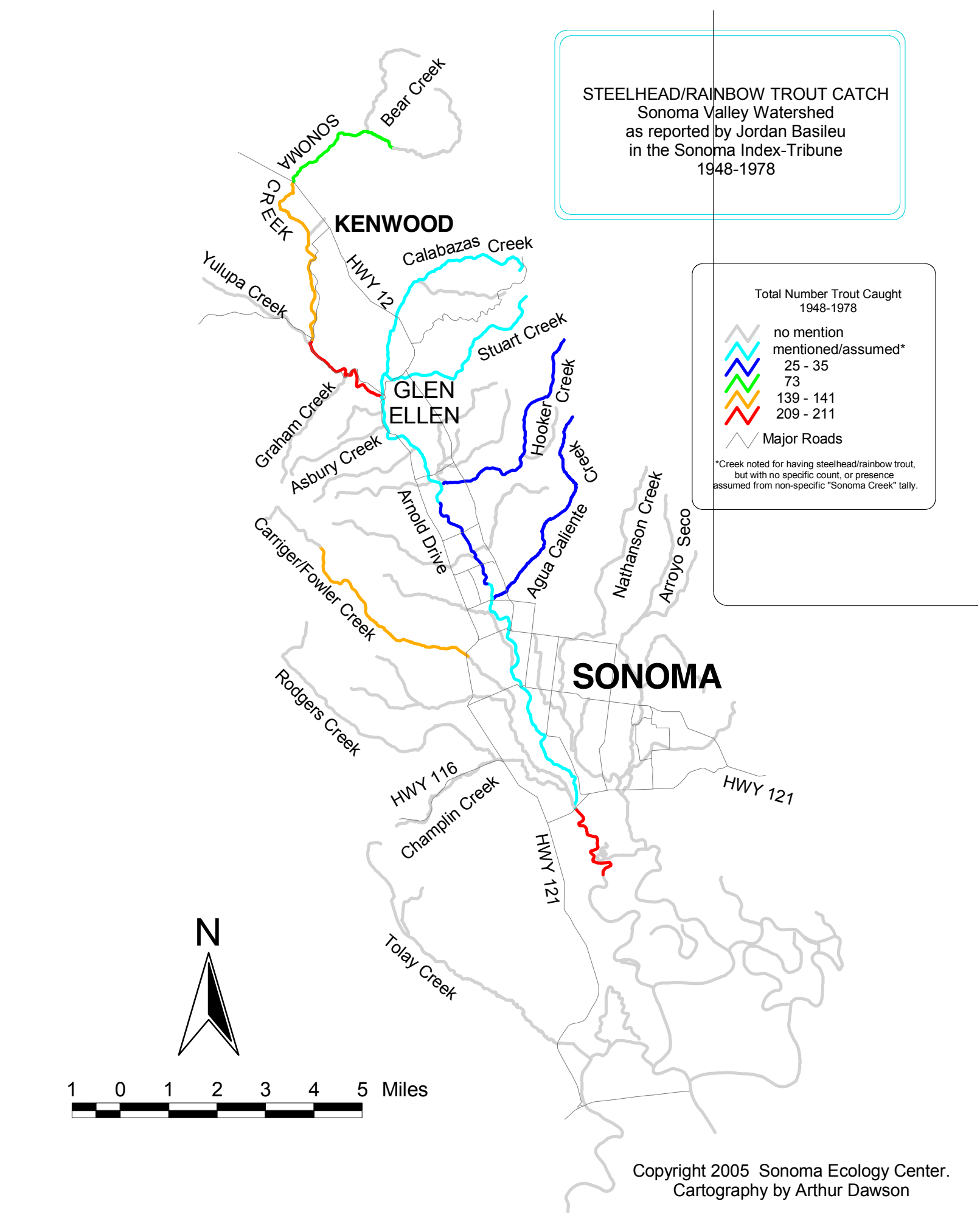
STEELHEAD/RAINBOW TROUT CATCH
Sonoma Valley Watershed
as reported by Jordan Basileu
in the Sonoma Index-Tribune
1948-1978
Total Number Trout Caught
1948-1978
no mention
mentioned/assumed*
25 - 35
73
139 - 141
209 - 211
Major Roads
*Creek noted for having steelhead/rainbow trout, but with no specific count, or presence assumed from non-specific "Sonoma Creek" tally.
