STATE OF CALIFORNIA

The Resources Agency

DEPARTMENT OF FISH AND GAME

Thomes-Newville Unit
Fish and Wildlife Evaluation

A STATUS REPORT

Submitted June, 1983

This report was prepared under interagency agreement
between the California Department of Fish and Game
and the California Department of Water Resources

STATE OF CALIFORNIA

The Resources Agency

DEPARTMENT OF FISH AND GAME

Thomes-Newville Unit
Fish and Wildlife Evaluation

A STATUS REPORT

Submitted June, 1983

This report was prepared under interagency agreement
between the California Department of Fish and Game
and the California Department of Water Resources

FOREWORD

In the late 1970's the California Department of Water Resources (DWR) organized an additional element, the Future Supplies Program, of the State Water Project (SWP) to identify possible sources to guarantee "firm water" as part of a commitment to water purchasers in the various SWP service areas. Presently, the SWP can guarantee (during dry years) about 2.5 million acre-feet (maf) annually, whereas water demands could reach 4.23 maf by the end of the century. Several alternatives for developing additional water sources have been identified; a Thomes-Newville Unit is one of them.

This report provides part of the input on fish and wildlife that would be required in the event that construction of this project is pursued. At present, however, planning on this project has been discontinued as a result of the June 1982 vote against the Peripheral Canal and other potential SWP elements (Proposition 9). If project planning is completed at some later date, some additional planning for fish and wildlife will be required.

C-099726

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

H. D. Carper, Director

This report was prepared under the supervision of

Harold K. (Pete) Chadwick . . . . . Program Manager, Bay-Delta Project

and

Larry K. Puckett . . . . . Supervisor, Contract Services Section

by

Charles J. Brown, Jr. . . . . Associate Fishery Biologist
Eldon D. Smith . . . . . Associate Wildlife Biologist
John M. Siperek, Jr. . . . . Wildlife Biologist
Nick A. Villa . . . . . Fishery Biologist
Harvey H. Reading . . . . . Fishery Biologist
Jeffrey P. Finn . . . . . Wildlife Biologist

TABLE OF CONTENTS

TABLES

TABLES (Continued)

TABLES (Continued)

FIGURES

FIGURES (Continued)

APPENDICES

CHAPTER 1

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

This report describes physical and operational features of a potential new water supply for the State Water Project. The report includes descriptions of the terrestrial and aquatic resources, preliminary estimates of project effects on these resources, estimates of measures that might be required to offset adverse effects and recommendations on studies needed if project planning is pursued further.

CONCLUSIONS AND RECOMMENDATIONS

1. In a report titled Fish and Wildlife Considerations in State Water Project Planning (October, 1979), we concluded that surface water development below the Sacramento-San Joaquin estuary could have less overall impact on wildlife and aquatic resources than developments above the estuary. We now conclude that of the two projects evaluated further since that report, Los Vaqueros and Thomes-Newville (formerly Glenn Reservoir), the latter project would have less overall impact. Our earlier conclusion was based mainly on the fact that a Glenn Project would have a greater adverse impact than a Los Vaqueros Project because it involved pumping up to 241 cms (8,500 cfs) from the upper Sacramento River. As now envisioned, a Thomes-Newville Project would store inflow from tributaries to the Sacramento River (would not require pumping from the river) and it would include a water exchange with local irrigation facilities that would prevent any adverse effects on Sacramento River water quality (primarily turbidity).

C-099733

2. Flow reduction would limit spawning and rearing habitat for a small population of chinook salmon. Compensating habitat could be created by providing suitable substrate and flow at the outlet channel of the Tehama-Colusa Canal.

3. Reduction of flow in Thomes Creek may limit spawning and rearing opportunities for nongame fishes such as Sacramento squawfish and Sacramento suckers.

4. The reservoirs would inundate aquatic and terrestrial habitat for invertebrates, amphibians, and reptiles.

5. No rare or endangered species of invertebrate, amphibian, reptile, or fish was found although completion of sampling might reveal one or more species.

6. Construction of the reservoirs, appurtenances and diversion facilities would result in direct loss of 6 080 hectares (15,000 acres) of wildlife habitat.

7. Populations of some wildlife species would be reduced as a result of habitat loss with no opportunity for compensation.

8. Detrimental redistribution of wintering waterfowl in the Sacramento Valley with large concentrations of rafting birds on the reservoir is a possibility. Further studies will be necessary if studies resume. Management measures must be undertaken to help insure against development of a problem.

9. Project appurtenances such as diversion canals, road realignments, and recreation developments could cause additional impacts on wildlife. Cooperative planning has already resulted in minimizing potential impacts. Continued coordination would be required in later planning.

10. There is a wintering population of endangered southern bald eagles utilizing habitat in the project area and throughout the Thomes and

Stony Creek drainages. Maintenance of riparian habitat below project diversions and sustained fish populations would help continue the use of the area by wintering eagles. Identification and protection of key roosting habitats along the new reservoir margin would encourage use by eagles.

11. The project would provide additional habitat for water-associated birds.

12. Approximately 19 percent of the current winter range of the Thomes Creek (Lake Hollow) deer herd would be inundated by Newville Reservoir and the Thomes Creek Diversion facilities. It is probable that this impact could be compensated by habitat improvements in the Thomes Creek drainage above the proposed reservoir site. Other species of wildlife would benefit from increased productivity and diversity resulting from habitat improvement.

13. Abrupt termination of studies described in this report resulted in their being incomplete due to lack of data or insufficient time to analyze data.

14. Analysis of all data collected during studies included in this report should be completed as the first phase of any future study.

15. Specific fish and wildlife compensation plans should be prepared following completion of additional studies and additional site specific studies within potential habitat improvement areas.

16. A project habitat management agreement should be prepared and entered into by cooperating agencies. A wildlife planning and evaluation team should be created with representatives from each agency to oversee implementation of the agreement.

17. To the greatest possible extent the wildlife habitat agreement should be integrated with the objectives of the Federal-State Coordinated Resource Plan prepared for the Thomes Creek area.

C-099735

CHAPTER 2. INTRODUCTION

As part of their Future Supplies Program for the past three years, DWR has been in the process of evaluating the most viable alternatives for additional water supply sources for the SWP. Until the recent vote in June 1982, the elements chosen as most promising for further consideration were the Peripheral Canal and two reservoir projects (Thomes/Newville and Los Vaqueros).

Considerable time was also spent evaluating the potential for conjunctive use of surface water and groundwater storage in Southern California. Other elements that could add to future supplies are the Cottonwood Creek Project, currently in the final stage of a Corps of Engineers' reaffirmation study (which could lead to a design and construction stage) and an enlarged Shasta Lake project, currently in an appraisal-level status which constitutes only the infancy of planning.

The Contract Services Section was asked to develop study plans for determining potential impacts on fish and wildlife of a Thomes/Newville or a Los Vaqueros Project. The actual studies were to aid DWR in determining the feasibility of building either or both of the projects.

These studies were initiated in 1979 and were to culminate with a DFG summary report and input for a draft Environmental Impact Report by June 1983.

Since the June 1982 vote on Proposition 9, however, the studies have been discontinued. Hence, this report is part of a wind down of studies process undertaken by DWR and constitutes a status report. The field studies were already fairly complete when discontinuation was requested;

hence, much of the input is fairly comprehensive. The primary shortcoming of this investigation is not having enough time to consider probable project impacts and to develop detailed compensation or mitigation measures.

This report provides a brief description of the proposed project, a description of the status of our knowledge of resources that would likely be affected, and insight into project impacts and compensation potentials. It also includes a description of study needs and costs in the event the project is pursued at a later date.

CHAPTER 3. PROJECT DESCRIPTION

The Thomes-Newville Unit would be located on the west side of the Sacramento Valley on the Glenn-Tehama County line, about 160 km (100 mi) northwest of Sacramento. The Thomes-Newville Unit would capture surplus water from Thomes and Stony Creeks.

Studies completed in 1980 showed that the Thomes-Newville Unit would fit well into a staged sequence of features to meet expected SWP demands in the 1990s. Accordingly, the DWR focused its planning efforts on the Thomes-Newville Unit to produce a plan formulation report and draft environmental impact report by June 1984. If the unit met the necessary environmental, economic, and financial criteria, it could have been scheduled for completion in the mid-1990s. To meet this schedule, construction would have had to begin in about 1988.

The Thomes-Newville Unit is a smaller version of the Glenn Reservoir-River Diversion Unit, which was originally proposed for offstream storage of surplus Sacramento River water. However, the Thomes-Newville Unit would operate entirely with local runoff; there would be no diversion of Sacramento River water involved. Construction of the Thomes-Newville Unit would not preclude an eventual offstream storage development using the original Glenn Reservoir concept. But, the smaller plan would be independently viable and it would involve no commitment to later expansion. Studies of Glenn Reservoir were terminated in late 1980 when the decision was made to concentrate on the Thomes-Newville Unit.

Newville Reservoir

The central feature of the Thomes-Newville Unit would be Newville Reservoir, formed by an embankment-type dam on North Fork Stony Creek (Map). The North Fork has a limited drainage area and little surplus water; most of the water supply for Newville Reservoir would come from adjacent streams, as shown in the figure. Newville Reservoir would inundate about 20 sections of land that is used primarily for cattle grazing. The prospective reservoir area is all privately owned; the reservoir would inundate all or part of the lands of about 20 separate owners, but over 80 percent of the land is held by 5 owners. There are nine dwellings in the reservoir area.

Thomes Creek Diversion Facilities

Surplus water from Thomes Creek would be conveyed from a 29-m (95-ft) high concrete diversion dam located about 6 km (4 mi) southwest of Paskenta. A diversion canal would be excavated through a saddle on the drainage divide to discharge directly to the northwest corner of Newville Reservoir.

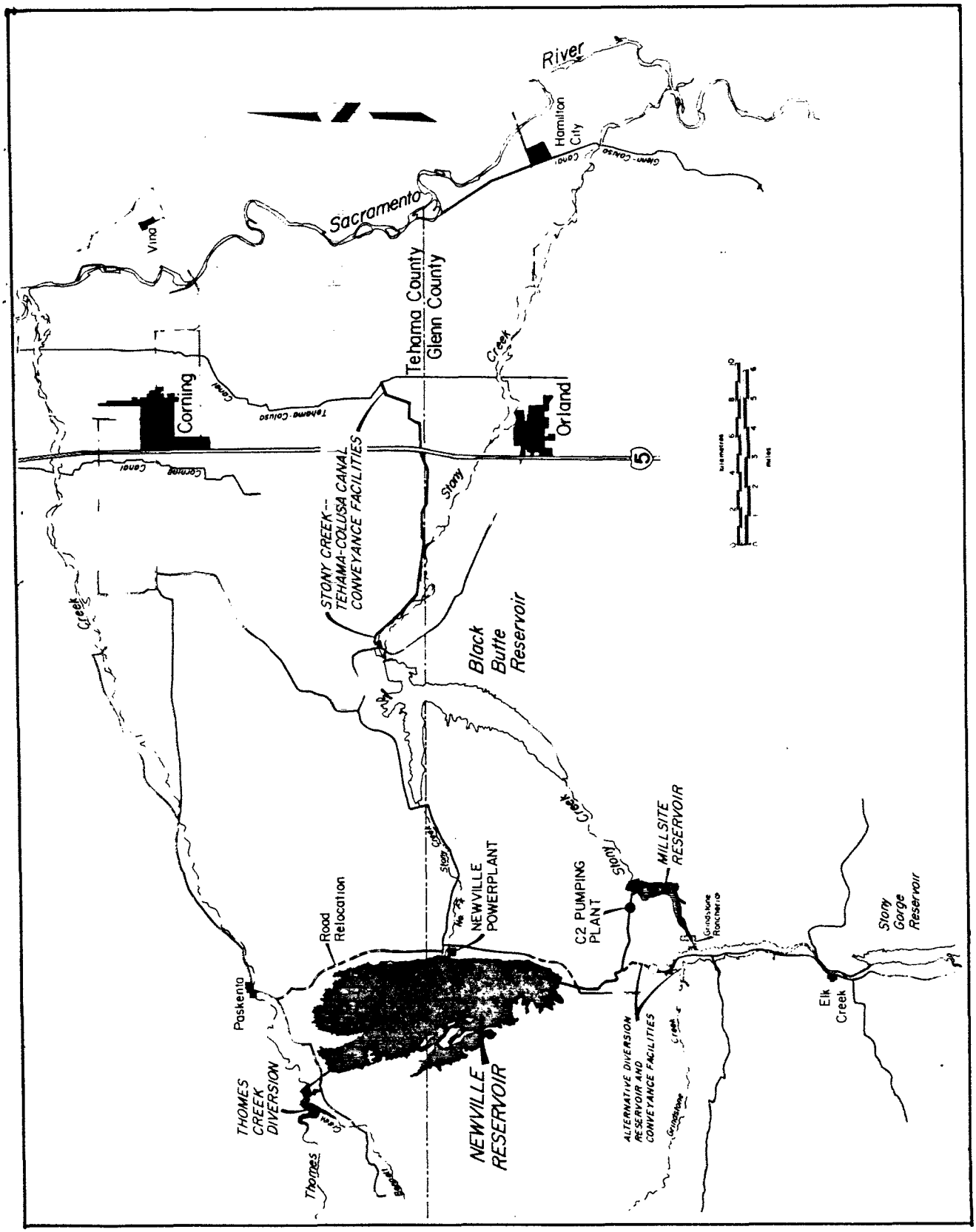

FIGURE 3-1. Thomes-Newville Unit

C-099739

Stony Creek Diversion Facilities

The basic plan for diversion of surplus flow from Stony Creek would involve a small Millsite Reservoir located at Julian Rocks about 8 km (5 mi) upstream from the Corps of Engineers' Black Butte Reservoir. A pumping plant would lift the water about 99 m (325 ft) to the south end of Newville Reservoir via a penstock, tunnel, and channel system. Previous plans showed a more northerly alignment for the conveyance facilities between Millsite and Newville Reservoirs; the alignment shown in the figure was found superior in 1981 studies.

The basic Stony Creek diversion plan was devised to avoid impacting the Grindstone Indian Rancheria; Millsite Reservoir was sized to stay within the active stream channel at the Rancheria. In early 1981, the Tribal Council expressed a willingness to consider relocating the Rancheria if necessary. Subsequently, a wider range of diversion layout was examined and the alternative shown on the figure was determined to be the most promising of those that would necessitate relocation of the Rancheria. The alternative plan would employ a diversion dam located right at the Rancheria. The resulting reservoir would be about 24 m (80 ft) higher than the Millsite Reservoir in the basic plan. This would reduce the pumping lift to Newville Reservoir and allow the conveyance facilities to be somewhat shorter. Preliminary cost comparisons indicated that the upstream site might be significantly less costly than the original Millsite plans. Geologic exploration and drilling of the upstream site was being arranged when the decision was made to terminate all Thomes-Newville Unit planning.

Preliminary appraisals were also being made of another alternative plan using a gravity diversion from a dam about 3 miles upstream from the mouth of Grindstone Creek. The gravity diversion could be supplemented by pumped diversions from Stony Creek, if desired. This alternative appeared to have promise also and would be examined more intensely if planning were resumed at some time in the future.

Release Facilities

Releases from Newville Reservoir would pass through a powerplant at the toe of the dam and flow down North Fork Stony Creek to Black Butte Reservoir. Because of natural inflow and gravity diversions from Thomes Creek, considerably more water would pass through the generating plant than would have to be pumped and the development would produce a small net surplus of electrical energy once initial filling was completed.

From Black Butte Reservoir, SWP releases would probably be diverted to a separate conveyance facility that would deliver them to the Central Valley Project's Tehama-Colusa Canal north of Orland. This would eliminate potential water quality or temperature impacts that would result from direct release to the Sacramento River. It would also avoid possible problems with bank erosion and channel losses that could occur if the releases were added to the normal flow of lower Stony Creek. Maximum releases for SWP yield would be on the order of 280 to 420 m^3/s (1,000 to 1,500 ft^3/s). An exchange agreement would have to be negotiated with the U. S. Bureau of Reclamation;

this would provide for reducing diversions to the Tehama-Colusa Canal in direct relation to the deliveries to the canal from the Thomes-Newville facilities. The net result would be an increase in river flow (credited to the SWP). If this exchange agreement could not be worked out, a similar one might be arranged with the Glenn-Colusa Irrigation District; this would require longer conveyance facilities, but would avoid increasing summer river flows between Red Bluff and Hamilton City.

Sizing

Preliminary engineering studies in 1981 indicated that the optimum sizes could be approximately as follows:

Newville Reservoir

Dam height	-	88 to 99 m (288 to 325 ft)
Pool elevation	-	265 to 276 m (868 to 905 ft)
Storage capacity	-	1 750 000 to 2 350 000 dam^3 (1,420,000 to 1,900,000 ac-ft
Surface area (full)	-	5 000 to 5 700 ha (12,300 to 14,100 ac)

Thomes Creek Diversion

Diversion capacity	-	280 m^3/s (10,000 ft^3/s) (Larger sizes were being considered to increase flood protection on Thomes Creek.)

Stony Creek Diversion

Millsite Reservoir elevation	-	183 m (600 ft)
Millsite Reservoir capacity	-	16 200 dam^3 (13,100 ac-ft)
Diversion capacity	-	57 to 113 m^3/s (2,000 to 4,000 ft^3/s)
Maximum pump lift	-	approximately 99 m (approximately 325 ft)

Operation

The Thomes-Newville Unit would make use of water surplus to all other needs. The key principle would be to avoid interference with the rights or water supplies of local or other users of Stony and Thomes Creek water. Water would be stored in Newville Reservoir only when it would otherwise flow on down the Sacramento River to the ocean.

For example, diversion of Thomes Creek flows would be confined to winter and spring months of high runoff. Thomes Creek would never be completely diverted; a portion would be bypassed to maintain a live stream and to continue downstream ground water recharge. Except during the spring of years of unusually high runoff, there would be no diversions during the irrigation season; Thomes Creek flows available for local irrigation use would be unaffected by the Thomes-Newville Unit. Thus, the principal project impact on Thomes Creek would be a reduction of high winter and spring flows.

Stony Creek is already regulated by East Park, Stony Gorge, and Black Butte reservoirs to supply water to the Orland Project and to the CVP. Nevertheless, a significant amount of unregulated surplus water is available in many years. This surplus water occurs primarily in the December through March period in the form of releases made to maintain flood control storage space in Black Butte Reservoir. The Thomes-Newville Unit would divert a portion of this surplus water to Newville Reservoir. This would reduce winter spills at Black Butte Dam.

There would be no impact on the operation or yield of the Orland Project reservoirs, which are both upstream from the potential point of diversion to Newville Reservoir. Likewise, summer flows of Stony Creek would be unaffected, because SWP releases from Newville Reservoir would be carried in a separate conveyance facility beginning at Black Butte Dam. Winter flows of lower Stony Creek would often be reduced (but could occasionally be increased if Thomes Creek water were diverted through a full Newville Reservoir for power production).

Under average conditions, about six to seven years would be required to fill Newville Reservoir after the completion of construction. Thereafter, it would reach the full mark in the spring of about half of the years. Average drawdown during the summer would depend on the operating criteria eventually selected, but a 4-m (13-ft) drawdown during the summer would be typical. Extreme drawdown would occur only during infrequent prolonged dry spells of several years' duration.

Yield

Operated in conjunction with other SWP features, the Thomes-Newville Unit would increase dry-period yield of the SWP by some 230 000 to 320 000 dam^3 (190,000 to 260,000 ac-ft) per year, depending on the size and operating mode selected. The corresponding average annual yields would range from 160 000 dam^3 (130,000 ac-ft) down to about 110 000 dam^3 (90,000 ac-ft). About half of the new yield would be derived from Thomes Creek surplus flows and about half from Stony Creek surplus flows.

CHAPTER 4

WILDLIFE HABITAT

Introduction

The first step to assess the effect of any project on wildlife resources is to identify and inventory wildlife habitats which would be affected by the project. Through studies on wildlife populations that utilize these habitats, the habitats can be evaluated and projections can be made on the overall impact of the project in terms of wildlife losses. Once losses have been estimated, recommendations on compensating those losses can be developed. Land management and habitat improvement practices should be implemented on other lands in the vicinity of the project to achieve compensation; therefore, detailed inventory of existing habitats on those proposed compensation lands is also required. Wildlife studies and subsequent habitat evaluations can then be carried out to determine habitat improvement potential to compensate for project losses.

Methods

Lands that would be inundated by Newville Reservoir and the diversion reservoirs on Thomes and Stony Creeks were delineated on USGS 15' topographic maps. For the purpose of designing wildlife population studies within inundation areas, the level of refinement which would identify plant communities was judged to be adequate. The plant communities identified were grassland (GR), oak-savannah (OS), oak-pine woodland (OP), chaparral (CH) and riparian (RIP). Description of these plant communities is provided by the Preliminary Survey of the Glenn-Tehama Reservoir Site Floritics prepared for the Department of Water Resources by Stout and Collins in 1979. With the use of aerial photographs, USGS soil-vegetation maps and a limited amount of ground truthing,

plant communities were mapped and acreages were determined with the use of a planimeter.

Intensive study of the Thomes Creek deer herd throughout the entire range (discussed in Chapter 5) required more detailed habitat inventory. As studies progressed, we determined that lands to be manipulated for compensating project wildlife losses would be within the Thomes Creek deer herd range; therefore, inventory of habitat at the vegetation-type level of refinement was appropriate. Monitoring radio-collared deer, as discussed in Chapter 5, delineated boundaries for the herd. Vegetation types were mapped and acreages were calculated with a planimeter from USGS soil-vegetation maps and USFS timber-type maps and aerial photographs. More extensive on-the-ground investigation of habitats (ground-truthing) was performed in these areas than in the inundation areas.

Results

Utilizing the largest surface acreage configuration of project facilities proposed for Newville Reservoir, Thomes Creek Diversion Reservoir and Canal, and Stony Creek Diversion (Millsite) Reservoir and conveyance, the project habitat loss was calculated at 6 080 ha (15,000 acres). Inventory of wildlife habitat by plant communities are shown in Table 1.

Table

Habitat Inventory of the Project Area

Habitat (Plant Community)		Hectares	Acres
Grassland	(GR)	4,870	12,020
Oak Savannah	(OS)	750	1,850
Oak-Pine Woodland	(OP)	170	420
Chaparral	(CH)	45	110
Riparian	(RIP)	245	600
	Total	6,080	15,000

A detailed summary of the habitat inventory of the Thomes Creek deer herd range is presented in Chapter 5.

Habitat Evaluation

Evaluations of habitat relative to specific wildlife population studies are presented in Chapter 5 (to the extent studies were completed). The majority of wildlife population studies data was recorded and prepared for computer analysis. Thorough habitat evaluation cannot be completed until computer analysis is accomplished.

C-099745

CHAPTER 5. GENERAL WILDLIFE STUDIES

A. General Wildlife Inventories

Our inventories do not provide complete information for all wildlife; we concentrated efforts on general inventories and on certain species which are especially significant for one or more reasons.

Computer programs were designed to plot locations of wildlife species in relationship to other species or physical parameters during certain periods of time. We decided that habitat types should be digitized within the computer so that habitat use by certain species could also be analyzed. However, due to the termination of the Thomes-Newville Project studies, these data were only keypunched and entered into a computer data base. No analysis was performed.

Wildlife observations were performed within the proposed Thomes-Newville Project site including areas where appurtenant structures such as diversion reservoirs were planned. Observations were also performed on lands adjacent to the project which would likely be affected by project construction and operation.

Methods

Information on occurrence and distribution of birds and mammals was obtained by either casual observations or by field studies designed to provide this information. Data obtained, which included species, dates observed, location, and name of recorder, were keypunched and entered into a DWR computer data base for analysis.

C-099746

Sources for this general inventory were from incidental sightings, night surveys, mammal trapping, raptor surveys, riparian surveys, stock pond surveys, and variable circular plot bird censuses.

Data were recorded on special sheets which included species code, data, Universal Transverse Mercator (UTM) number, and the initials of the recorder.

Standard species codes for computerization were developed in consultation with California Natural Diversity Data Base (CNDDB) personnel. Many species already had been assigned codes; however, if a species code did not exist, family alpha codes from the Nature Conservancy National Guide were used to precede four alpha codes from the common name of the species. For example, the ferruginous hawk is DFCO8 (existing CNDDB code), but the rough-legged hawk is DFRLHA (CNDDB family code (DF) plus four alpha letters from the common name). The code basis for common names is:

One word - Use first four letters.

Two words - Use first two letters of each word.