KENWOOD
GLEN ELLEN
SONOMA
Bear Creek
SONOMA CREEK
Yulupa Creek
HWY 12
Calabazas Creek
Stuart Creek
Hooker Creek
Graham Creek
Asbury Creek
Arnold Drive
Agua Caliente Creek
Nathanson Creek
Arroyo Seco
Carriger/Fowler Creek
Rodgers Creek
HWY 116
Champlin Creek
HWY 121
HWY 121
Tolay Creek
N
1 0 1 2 3 4 5 Miles
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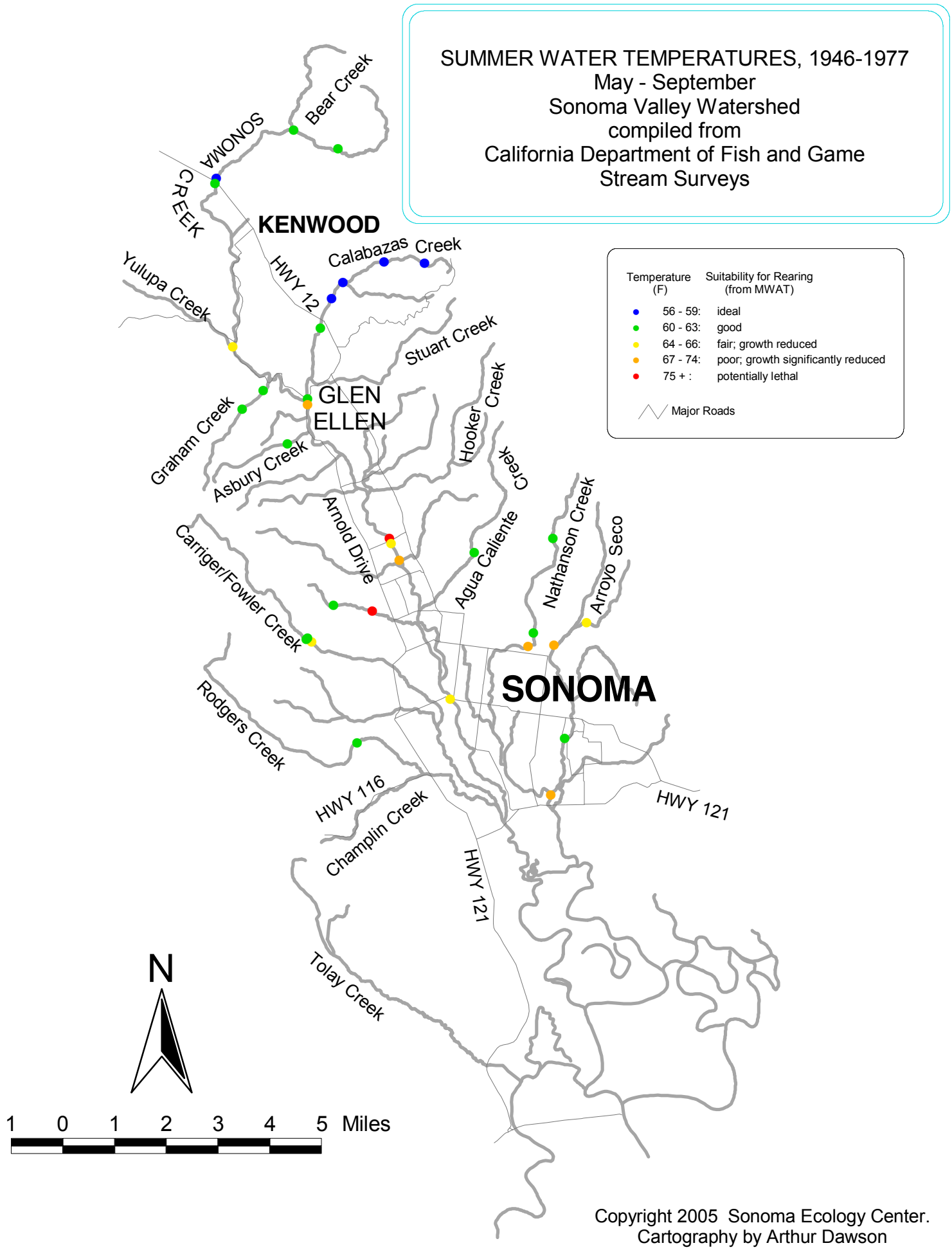

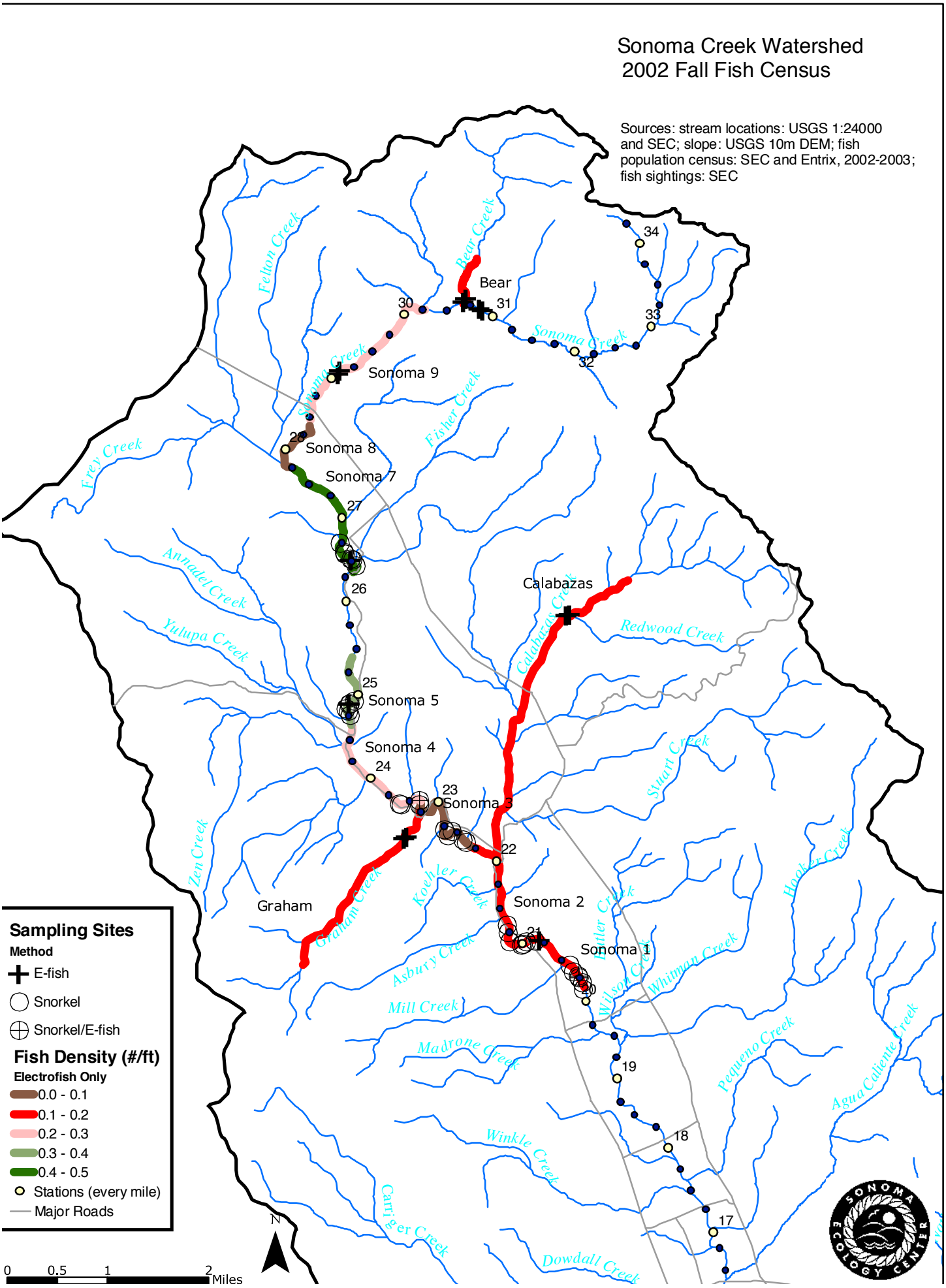
Sonoma Creek Watershed
2002 Fall Fish Census
Sources: stream locations: USGS 1:24000 and SEC; slope: USGS 10m DEM; fish population census: SEC and Entrix, 2002-2003; fish sightings: SEC
Felton Creek
Bear Creek
Bear
34
30
31
33
Sonoma Creek
32
Sonoma 9
Fisher Creek
Frey Creek
28
Sonoma 8
Sonoma 7
27
Annadel Creek
26
Yulupa Creek
Calabazas
Calabazas Creek
Redwood Creek
25
Sonoma 5
Sonoma 4
24
23
Sonoma 3
Stuart Creek
Zen Creek
22
Graham
Graham Creek
Koehler Creek
Sonoma 2
Hooker Creek
Butler Creek
Sonoma 1
Asbury Creek
Whitman Creek
Wilson Creek
Mill Creek
Madrone Creek
19
Pequeno Creek
Agua Caliente Creek
Winkle Creek
18
Carriger Creek
17
Dowdall Creek
Sampling Sites
Method
E-fish
Snorkel
Snorkel/E-fish
Fish Density (#/ft)
Electrofish Only
0.0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
Stations (every mile)
Major Roads
N
0 0.5 1 2 Miles
SONOMA ECOLOGY CENTER