Three words - Use first letter of first two words and first two letters of last word.

To identify location, a UTM number was developed using the last four digits of the east-west coordinates and the north-south coordinates. This system accurately identified the location of each siting to within 100 metres (328 ft) or within one hectare (2.5 acres). Clear plastic 100 m^2 (2.5 ac) grid overlays were placed over standard 7.5-minute USGS quad maps to determine UTM values; the north-south coordinates were recorded first, followed by the east-west coordinates.

A source code documented the type of census and detection method.

Data sheets were sent to the computer services section of DWR to be utilized in a program to describe species occurrence either geographically or by textual reference, such as species code and date. Maps could then be developed and projected on a screen or plotted, at any scale, showing overlays such as species occurrence, project feature, vegetation type, quad, county, or watershed. This would allow the investigator to analyze bird and mammal occurrence in concert with other important attributes. For example, if project features would affect the distribution of wintering bald eagles or nesting golden eagles during certain time periods, this could be easily depicted. This information would be needed ultimately to help identify mitigation measures.

Results and Discussion

All data were entered into a computer for storage; however, no data analysis was performed. A preliminary list of birds and mammals observed or assumed to be within the project area or along Thomes Creek was developed, however. (Appendix Tables 1 and 2). One hundred eighteen species of birds occur in this area, forty-five of these were confirmed as breeding and thirty-five more probably breed in or around the project site. Studies of small mammals were just begun when this project was terminated; therefore, data are lacking on occurrence of most mammal species.

Because of more data on birds, we should mention several species of special concern that would require consideration in the event of future studies and development of mitigation:

Bald Eagle (endangered species) - This species winters regularly along Thomes Creek and in the reservoir area. Although they are not known to breed in the immediate area, one adult was observed in May (the breeding season) 1982 along Thomes Creek near Flournoy. More information on bald eagles is presented later.

Golden Eagle - Golden eagles are present all year but are more numerous in the winter. Two nests were located in 1982 on ridges that would form the reservoir. One pair hatched one chick, but the chick disappeared after about three weeks. The second pair prepared a nest with fresh boughs but no other activity was ever seen.

Prairie Falcon - These are resident birds and two nests which had young were located in 1982.

Bank Swallow - These birds are summer visitors. Two nesting colonies were located on Thomes Creek in 1982. One colony was near the end of riparian transect number 3 and consisted of 26 holes. The second colony was near the end of riparian transect number 5 and consisted of four nest holes.

Long-Eared Owl - Three owls were found wintering in the yard trees of an abandoned homestead in the reservoir site in 1982. Later, one adult disappeared and the other two produced five young. The nest was located in a broken-down cottonwood tree.

Swainson's Hawk - An adult, dark phase, and an immature bird were observed June 10, 1982, on the south bank of Thomes Creek near the end of transect number 5.

The following species of concern are known (*) or probably (+) breed in the area:

* Marsh hawk	+ Yellow warbler
* Red-shouldered hawk	+ Yellow-bellied chat
+ Screech owl	* Great blue heron
* Burrowing owl	* Tricolored blackbird
+ White-tailed kite	

Species of concern which winter or are transient in the area are:

Coopers hawk	Willow flycatcher
Sharp-shinned hawk	Osprey

While not considered species of special concern, three species of birds are of special interest in this area:

Rufous-Crowned Sparrow - One bird was seen near Williams Butte and another pair was seen in the Salt Creek area carrying food to their young. These birds have not been recorded breeding nearly this far north on the west side of the Sacramento Valley (This suggests a breeding range extension of approximately 192 km (120 mi).

Say's Phoebe - A pair, which was probably nesting since the male was singing, was seen at Williams Butte. A bird was also seen there on June 1, 1982. These birds are known to nest in niches on cliffs. At raptor point number one (page 29), a Say's Phoebe was seen earlier in the year. Later, on June 7, 1982, a pair was seen at this point near a pothole in the cliff. These sightings are important because only one other record is known for the Say's Phoebe in the Central Valley.

White-Throated Swift - Although these swifts are not known to nest in Tehama County, 12 birds were seen at Williams Butte in April and 5 on June 12, 1982. This butte appears to be ideal nesting habitat for the swifts.

B. Census of Wintering Bald Eagles

A winter survey of bald eagles was conducted along Thomes Creek, which included arrival and departure dates of wintering eagles, population estimate, and observations on forage selection.

The study area was a roughly rectangular section of land encompassing Thomes Creek as it emerges from steep foothills and flows east to Henleyville (Figure 5-1). Habitats included rolling grassland which support sheet and cattle; pastures bordered by thin strips of blue oaks (Quercus douglasii) and cottonwoods (Populus fremontii); riparian vegetation along Thomes Creek, with several pockets of denser vegetation near Henleyville and Flournoy; and oak woodland with scattered digger pines (Pinus sabiniana) in the western portion of the study area.

Methods

Roadside counts of bald eagles were made periodically from December 21, 1979, to April 16, 1980. The surveys were conducted by car along paved roads paralleling Thomes Creek from Henleyville to Crowsfoot Point, and a section of road south of the creek (Squaw Hollow), for a distance of approximately 49 kilometres (30 mi). The census route was driven three times a week until mid-March when the interval became weekly.

Observations were from dawn until late afternoon. The duration of each survey day depended on the number of eagles observed along the route. The vehicle was stopped and behavior of individual eagles was recorded until the eagle moved out of range of the observer (approximately 0.5 km (0.3 mi) on either side of the road). Binoculars

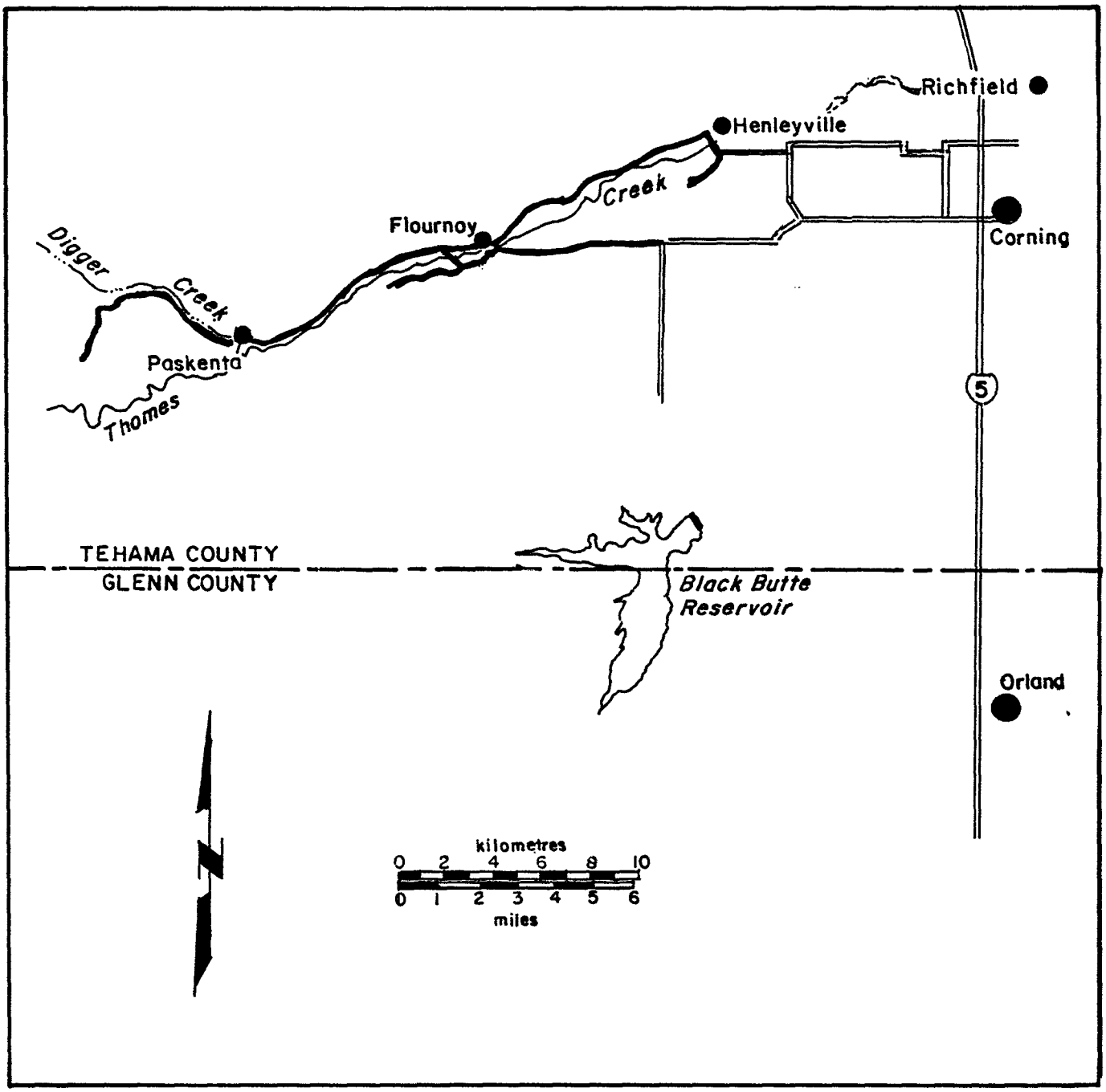

FIGURE 5-1. Bald Eagle winter survey route conducted in southern Tehama County, 1979-1980

C-099752

(7 x 50) and a 15-60X zoom spotting scope were used for identification and determining the sex and age of eagles. Weather conditions were noted at the start of each survey.

Additional random sightings of bald eagles made during the study period were recorded under a separate "at-large" data section and later entered into the computer occurrence and distribution program. In addition, population size was estimated using the Bounded Count Method (Overton, 1971).

Results

One hundred eleven bald eagles were sighted during 38 census days; 78 adults (70% of total) and 33 immatures (30%). Only one eagle was seen on each survey day until January 4 when four birds were seen. No eagle was sighted on three of the last four days of the census. Maximum numbers were observed in early March, with ten sightings on one census day (Figure 5-2). Survey data were analyzed using the Bounded Count Method, resulting in a population estimate of 11 eagles and confidence interval (Alpha = 0.05) of 10-29. At-large sightings from December to April totalled 105 bald eagles; 65 adults (62%) and 40 immatures (38%). An airplane flight in late January and two raft trips on Thomes Creek in March accounted for ten sightings. Four eagles were spotted from the plane, but no sighting was recorded during a ground survey conducted that day.

Eagles were observed perching along Thomes Creek and small tributary creeks, flying in the vicinity of the creeks, or perching or

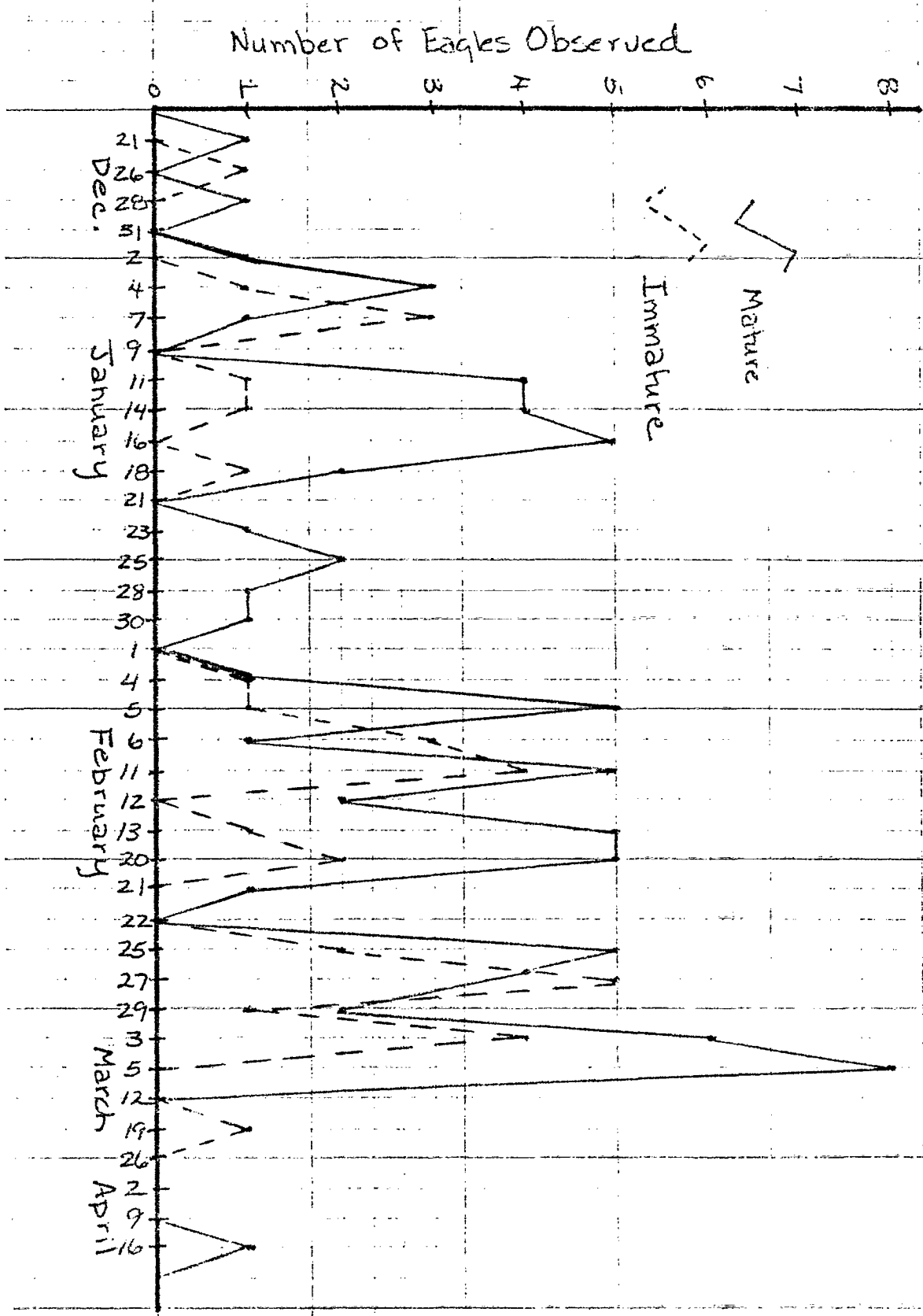

Fig. 5-2 Number of bald eagles observed during roadside census in southern Tehama County, 1979-1980.

soaring in areas near from the creek. An equal percent of immatures and adults were sighted in open grassland occupied by grazing sheep (Table 5-1) Ninety sightings were made along the survey route between Henleyville and Flournoy, seven between Flournoy and Paskenta, eight west of Paskenta along a small tributary creek, one on upper Thomes Creek west of Paskenta, and five in the Squaw Hollow area south of the creek.

Few observations of eagles feeding were made during the survey. A total of 26 sightings occurred in areas where sheep were present, but only one was actually feeding. In mid-February, a mature bald eagle was observed feeding on sheep afterbirth in a pasture north of the survey road. One month earlier, two adults and an immature were seen on the ground in this same field, near a fresh sheep carcass but not actually feeding on it. No eagle was observed feeding on fish during census days; however, a U. S. Forest Service employee saw a mature eagle swoop down and take a fish from a small tributary creek (Henderson, pers. comm.).

Discussion

A general survey of bald eagle winter habitat was conducted by Detrich (1978) in Shasta, Trinity, and Tehama Counties. This study did not include specific data on numbers of eagles utilizing the creeks flowing from the western side of the valley in Tehama County, however. Twice as many immatures as adults were observed in the tri-county valley area during the survey. In contrast, our study showed a 3:1 adult to immature ratio, which agreed with data from wintering bald eagle populations studied by Southern (1963, 1964) in Illinois and Woffinden and Murphy (1977) in Utah.

Table 5-1. Activity or location of bald eagles sighted during periodic winter survey of Thomes Creek, 1979-1980

Activity	Immature	(% of Total Immature	Mature	(% of Total Mature	Overall Total	(% of Total
Perched on Thomes Creek	24	(73%)	46	(59%)	70	(63%)
Perched along tributary	1	(3%)	10	(13%)	11	(10%)
Perching/soaring in areas away from creek; sheep present	4	(12%)	9	(12%)	13	(12%)
Perching/soaring in areas away from creek; sheep not present	1	(3%)	-		1	(1%)
Flying along creek	3	(9%)	11	(14%)	14	(13%)
Flying away from creek	-		2	(3%)	2	(2%)
Total	33 (T.I.)		78 (T.M.)		111	

C-099756

The number of bald eagle sightings between Henleyville and Flournoy greatly outnumbered those in any other portion of the survey area. The apparent preference of the eagles for this area could be influenced by the presence of perching habitat along the creek, and close proximity to large sheep pastures north of the survey road and south of the creek in Squaw Hollow. Potential human disturbance (ranches, homes) was also relatively low in this area compared to the more westerly portions of the study area.

The population estimate of 11 wintering bald eagles was probably low, since only 20 km (12.4 mi) of 30 km (18.6 mi) of Thomes Creek flowing through the study area were visible from the survey roads. The remaining 10 km (0.6 mi) of creekside riparian was situated either behind oak woodland, orchard, foothills, or too far away from the road to see clearly. Theoretically, perching eagles could utilize the entire reach of stream. Although the continuous band of creekside riparian becomes sparse in some areas, one of the trees used most frequently by perching eagles was in an open area along the creek (with the closest tree nearly 100 m (330 ft) away).

Based on our survey, wintering eagles apparently arrive in the study area in early January and depart in mid-March. Available forage sources during this period include livestock carrion and fish. Sheep, cattle, and swine pasture throughout the study area from early January to the conclusion of the survey period. Detrich (1978) found sheep carrion to be an important forage source for wintering eagles in Tehama County; the greatest use was by immatures. No difference in mature versus immature eagles sighted in association with sheep was observed in our study. Although only one eagle

was observed feeding on fish, eagles would have access to spawning squawfish and suckers in Thomes Creek and tributary creeks which flowed continuously during the study period. They may also feed in outlying areas such as the mouth of Thomes Creek or Black Butte Reservoir.

C-099758

Reference List

Detrich, Phillip J. 1978. Bald eagle winter habitat study - Shasta, Trinity and Tehama Counties, California. U. S. Forest Service.

Overton, W. S. 1971. Estimating the numbers of animals in wildlife populations. Page 426. In Robert H. Giles, ed., Wildlife Management Techniques. The Wildlife Society, Washington, D. C.

Southern, W. E. 1963. Winter populations, behavior and seasonal dispersal of bald eagles in northwestern Illinois. Wilson Bull. 75(1): 42-45.

----. 1964. Additional observations on wintering bald eagle populations: Including remarks on biotelemetry techniques and immature plumages. Wilson Bull. 76(2): 121-137.

Woffinden, N. D., and J. R. Murphy. A roadside raptor census in the eastern Great Basin - 1973-1974. Raptor Res. 11(3): 62-66.

C. Night Surveys

The purpose of this study was to determine the occurrence and distribution of nocturnal birds and mammals; however, prior to the termination of field work, only two census nights were completed.

Methods

The study area for this portion of work was the proposed inundation area, surrounding lands, and areas adjacent to Thomes Creek.

Owl surveys were made at night by stopping at convenient turnouts adjacent to various habitats such as oak woodland, chaparral, grassland, and riparian. The stop sites were selected subjectively to minimize disturbing residents and to cover the different habitats adjacent to the existing road systems. Surveys were from 3:30 a.m. until dawn.

At each stop, which was for 15 minutes, pre-recorded owl calls were played on a cassette recorder and amplifier for one to two minutes. The tape was played, followed by a one-minute pause during which answering calls were noted. This sequence was followed for all species thought to occur in the area, with calls being played sequentially starting with the least predominant species and ending with the most predominant.

Mammal sightings were also noted while driving from one stop site to the next.

Results and Discussion

Since this study was for only two nights, only a small amount of data were collected. On the first night, five screech owls and three long-eared owls were located. The second night revealed five screech owls and four great-horned owls. No mammal was observed either night. Data were transferred to the occurrence and distribution computer data base.

D. Diurnal Raptor Viewing Points

This was another study to determine the occurrence and distribution of raptors within the proposed reservoir site. Diurnal raptors are generally very visible and have large home ranges, making observations easy.

Methods

The study area was the proposed reservoir site and immediate area surrounding. Four ridge tops with unobstructed views of the proposed reservoir were selected. The UTM coordinates for these sites are:

Points	UTM Coordinate
#1	40405385
#2	40715364
#3	40805358
#4	40545407

Each site was visited weekly and using a 15-60X spotting scope and various field guides, data on species, numbers, age, sex, habitat, and possible nesting sites were recorded. Temperature (Centigrade), sky conditions, and wind velocity were noted at the start and finish of each survey.

Results and Discussion

All data collected were transferred to the occurrence and distribution computer data base and have not been analyzed.

E. Stock Pond Surveys

Four stock ponds were selected to determine which waterfowl and shorebird species were presently using the proposed reservoir site.

Methods

Four of the largest stock ponds with good year-round access were selected within the reservoir site. The UTM coordinates for these sites are:

Pond	UTM Coordinate
#1	40405385
#2	40715364
#3	40805358
#4	30855414

Stock pond number one was surveyed throughout the study period. Study of ponds number two and three was terminated in April because of access problems at which time stock pond four was added. Each pond was visited weekly and with the aid of a spotting scope and various field guides, data on age, sex, number, species, and habitat were recorded. In addition, wind, temperature, and sky conditions were noted.

Results and Discussion

All data were transferred to the occurrence and distribution computer data base but were not analyzed.

F. Riparian Transects

Riparian habitats have a diverse avian fauna, and to evaluate diversity, occurrence, and distribution of species, several belt transects were established along riparian corridors.

Study Area and Methods

Sites for transects were selected in undisturbed areas with typical vegetation close to road access. Transects were 2 km (1.25 mi) long and the width varied with the width of the riparian vegetation. The sampling procedure involved a weekly walk through the middle of the transect recording the number and type of species seen (with binoculars) and heard. Temperature (Centigrade), sky conditions, and wind velocity were noted at the start and finish of each transect.

The location of the transects were along Thomes Creek and Salt Creek. Mid-transect UTM coordinates along with a brief description of locations are:

#1 - Thomes Creek (41635422) - On the south side of the creek.

#2 - Thomes Creek (41895498 - From the Corning road near Flournoy, east, on the south side of the creek.

#3 - Thomes Creek (42315583) - Starts near Simpson Road and runs west on the south side of the creek.

#4 - Thomes Creek (42545643) - From the Rawson Road bridge west on the south side of the creek.

#5 - Thomes Creek (42525694) - Starts near Road 99@ and runs west on the north side of the creek.

#1 - Salt Creek (40475343) - Starts near the gorge on USFS land and runs generally east.

#2 - Salt Creek (40445339) - Starts at the confluence of the north and south forks of Salt Creek and runs south to the edge of a ridge west of the creek.

Results and Discussion

All data were transferred to the occurrence and distribution computer data base but were not analyzed.

G. Variable Circular Plot Bird Census

This relatively new bird census method is probably one of the best tools biologists have to determine bird densities in various habitat types. From a central point, the observer counts all birds seen or heard and estimates the horizontal distance from the point to the bird. Density and species composition can then be calculated.

Study Area and Method

Twenty-eight variable circular plots (VCPs) were established in or adjacent to the proposed reservoir site in four habitat types: grassland (GR), oak-digger pine-chaparral (OC), oak-woodland (OW), and chamise chaparral (CC). The UTM coordinates are listed in Table 5-2.

TABLE 5-2

VARIABLE CIRCULAR PLOT UTM COORDINATES

Habitat	Plot #	UTM Coordinate
GR	1	40955349
GR	2	40995349
GR	3	41035349
GR	4	41035352
GR	5	41035355
GR	6	40425354
GR	7	40395356
GR	8	40375358
GR	9	40345361
GR	10	40325367
OW	1	41095339
OW	2	41065339
OW	3	41035339
OW	4	41005339
OW	5	40975339
OW	6	40415359
OW	7	40435357
OW	8	40455356
OW	9	40475358
OW	10	40485360
OC	1	40515346
OC	2	40545345
OC	3	40525342
OC	4	40985338
OC	5	40955338
CC	1	40515342
CC	2	40495342
CC	3	40495346

In the grassland and oak-woodland plot, centers were located 360 metres (1,188 ft) apart. Due to the relatively small amount of habitat, the centers were 200 metres (660 ft) apart in the chaparral areas.

Results and Discussion

One hundred forty-five species of birds were identified in the four habitat types. Grassland had, by far, the greatest number of birds present, with oak-woodland second, followed by oak-digger pine-chaparral, and finally chamise-chaparral. However, plots #6 through #10 (for grassland and oak-woodland) were only censused twice because of access problems. Oak-woodland had a slightly higher species diversity (53) than did grassland (50). The oak-digger pine-chaparral had a somewhat lower species diversity (42), while chamise-chaparral had a very low diversity of only 17 species. These figures reflect the amount of habitat available and the poor condition of the chaparral communities.

A computer program has been designed to analyze data for further evaluation. Thus far, all data for VCPs have been keypunched and are stored in a computer file for later use.

CHAPTER 5

APPENDIX TABLE 1

PRELIMINARY LIST OF BIRDS WITH SPECIES CODES

Order Podicipediformes

Family Podicipedidae

DB WEGR (*Aechmophorus occidentalis* - Western Grebe)

DB EAGR (*Podiceps caspicus* - Eared Grebe)

DB PBGR *Podilymbus podiceps* - Pied-Billed Grebe

Order Pelecaniformes

Family Phalacrocoracidae

DC 442 *Phalacrocorax auritus* - Double-Crested Cormorant

Order Anseriformes

Family Anatidae

DD WHSE (*Olor columbianus* - Whistling Swan)

DD CAGO *Branta canadensis* - Canada Goose

DD WFGO (*Anser albifrons* - White-Fronted Goose)

DD SNGO (*Chen caeruluscens* - Snow Goose)

DD ROGO (*Chen rossii* - Ross' Goose)

DD MALL *Anas platyrhynchos* - Mallard

DD PINT (*Anas acuta* - Pintail)

DD GADW (*Anas strepera* - Gadwall)

DD AMWI *Anas americana* - American Wigeon

DD NOSH (*Anas clypeata* - Northern Shoveler)

DD BWTE (*Anas discors* - Blue-Winged Teal)

DD CITE + *Anas cyanoptera* - Cinnamon Teal

DD GWTE (*Anas crecca carolinensis* - Green-Winged Teal)

DD D40 (*Aix sponsa* - Wood Duck)

DD REDH (*Aythya americana* - Redhead)

DD CANV (*Aythya valisineria* - Canvasback)

DD RNDU *Aythya collaris* - Ring-Necked Duck

DD LESC *Aythya affinis* - Lesser Scaup

DD COGO (*Bucephala clangula* - Common Goldeneye)

DD BUFF *Bucephala albeola* - Bufflehead

DD RUDU *Oxyura jamaicensis* - Ruddy Duck

DD MEME *Mergus merganser* - Common Merganser

Order Falconiformes

Family Cathartidae

DE TUVU + Cathartes aura - Turkey Vulture

Family Accipitridae

DF E78 + Elanus leucurus -Black-Shouldered Kite
DF 361 Accipiter cooperii - Cooper's Hawk
DF 362 Accipiter striatus - Sharp-Shinned Hawk
DF 388 + Circus cyaneus - Marsh Hawk
DF RLHA Buteo lagopus - Rough-Legged Hawk
DF C08 (Buteo regalis - Ferruginous Hawk)
DF RTHA * Buteo jamaicensis - Red-Tailed Hawk
DF RSHA * Buteo lineatus - Red-Shouldered Hawk
DF 377 + Buteo swainsoni - Swainson's Hawk
DF 370 * Aquila chrysaetos - Golden Eagle
DF 416 Haliaeetus leucocephalus - Bald Eagle

Family Pandionidae

DF 435 Pandion haliaetus - Osprey

Family Falconidae

DG 952 * Falco mexicanus - Prairie Falcon
DG 408 (Falco peregrinus - Peregrine Falcon)
DG MERL Falco columbarius - Merlin
DG AMKE * Falco sparverius - American Kestrel

Order Galliformes

Family Phasianidae

DH CAQU + Lophortyx californicus - California Quail
DH RNPH + Phasianus colchicus - Ring-Necked Pheasant

Order Ciconiiformes

Family Ardeidae

DJ 380 Casmerodius albus - Great Egret
DJ SNEG (Egretta thula - Snowy Egret)
DJ CAEG (Bubulcus ibis - Cattle Egret)
DJ 371 * Ardea herodias - Great Blue Heron
DJ GRHE + Butorides virescens - Green Heron
DJ BCNH Nycticorax nycticorax - Black-Crowned Night Heron
DJ AMBI (Botaurus lentiginosus - American Bittern)

Order Gruiformes

Family Rallidae

DM VIRA (Rallus limicola - Virginia Rail)

DM COGA (Gallinula chloropus - Common Gallinule)

DM AMCO Fulica americana - American Coot

Order Charadriiformes

Family Charadriidae

DP MOPL (Charadris montana - Mountain Plover)

DP AGPL (Pluvialis dominica - American Golden Plover)

DP BBPL (Pluvialis squatarola - Black-Bellied Plover)

DP SEPL (Charadrius semipalmatus - Semipalmated Plover)

DP KILL Charadrius vociferus - Killdeer

Family Recurvirostridae

DN AMAV (Recurvirostra americana - American Avocet)

DN BNST (Himantopus mexicanus - Black-Necked Stilt)

Family Scolopacidae

DQ 622 (Numenius americanus - Long-Billed Curlew)

DQ WHIM (Numenius phaeopus - Whimbrel)

DQ MAGO (Limosa fedoa - Marbled Godwit)

DQ SOSA (Tringa solitaria - Solitary Sandpiper)

DQ SPSA + Actitis macularia - Spotted Sandpiper

DQ WILL (Catoptrophorus semipalmatus - Willet)

DQ GRYE Tringa melanoleucus - Greater Yellowlegs

DQ LEYE (Tringa flavipes - Lesser Yellowlegs)

DQ SBDO (Limnodromus griseus - Short-Billed Dowitcher)

DQ LBDO (Limnodromus scolopaceus - Long-Billed Dowitcher)

DQ PESA (Calidris melanotos - Pectoral Sandpiper)

DQ DUNL (Calidris alpina - Dunlin)

DQ BASA (Calidris bairdii - Baird's Sandpiper)

DQ LESA (Calidris minutilla - Least Sandpiper)

DQ WESA (Calidris mauri - Western Sandpiper)

DQ COSN Capella gallinago - Common Snipe

Family Phalaropodidae

DR WIPH (Steganopus tricolor - Wilson's Phalarope)

DR NOPH (Lobipes lobatus - Northern Phalarope)

Family Laridae

DS HEGU (Larus argentatus - Herring Gull)

DS THGU (Larus thayeri - Thayer's Gull)

DS E88 (Larus californicus - California Gull)

DS RBGU (Larus delawarensis - Ring-Billed Gull)

DS MEGU (Larus canus - Mew Gull)

DS BOGU (Larus philadelphia - Bonaparte's Gull)

DS FOTE (Sterna forsteri - Forster's Term)

DS BLTE (Chlidonias niger - Black Tern)

Order Columbiformes

Family Columbidae

D3 BTPI Columba fasciata - Band-Tailed Pigeon

D3 RODO + Columba livia - Rock Dove

D3 MODO * Zenaida macroura - Mourning Dove

Order Cuculiformes

Family Cuculidae

DU ROAD + Geococcyx californianus - Roadrunner

Order Strigiformes

Family Tytonidae

DV BAOW + Tyto alba - Barn Owl

Family Strigidae

OV 675 + Otus asio - Screech Owl

DV GHOW * Bubo virginianus - Great Horned Owl

DV 676 * Asio otus - Long-Eared Owl

DV 677 (Asio flammeus - Short-Eared Owl)

DV K96 * Speotyto cunicularia - Burrowing Owl

DV SWOW (Aegolius acadicus - Saw-Whet Owl)

DV PYOW (Glaucidium gnoma - Pygmy Owl)

Order Caprimulgiformes

Family Caprimulgridae

DW DOWI Phalaenoptilus nuttallii - Poor-Will

DW LENI Chordeiles acutipennis - Lesser Nighthawk

Order Apodiformes

Family Apodidae

DX VASW *Chaetura vauxi* - Vaux's Swift

DX WTSW *Aeronautes saxatalis* - White-Throated Swift

Family Trochilidae

DX CAHU (*Stellula calliope* - Calliope Hummingbird)

DX ANHU + *Calypte anna* - Anna's Hummingbird

DX BCHU (*Archilochus alexandri* - Black-Chinned Hummingbird)

DX COHU (*Calypte costae* - Costa's Hummingbird)

DX RUHU *Selasphorus rufus* - Rufous Hummingbird

DX ALHU (*Selasphorus sasin* - Allen's Hummingbird)

Order Coraciiformes

Family Alcedinidae

DY BEKI *Megaceryle alcyon* - Belted Kingfisher

Order Piciformes

Family Picidae

DY YSFL (*Colaptes auratus auratus* - "Yellow-Shafted" Flicker)

DY RSFL *Colaptes auratus cafer* - "Red-Shafted" Flicker

DY NUWO * *Picoides nuttallii* - Nuttall's Woodpecker

DY ACWO * *Melanerpes formicivorus* - Acorn Woodpecker

DY LEWO *Melanerpes lewis* - Lewis' Woodpecker

DY RBSA *Sphyrapicus varius daggetti* - "Red-Breasted" Sapsucker

DY HAWO *Picoides villosus* - Hairy Woodpecker

DY DOWO * *Picoides pubescens* - Downy Woodpecker

Order Passeriformes

Family Tyrannidae

EA WEKI * *Tyrannus verticalis* - Western Kingbird

EA CAKI (*Tyrannus vociferans* - Cassin's Kingbird)

EA ATFL * *Myiarchus cinerascens* - Ash-Throated Flycatcher

EA BLPH * *Sayornis nigricans* - Black Phoebe

EA SAPH + *Sayornis saya* - Say's Phoebe

EA 405 *Empidonax traillii* - Willow Flycatcher

EA HAFL *Empidonax hammondii* - Hammond's Flycatcher

EA DUFL *Empidonax oberholseri* - Dusky Flycatcher

Family Tyrannidae (continued)

EA GRFL (Empidonax wrightii - Gray Flycatcher)

EA WEFL * Empidonax difficilis - Western Flycatcher

EA WWPE + Contopus sordidulus - Western Woodpewee

EA OSFL *(Nuttallornis borealis - Olive-Sided Flycatcher)

Family Alaudidae

ER HOLA * Eremophila alpestris - Horned Lark

Family Hirundinidae

EB BASW + Hirundo rustica - Barn Swallow

EB CLSW * Petrochelidon pyrrhonota - Cliff Swallow

EB VGSW * Tachycineta thalassina - Violet-Green Swallow

EB TRSW * Iridoprocne bicolor - Tree Swallow

EB 901 * Riparia riparia - Bank Swallow

EB RWSW * Stelgidopteryx ruficollis - Rough-Winged Swallow

EB 447 (Progne subis - Purple Martin)

Family Corvidae

EC STJA (Cyanocitta stelleri - Steller's Jay)

EC SCJA * Aphelocoma coerulescens - Scrub Jay

EC YBMA * Pica nuttalli - Yellow-Billed Magpie

EC CORA + Corvus corax - Common Raven

EC COCR + Corvus brachyrhynchos - Common Crow

Family Paridae

ED CBCH (Parus rufescens - Chestnut-Backed Chickadee)

ED PLTI * Parus inornatus - Plain Titmouse

ED BUSH * Psaltriparus minimus - Bushtit

Family Chamaeidae

EF WREN + Chamaea fasciata - Wrentit

Family Cinclidae

EF DIPP Cinclus mexicanus - Dipper

Family Sittidae

EE WBNU * Sitta carolinensis - White-Breasted Nuthatch

EE RBNU (Sitta canadensis - Red-Breasted Nuthatch)

Family Certhiidae

EF BRCR Certhia familiaris - Brown Creeper

Family Troglodytidae

EG HOWR + Troglodytes aedon - House Wren

EG WIWR (Troglodytes troglodytes - Winter Wren)

EG BEWR * Thryomanes bewickii - Bewick's Wren

EG ROWR * Salpinctes obsoletus - Rock Wren

EG CAWR * Catherpes mexicanus - Canyon Wren

EG LBMW (Telmatodytes palustris - Long-Billed Marsh Wren)

Family Mimidae

EQ MOCK + Mimus polyglottos - Mockingbird

EQ SATH (Oreoscoptes montanus - Sage Thrasher)

EQ CATH + Toxostoma redirirum - California Thrasher

Family Turdidae

EH AMRO + Turdus migratorius - American Robin

EH VATH Ixoreus naevius - Varied Thrush

EH TOSO Myadestes townsendi - Townsend's Solitaire

EH HETH Catharus guttata - Hermit Thrush

EH SWTH Catharus ustulata - Swainson's Thrush

EH WEBL * Sialia mexicana - Western Bluebird

EH MOBL Sialia currucoides - Mountain Bluebird

Family Sylviidae

EJ BGGN * Polioptila caerulea - Blue-Gray Gnatcatcher

EJ GCKI Regulus satrapa - Golden-Crowned Kinglet

EJ RCKI Regulus calendula - Ruby-Crowned Kinglet

Family Motacillidae

ES WAPI Anthus spinoletta - Water Pipit

Family Bombycillidae

ES CEWA Bombycilla cedrorum - Cedar Waxwing

Family Ptilogonatidae

PHAI (Phainopepla nitens - Phainopepla)

Family Laniidae

EK LOSH + Lanius ludovicianus - Loggerhead Shrike

EK NOSH (Lanius excubitor - Northern Shrike)

C-099773

Family Sturnidae

STAR * Sturnus vulgaris - Starling

Family Vireonidae

EL SOVI Vireo solitarius - Solitary Vireo

EL HUVI + Vireo huttoni - Hutton's Vireo

EL WAVI Vireo gilvus - Warbling Vireo

Family Parulidae

EM OCWA Vermivora celata - Orange-Crowned Warbler

EM NAWA Vermivora ruficapilla - Nashville Warbler

EM 397 + Dendroica petechia - Yellow Warbler

EM YRWA Dendroica coronata coronata - Yellow-Rumped Warbler

EM TOWA Dendroica townsendi - Townsend's Warbler

EM HEWA Dendroica occidentalis - Hermit Warbler

EM BTGW Dendroica nigrescens - Black-Throated Gray Warbler

EM COYE * Geothlypis trichas - Common Yellowthroat

EM E99 + Icteria virens - Yellow-Breasted Chat

EM MAWA Oporornis tolmiei - MacGillivray's Warbler

EM WIWA Wilsonia pusilla - Wilson's Warbler

Family Ploceidae

HOSP + Passer domesticus - House Sparrow

Family Icteridae

EN WEME * Sturnella neglecta - Western Meadowlark

EN YHBL Xanthocephalus xanthocephalus - Yellow-Headed Blackbird

EN RWBL * Agelaius phoeniceus - Red-Winged Blackbird

EN 022 * Agelaius tricolor - Tricolored Blackbird

EN BRBL * Euphagus cyanocephalus - Brewer's Blackbird

EN BHCO + Molothrus ater - Brown-Headed Cowbird

EN BUOR * Icterus galbula bullockii - Northern Oriole

Family Thraupidae

ET WETA Piranga ludoviciana - Western Tanager

Family Fringillidae

EP BHGR + Pheucticus melanocephalus - Black-Headed Grosbeak
EP EVGR Hesperiphona vespertina - Evening Grosbeak
EP INBU (Passerina cyanea - Indigo Bunting)
EP LABU + Passerina amoena - Lazuli Bunting
EP PUFI Carpodacus purpureus - Purple Finch
EP HOFI + Carpodacus mexicanus - House Finch
EP PISI Spinus pinus - Pine Siskin
EP AMGO + Spinus tristis - American Goldfinch
EP LEGO Spinus psaltria - Lesser Goldfinch
EP RSTO Pipilo erythrophthalmus - Rufous-Sided Towhee
EP BRTO + Pipilo fuscus - Brown Towhee
EP SASP Passerculus sandwichensis - Savannah Sparrow
EP GRSP (Ammodramus savannarum - Grasshopper Sparrow)
EP VESP (Pooecetes gramineus - Vesper Sparrow)
EP LASP * Chondestes grammacus - Lark Sparrow
EP SASP Amphispiza belli - Sage Sparrow
EP DAEY Junco hyemalis - "Dark-Eyed" Junco
EP RCSP Aimophila ruficeps - Rufous-Crowned Sparrow
EP CHSP Spizella passerina - Chipping Sparrow
EP BCSP (Spizella atrogularis - Black-Chinned Sparrow)
EP WCSP Zonotrichia leucophrys - White-Crowned Sparrow
EP GCSP Zonotrichia atricapilla - Golden-Crowned Sparrow
EP WTSP (Zonotrichia albicollis - White-Throated Sparrow)
EP FOSP Passerella iliaca - Fox Sparrow
EP LISP Melospiza lincolnii - Lincoln's Sparrow
EP SOSP Melospiza melodia - Song Sparrow
EP CCLO (Calcarius ornatus - Chestnut-Collared Longspur)
EP LALO (Calcarius lapponicus - Lapland Longspur)

* Confirmed breeder (45 species)

\+ Probably breeder; seen in appropriate habitat regularly during the breeding season (35 species)

( ) Species not yet documented but of possible occurrence (118 species known)

___ Double underlined, sensitive or species of special concern

---

Robbins, C. S., et al. 1966. Birds of North America. Golden Press, New York. 339 p.

CHAPTER 5

APPENDIX TABLE 2

PRELIMINARY LIST OF MAMMALS WITH SPECIES CODES

Order Marsupiala

Family Didelphidae

(*Didelphis virginiana* - Virginia Opossum)

Order Insectivora

Family Soricidae

FAORSH (*Sorex ornatus* - Ornate Shrew)

FATRSH *Sorex trowbridgii* - Trowbridge's Shrew

Family Talpidae

FBSHMO (*Neurotrichus gibbsii* - Shrew-Mole)

FBBFMO (*Scapanus latimanus* - Broad-Footed Mole)

Order Chiroptera

Family Vespertilionidae

FDLBMY (*Myotis lucifugus* - Little Brown Myotis)

FDYUMY (*Myotis yumanensis* - Yuma Myotis)

FDLEMY (*Myotis evotis* - Long-Eared Myotis)

FDFRMY (*Myotis thysanodes* - Fringed Myotis)

FDLLMY (*Myotis volans* - Long-Legged Myotis)

FDCAMY (*Myotis californicus* - California Myotis)

FDSHBA (*Lasionycteris noctivagans* - Silver-Haired Bat)

FDWEPI (*Pipstrellus hesperus* - Western Pipistrelle)

FDBBBA (*Eptesicus fuscus* - Big Brown Bat)

FDREBA (*Lasiurus borealis* - Red Bat)

FDHOBA (*Lasiurus cinereus* - Hoary Bat)

FDTBBA (*Plecotus townsendii* - Townsend's Big-Eared Bat)

FDPABA (*Antrozous pallidus* - Pallid Bat)

Family Molossidae

FEBFBA (*Tadarida brasiliensis* - Brazilian Free-Tailed Bat)

Order Lagomorpha

Family Leporidae

FFBRRA (Sylvilagus bachmani - Brush Rabbit)

FFDECO Sylvilagus audubonii - Desert Cottontail

FFBJRA Lepus californicus - Black-Tailed Hare

Order Rodentia

Family Sciuridae

FGCGSQ Spermophilus beecheyi - California Ground Squirrel

FGWGSQ (Sciurus griseus - Western Gray Squirrel)

FGSOCH (Eutamias sonomae - Sonoma Chipmunk)

Family Geomyidae

FHBPGO (Thomomys bottae - Botta Pocket Gopher)

Family Heteromyidae

FJHKRA Dipodomys heermanni Tularensis - Heermann's Kangaroo Rat

Family Castoridae

FKBEAV (Castor canadensis - Beaver)

Family Cricetidae

FLWHMO Reithrodontomys megalotis - Western Harvest Mouse

FLCAMO (Peromyscus californicus - California Mouse)

FLDEMO Peromyscus maniculatus - Deer Mouse

FLBRMO (Peromyscus boylii - Brush Mouse)

FLPIMO (Peromyscus truei - Pinyon Mouse)

FLDFWO Neotoma fuscipes - Dusky-Footed Woodrat

FLCAVO (Microtus californicus - California Vole)

FLMUSK (Ondatra zibethicus - Muskrat)

Family Muridae

(Rattus rattus - Black Rat)

(Rattus norvegicus - Norway Rat)

(Mus musculus - House Mouse)

Order Carnivora

Family Canidae

FPCOYO (Canis latrans - Coyote)

FPREFO Vulpes vulpes - Red Fox

FPGRFO Urocyon cinereoargenteus - Gray Fox

Family Procyonidae

FRRING *Bassariscus astutus* - Ringtail

FRRACC *Procyon lotor* - Raccoon

Family Mustelidae

FSLTWE (*Mustela frenata* - Long-Tailed Weasel)

FSMINK (*Mustela vison* - Mink)

FSBADG (*Taxidea taxus* - Badger)

FSWSSK (*Spilogale gracilis* - Western Spotted Skunk)

FSSTSK *Mephitis mephitis* - Striped Skunk

FSRIOT (*Lutra canadensis* - River Otter)

Family Felidae

FTMOLI *Felis concolor* - Mountain Lion

FTBOBC *Felis rufus* - Bobcat

FTFHCA *Felis domesticus* - Feral House Cat

Order Artiodactyla

Family Suidae

Sus scrofa - Wild Pig

Family Cervidae

FVBTDE *Odocoileus hemionus columbianus* - Black-Tailed Deer

( ) Species not yet documented but of possible occurrence

References

Burt, William Henry, and Richard Philip Grossenheider. 1976. A field guide to the mammals; field marks of all North American species found north of Mexico. 3rd edition. Houghton-Mifflin Co., Boston. 289 pp.

Hall, E. Raymond, and Keith R. Kelson. 1959. The mammals of North America. V. 1-2. The Ronald Press Co., New York. 1083 pp.

Ingles, Lloyd G. 1965. Mammals of the Pacific states. Stanford University Press, Stanford, California. 506 pp.

Jones, J. Knox, Jr., Dilford C. Carter, and Hugh H. Genoways. 1975. Revised checklist of North American mammals north of Mexico. Occasional Papers of the Museum, Texas Tech. University, No. 28. 14 pp.

CHAPTER 6. DEER

Introduction

Reconnaissance-level wildlife investigations of the proposed Glenn Reservoir site during 1978-79 revealed significant concentrations of wintering deer utilizing the north and northwestern portions of the project area. Results of these investigations were summarized in a report entitled "Fish and Wildlife Considerations in State Water Project Planning", dated October 1979. Included was a recommendation for intensive investigation of the Thomes Creek herd as part of feasibility studies for any future project.

These intensive investigations began with a radio telemetry surveillance of deer movement and activity throughout their range as the major element for study of this herd. The purpose of the surveillance was to provide information basic for developing recommendations on mitigation and to recommend design modifications to reduce project impacts on deer. In addition to information for planning, this investigation would also be used for management of the Thomes Creek deer herd, thereby contributing to achieving objectives of the California Deer Plan.

Other study elements undertaken to provide information on the deer herd were:

1. Population census.
2. Mapping vegetation types throughout the herd range.
3. Investigations of fawn survival and habitat utilization.
4. Determine health and reproductive status of the herd.
5. Observe behavior on the winter range in relation to habitat type.

Description of Study Area

The study area covers approximately 518 km^2 (200 mi^2) in the southwestern corner of Tehama County. The deer in this area have traditionally been identified and managed as the Lake Hollow herd but are now referred to as the Thomes Creek herd. They spend summers on Mendocino National Forest and private timber company lands from Anthony Peak to the Yolla Bolly Wilderness Area, and they spend winters on private land and Bureau of Land Management (BLM) lands in the foothills of lower Thomes Creek in (or near) the proposed Thomes-Newville Unit.

The range of this herd consists primarily of the east slope of the inner coast range of western Tehama County. Elevations range from about 240 metres (800 ft) to slightly over 2 400 metres (8,000 ft) (at Soloman Peak in the south Yolla Bollys). Topography of the area is generally steep, especially in the canyons of major streams such as Thomes Creek.

Summer range for the migratory Thomes Creek herd is characterized by steep-sloped ridges, peaks and canyons densely covered by brush at lower reaches and pine and fir at higher elevations. Many open glade areas occur on south facing slopes of the major drainages, and these are characterized by heavy soils which support extensive grass and herbaceous ground cover. These glades are most extensive in upper Thomes Creek and are heavily utilized by deer. The higher mountains have thick timber with relatively few open meadows.

Winter range is typically the lower chaparral belt and oak-woodland-grass type of vegetation. Chaparral areas are generally steep and highly erodible, while the oak-woodland-grass type consists of rolling foothills and some flatland along stream courses. Although the canyons of major drainages have steep slopes, stream gradients are low. Glade areas along upper Thomes Creek are utilized, in some cases as both summer and winter range.

The vegetative communities of this deer range (Figure 6) consist of three broad types : oak woodland-annual grass; chaparral (chamise and other brush species); and pine-Douglas fir (mixed conifer).

Blue oak (Quercus douglasii) and Garry oak (Q. garryana) are the primary hardwood species of the oak woodland-grass type, with annual grasses of the tribes Bromus and Festuca and forbs as understory. Forb composition is primarily filaree (Erodium spp), lotus (Lotus spp), and bur clover (Medicago hispida). Numerous other native and introduced plants also occur.

The chaparral community consists primarily of chamise (Adenostoma fasciculatum), interspersed with buck brush (Ceanothus cuneatus), birchleaf mahongany (Cercocarpus betuloides), scrub oaks (Quercus spp.), manzanita (Arctostaphylos spp.), and silktassel (Garrya fremontii). Interior live oak (Q. wislizenii), occasional stands of black oak (Q. kellogii) and scrub type Garry oak also occur and provide important mast (acorns) for deer.

The pine-Douglas fir association includes: ponderosa pine (Pinus ponderosa), sugar pine (Pinus lambertiana), incense cedar (Callocedrus decurrens), Douglas-fir (Pseudotsuga menziesii taxifolis), and the true firs (Abies spp.). Conifer areas influenced by logging and wildfire sometimes contain dense brush fields which predominated by manzanita, mountain whitethorn (Ceanothus cordulatus), deer brush (Ceanothus integerrimus), snow brush (Ceanothus velutinus), gooseberry (Ribes spp.) and other species. Perennial grasses replace annuals to a large extent within the timber vegetation type.

Soils in the mountain and foothill ranges are composed of four primary associations. Maymen-Los Gatos-Parrish; Heneke-Stonyford; Dubakella-Neuns; and Sheetiron-Josephine. In the lower foothills and valley areas, there are two primary soil associations, Newville-Dibble; and Millsholm-Lodo.

The Maymen-Los Gatos-Parrish association occurs along the eastern slope of the Coast Range between 300 m (1,000 ft) and 1 200 m (4,000 ft) elevation. The soils are shallow to moderately deep, steep to very steep, and rocky, generally underlain by hard sandstone and shale. Maymen soils are gravelly loam less than 508 mm (20 in) deep, Los Gatos soils are ligh clay loams as much as 762 mm (30 in) deep, and Parrish soils are as much as 1 016 mm (40 in) deep. Hull soils, a minor series within the above association, are the soils of the glade areas, generally less than 762 mm (30 in) deep, supporting grasses and forbs in moderate quantity and good quality. The Maymen-Los Gatos-Parrish association comprises the bulk of intermediate range and a portion of the winter range.

The Henneke-Stonyford association occupies a narrow strip along the eastern edge of the coast range and comprises the bulk of the winter range of the Thomes Creek deer herd. The soils are shallow to moderately shallow, steep to very steep and rocky, underlain by serpentine and greenstone (altered basalt and andesite), and formed from serpentine. Soils of serpentine orgina generally produce vegetation of poor nutritive value and are not utilized extensively by deer and other wildlife.

The climate of deer winter range areas is characteristic of the upper Sacramento Valley region of California. The winters are mild and the summers hot and dry. Freezing temperatures sometimes occur from October through March. The rainy season generally extends from October through April. Comparatively gentle rains fall during October and November, increasing in intensity during the winter and tapering off during the spring months. Snow occurs occasionally below 900 m (3,000 ft), but usually melts rapidly and is seldom a problem to deer on the winter range. Seasonal precipitation, both in quantity and distribution, is the primary factor influencing forage production on the winter range.

Temperatures during the winter range from below 0 C (32 F) at night to approximately 13 C (55 F) during the day. Summer temperatures often exceed 37.8 C (100 F) from mid-June through mid-September.

Precipitation in the form of both rain and snow is much greater on the summer range. Snowfall is heavy (in excess of 2 540 mm (100 in) at the higher elevations. Rainfall recorded at Paskenta averages about 635 mm (25 in) annually.

Distribution of water is good throughout the range of the deer herd. Many smaller tributaries of Thomes Creek are live throughout the year, especially at higher elevations. Numerous other drainages at lower elevations are intermittent and flow only through the rainy season. In addition, there are a large number of springs and seeps throughout the deer herd range.

METHODS

Techniques Used for Study of Adult Does

Capture Technique: Initial trapping was conducted on the winter range beginning December 1979 and continuing each winter until enough adult does were captured and fitted with radio collars to replace the previous year's adults lost to mortality. Radio frequencies used were coordinated with the Wildlife Management telemetry coordinator. Sixteen traps were constructed for use in the study. Panel traps were used at the recommendation of Region 1 Wildlife Management personnel. Traps were baited with almond hulls and mistletoe and there was some experimentation with other baits. Alternative capture methods included use of tranquillizing drugs, drop nets, drive nets and snares. The latter methods were implemented when bait trapping was no longer effective.

Marking Technique: Only adult does and young fawns were fitted with radio collars. Most deer were tagged in both ears with numbered

metal ear tags. Plastic ear streamers were attached to the ear tag of each doe. Various colored streamers were used to identify trapping location. Blood samples were taken in cooperation with the DFG Pathology Section (Table 6-1).

Table 6-1. Handling of Deer Blood

Label each tube with deer age, sex, location, date, and ear tag number. Keep red and green top tubes at room temperature for two hours, then refrigerate if they cannot be processed within 24 hours. Refrigerate lavender top tube as soon as possible.

To process:

1. Centrifuge red and green top tubes (10-12 minutes; slowly work up to fast speed).
2. Discard clear fluid above cells in green tube, add saline of Penn/Strep.
3. Refrigerate all three tubes (red top can be frozen but not green or lavender tops).

Send samples by Greyhound collect to:

Dr. Jessup
Wildlife Investigations Laboratory, Suite D
1701 Nimbus Road
Rancho Cordova, CA 95670

Biological Sample - Notify Dr. Jessup upon arrival at 355-0124.

Surveillance of Radio-collared Deer

Collared deer were monitored during the three-year study period throughout their range. An attempt was made to record an average of one location per collared animal per week during nonmigration periods and one location per day during migration. Data were obtained by visual observations and radio locations. Both ground and airplane monitoring were conducted. Two

C-099785

methods of ground tracking deer were employed. The first method included a simple hand-held antennae, which was very mobile and generally used to "guide" observers to a deer's location. Once a deer was located, data were recorded on date, deer identification, UTM coordinates, sighting confidence (Table 6-2, and weather.

Table 6-2. Computer Numbering Codes for Confidence Levels of Tracking Accuracy

Code No.	Method
OA	Aircraft
	Hand-held Yagi
01.	Actual sighting
02.	Not seen but location known
03.	Not seen but location in small area known
04.	Not seen but location in general area known
05.	Not seen and general location not established
	Tracking Stations
06.	Between 9-29-80 and 10-15-80 at 1700 hours
07.	Between 10-15-80 (after 1700 hours) and 4-30-81
08.	After 4-30-81 on winter range
09.	After 4-30-81 on summer range

The second ground tracking method included two semipermanent tracking stations located at specific locations (Table 6-3). These tracking locations were selected to maximize the number and accuracy of deer to be monitored. To achieve a higher degree of accuracy, several types of antenna systems were developed and tested. Data collected from each tracking station included: deer identification, station location, starting angle to a beacon transmitter, either four or seven compass directions, start and finishing times, and null rating (clarity of signal, Appendix IX).

Table 6-3. Computer Numbering Code for Tracking Station Coordinates

Code No.	Station Name	Date	Latitude	Longitude
01.	Crowfoot Point	Before 10-14-80 at 1900	N4414050	E531900
02.	Crowfoot Top	After 10-14-80 at 1900	N4414540	E532050
03.	Ball Mountain		N4420020	E518450
04.	South Ridge		N4418500	E517000
05.	Buck Rock I		N4417710	E505550
06.	Buck Rock II		N4416500	E504550
07.	Buck Rock III		N4418170	E506760
08.	Mud Flat I	Before 10-14-80 at 1800	N4407510	E529730
09.	Mud Flat II	After 10-14-80 at 1800	N4408325	E528620
10.	Alltop (Beacom)		N4414525	E524830

Because of the obvious mobility, an air monitoring system was used to cover the time of migration when ground tracking became ineffective. This system included two small yagi antennas strapped to each strut of a fixed wing aircraft. Signals could be received by either antenna or by both antennas. After a location was identified in the air, it was plotted on a topographic map and later transferred to the same data sheet used for ground tracking.

A computer program was developed to refine data from the tracking stations to deer locations, so that these data, along with hand-held and air-tracking data could be plotted as maps of locations of animals over certain periods of time. These maps could then be overlayed onto vegetation and/or project feature maps for final analyses.

Techniques Used for Study on Fawns of Captured Does

Fawn capture sites were located in upper Thomes Creek drainage in western Tehama County. Fawning habitat is defined as the home range, including drop site, of a fawn during the first two months of life. This occurs typically from the end of June to the end of August. Capture sites of fawns which were chased and then captured were not evaluated. However, for each fawn captured, the following data were recorded: fawn identification, date, time, location, sex, right hind foot measurement, right ear length, minimum and maximum neck circumference, navel condition, general appearance, temperature, amount of pigment on hoofs, weight and comments including an age estimate and behavioral notes. Regression analysis comparing age with each fawn characteristic was calculated to determine if significant relationships existed.

Fawn capture sites were evaluated between August 5 and September 1, 1981. The location of the fawn was used as the center point for a vegetation plot. Circular plots 0.04 ha (0.1 ac) were examined for the species, number, height and dbh (diameter at breast height) of mature trees. The number of seedlings and saplings was recorded according to species. The length, diameter and decay class (Thomas, 1979) of dead and fallen trees was also noted

Using the same center, a second 0.016-ha (0.04-ac) circular plot was evaluated. Within this plot, shrub species were identified and individual stems counted. Percent shrub and slash cover were visually estimated.

Analysis of herbaceous vegetation was made within 1.0 m^2 (39.4-in^2) plots located at the four cardinal directions inside the edge of the 0.04-ha (0.1-ac) plot. Within these plots forb and grass species were identified and the number of stems and percent cover were estimated. Percent cover of litter, bare soil and rock were also estimated.

Additional data collected included: aspect (direction slope faces), slope, soil type, elevation, successional stage (Thomas, 1979) and the distances to the closest road and water. Plant species were listed in order of visual dominance . Aspect was determined by a hand-held compass and a clinometer was used to measure percent slope. Distance from the plot center was recorded for special features such as meadows, tree plantations, slash piles, log landings, burned plots and skid trails.

Using each one of the individual physical components from the plots, each component was examined to determine if an item occurred in a clumped, random or uniform distribution.

Factor analysis as described in the Statistical Package for the Social Sciences (SPSS, 1975) was used to detect significant correlations among different variables (for example, all components measured). Factor analysis "reduces" and "rearranges" the variables in order to determine whether a pattern or relationship exists. Note that only variables occurring in three or more plots were used in the analysis and only variables with significant correlations are reported in the results. Significant correlations are defined as those having either high positive or negative correlations on a scale from -1.000 to 1.000. Means and standard deviations were also computed for each variable (Appendices I and II).

Population Census Technique

A population estimating technique was employed on the winter range because migratory deer are highly concentrated at this time. This method involved selecting 2,000 standard mil/acre plots systematically throughout this region. From a known starting point, line transects containing 50 mil/acre plots were selected 90 m (300 ft) from and in a perpendicular line from the reach at 0.8 km (0.5 mi) intervals. Every accessible road throughout

the winter range was used. Each month all the plots were counted, recorded and cleared. Using standard statistical procedures. These data were evaluated to determine the deer population in the area.

Health and Reproduction Technique

Several facets of herd conditions can be understood by a combination of information from buck harvests, herd composition, mortality, and doe collections. Previous records of buck harvests and herd composition were obtained from Tom Ramsey (Department of Fish and Game). Mortality information was collected from fresh carcasses found during other field activities. Also, does were collected with the assistance of Bud Pyshora and Tom Ramsey, California Department of Fish and Game, Region I. Necropsies and accompanying analyses were performed by Fish and Game personnel. The deer were then given to local charitable organizations.

In late April, 22 does were collected on the intermediate range just as they had left the winter range.

The following data were taken from these does and necropsy methodology published by Salwasser and Jessup (1978) was followed (Table 6-4).

Analysis of Biological Samples

The following samples required further laboratory analysis:

1. Blood samples were sent to the California Department of Fish and Game Wildlife Investigations Lab for antibody titer analysis and plant species identification were obtained from rumen contents.
2. The following samples were analyzed by the Contract Services Section in Red Bluff.
    a. Ovaries were examined macroscopically for evidence of corpora luteum.
    b. Femur marrow fat content was determined by the oven-dried technique.

Table 6-4. Necropsy Methodology

Date:

Location:

Vegetation Type:

Sex:

Age and Size Classes:

Bled carcass weight (BCW)

Eviscerated carcass weight (ECW)

Hindfoot length

Contour length

Lower jaws and eyes to be used for aging

Herd Condition

Fat content on:

a. rump
b. mesentery
c. kidneys
d. heart
e. ribs
f. brisket
g. femus

Weight of adrenal glands

Collection and identification of external and internal parasites.

Antibody titers should be determined from blood samples taken.

Dietary Information

Rumen contents were collected for diet analysis.

Reproductive Condition

Ovaries were examined for the number of corpora lutea.

Fetuses were examined for the following:

a. number
b. sex
c. weight
d. crown rump length
e. forehead length
f. hindfoot length
g. body fat index

Behavior

Behavior was only monitored for establishment of activities within habitats which would be destroyed if the project was completed. Activities such as grazing, browsing, and traveling (Table 6-7) were recorded on a deer observation form. Calculations were made later to determine the percent of time each activity occurred in each habitat.

Miscellaneous

Habitat mapping as described in an earlier chapter was completed for the entire summer range. Also, an annotated bibliography was composed from the literature review during this study.

RESULTS AND DISCUSSION

Capture Technique

Seventy-seven deer were captured. Fifty-three animals were radio-collared (35 adult and yearling does and 18 fawns). In addition 17 fawns and 6 yearling bucks were captured and ear-tagged. The remaining seven animals were captured and released without tags or collars (mostly fawns or previously injured deer).

Surveillance of Radio-Collared Deer

As of September 28, 1982, 21,761 deer collar/days (1 collar/day = 1 collar on 1 deer for 1 day) has generated approximately 6,000 telemetry locations. All these data have been key punched at the DWR computer center and are waiting further analysis. Some of the data from the first year of study were hand-plotted and generated the estimates shown in Table 6-6.

Table 6-5

Key for Deer Observation Forms

Time = Military time - every five minutes

Dist. = Estimated distance (in metres) to cover from center of group

Act. = Activity of individual deer in the group (use letter to describe activity and number for the number of deer involved in that particular activity; example: T - 7 would mean 7 deer traveling.
Codes:

T = Traveling	G = Grazing
B = Bedding	Br = Browsing
R = Rutting	S = Standing

Temp. = Fahrenheit (check once every hour)

Sky = Sky conditions
Codes:

0 = Clear or a few clouds
1 = Partly cloudy (scattered) or variable sky
2 = Cloudy (broken) or overcast
4 = Fog or smoke
5 = Drizzle
8 = Showers

Wind = General direction plus code #; example, SE-1
Codes:

0 = Less than 1 mph, smoke rises vertically
1 = 1-3 mph, smoke drift
2 = 4-7 mph, wind felt on face; leaves rustle
3 = 8-12 mph, constant motion of leaves and twigs, extends light flag
4 = 13-18 mph, raises dust and loose paper; small branches moved
5 = 19-24 mph, small trees begin to sway

Group # = number of deer, age, and sex (if known). Use A for adult; F for fawn, F for female; and M for male.
Example: 2 FF, 2 AM (2 fawns - female, 2 adult males)

Hab. = Habitat type
Codes:

OS = Oak savannah	Rip = Riparian
GR = Grassland	OP = Oak-pine
Ch = Chaparral	

Table 6-6. Preliminary Estimates of Deer Home Range and Length and Time of Migration for the Lake Hollow Deer Herd[1/]

Deer I.D. No.	Summer Home Range in Acres	Winter Home Range in Acres	Approximate Length of Migration (airline miles)	Last Obs. on Winter Range 1980	First Obs. on Summer Range 1980
159.301	550 (n=15)	588 (n=4)	15	2/21/80	4/16/80
159.306	870 (n=10	430 (n=8)	19	4/15/80	5/19/80
159.310	371 (n=5)	673 (n=11)	11	4/25/80	4/29/80
159.320	750 (n=9)	486 (n=7)	19	4/8/80	5/19/80
159.326		320 (n-9)	32	4/17/80	6/11/80
159.335	1331 (n=6)	128 (n=6)	17	4/8/80	6/2/80
159.340	1825 (n=12)	691 (n=6)	10	4/2/80	4/9/80
159.346	271 (n=15)				5/15/80
159.348	204 (n=12)	504 (n=15)	13	5/1/80	5/8/80
159.356	256 (n=12)	622 (n=15)	13	5/1/80	5/8/80
159.365	205 (n=11)	154 (n=9)	12	4/18/80	4/29/80
159.371	389 (n=5)	166 (n=5)	19	2/21/80	6/2/80
159.391				4/15/80	6/30/80
159.415	1075 (n=16)	358 (n=15)	18	4/25/80	5/1/80
159.421	1382 (n=15)	1397 (n=12)		5/8/80	
159.425		700 (n=6)	7	4/16/80	4/24/80
159.430	538 (n=8)	660 (n=9)	13	4/18/80	6/11/80
159.441	256 (n=8)	230 (n=7)	12	4/15/80	4/24/80
	$\bar{x}$ = 684.9	$\bar{x}$ = 506.7	$\bar{x}$ = 15.3		
	Range = 204-1825	Range = 128-1397	Range = 7-32		

1/ This data is based on incomplete and inconsistent observations (i.e., random dayling visual and telemetry locations).

C—099794

Deer leave the winter ranges early in April and either hold for a month to six weeks in intermediate elevation glade and chaparral areas associated with most major streams or move directly to high elevation summer range. Their rate of climb to higher elevation seems to be influenced by presence of green feed (grasses and forbs), snow line, and individual behavior. The annual vegetation usually dries from mid-May until early June and then all deer move to higher elevations, usually into the more open timber and meadows/wet glades associated with the crest areas.

Fall migration begins in early October with a rapid shift into the chaparral and oak types of vegetation. The animals remain in this transition range for a month or longer, depending primarily on weather and/or acorn supply. Most deer reach the winter range by late October and breeding starts in early November. Hodson (1956) reported that wintering area for the Thomes Creek herd shifted from chaparral at intermediate elevations to lower annual grass ranges during the years from 1925-1930.

Improvement of habitat in transition ranges may change traditional movements, hence relocate deer use (Thornton, 1979). For example, since the improvements of transition ranges, most deer of the Alder Spring herd in Glenn County either no longer move to lower winter ranges or occupy them only during storms. Also (although more speculative), this evidence indicates that deer could be encouraged to remain at slightly higher elevations during the winter by habitat improvement. This would reduce the importance of the existing winter range in the reservoir site.

It became increasingly more important as the study progressed (to determine more precise mitigation information) to accurately document decreases in different habitat types. To accomplish this, several antenna systems were tested (Table 6-7) and one system was found satisfactory for the winter range ($\pm$ 1.02°).

Table 6-7. Summary of the Most Accurate Tracking Methods Tested

System	Test Location	Usage	Number of Antennae	Antennae Separation Distance in Wave Lengths	Polarization	n	$\bar{x}$	SD	T Value at 95% C.L.	Number of Readings	Error Limit
Tracking station	Winter range	After 10/15/80 winter range	2	2	Vert.	132	.04	1.37	1.98	4	± 1.36°
										7	± 1.02°
Tracking station	Summer range	Before 10/15/80 winter range	2	2	Hor.	225	.25	3.12	1.97	4	± 3.07°
										7	± 2.32°
Tracking station	Summer range	1981 summer range	2	2	Vert.	79	2.85	8.79	1.99	4	± 8.61°
										7	± 6.61°
Tracking station	Summer range	Test only	2	1	Vert.	30	4.47	10.86	2.04	7	± 8.37°
Tracking station	Summer range	Test only	4	3	Vert.	99	.26	4.26	1.98	7	± 3.19°
Tracking station	Summer range	Test only	4	2	Hor.	18	.89	4.17	2.11	7	± 3.32°
Aircraft tracking	Summer & winter range	Summer & winter range	2	-	Hor.	4	0	.49	3.18	1	± 1.56 mi
Hand-held	Summer range	Summer & winter range	1	-	Hor.	179	-2.8	25.4	1.97	1	± 50.04°
										5	± 22.38°
										10	± 15.82°

and one for the summer range (± 2.32°). A table was constructed to help promote a better understanding of tracking accuracy (Table 6-8). An error polygon describes the area in which an animal would have a 95% chance of being if it was the same distance from both tracking stations.

Table 6-8 Tracking Error Polygons

Winter Range

Base of stations is 4.5 miles.

Maximum tracking distance is 5.5 miles.

Average tracking distance is 2.75 miles.

Tracking Error	Maximum Error Polygon	Average Error Polygon
+1.02°(7 readings)	36.8 acres	9.4 acres
+1.36°(4 readings)	64.7 acres	19.7 acres
+3.07°(4 readings)	341.2 acres	92.0 acres

Summer Range

Base of stations is 1.8 miles.

Maximum tracking distance is 2.2 miles.

Average tracking distance is 1.1 miles.

Tracking Error	Maximum Error Polygon	Average Error Polygon
+2.34° (7 readings)	37.8 acres	9.0 acres
+8.61° (4 readings)	513.0 acres	113.4 acres

Finally, we found that the mountain lion (Felis concolor), coyote (Canis latrans), bobcat (L. rufous), and black bear (Ursus americana) are predators of this deer herd. The mountain lion and coyote are the most common predators. Of the mortality associated with this study, 24 percent was related to the lion; 16 percent to the coyote (Table 6-9).

C-099797

Table 6-9. Number of Radio-Collared Deer Lost to Various Mortality Factors

Cause	Mortality			% of
	Adult	Fawns	Total	Total
Predation				
Lion	2	4	6	24
Coyote	3	1	4	16
Bear	1	-	1	4
Raptor	-	1	1	4
Poaching	2	1	3	12
Natural Causes*	4	-	4	16
Broken Neck	1	1	2	8
Starvation	-	1	1	4
Parasite (lung worm)	-	1	1	4
Unknown**	1	1	2	8

Total collared sample . . . . 52 animals

Total mortality of sample . . 25 animals

* Carcasses found and determined to be nontraumatic death such as old age or undetermined disease.

**Collar only found; no evidence of cause of death.

Fawn Capture Sites

Fawn rearing areas were typically found between 1 700 m (5,600 ft) and 1 900 m (6,200 ft) elevation. Heavy fawn use appeared on 5 to 10 percent slopes with general use on slopes between 25 and 45 percent. Aspect, overall, tended to be towards the E-SE direction.

Soil series were comprised of three groups. Fifty percent were composed of Sheetiron, 46 percent Masterson, and 4 percent Hugo (SS, 1967).

In each 0.04-ha (0.1-ac) plot, gravelly-loam was the major soil type with 96% derived from metamorphic rock and 4% from sedimentary rock.

Six successional stages were examined and included: grass-forb, shrub-seedling, pole-sapling, young, mature and old growth. Forty-four percent of fawn use occurred in mature tree stands, while 32% occurred in the shrub-seedling stage.

Each 0.04-ha (0.1-ac) plot contained an average of 13.1 mature trees. Tree height ranged from less than 3 m (10 ft) to 40 m (130 ft) with 71% of the trees between 3 m (10 ft) and 12 m (40 ft) tall. Tree dbh ranged from less than 0.15 m (0.5 ft) to 1.4 m (4.5 ft) with 86% of the trees less than 0.6 m (2 ft) dbh.

An average of 16.6 seedlings and saplings was found in each plot. White fir (Abies concolor) was the most common seedling and sapling, occurring in 73% of the plots and averaging 227 trees per hectare (92 per acre). Ponderosa pine (Pinus ponderosa) and incense cedar (Libocedrus decurrens) were less predominant, each being found in 42 % of the plots.

Approximately 58% of all the 0.016-ha (0.04-ac) plots had less than 3,088 shrub stems per hectare (1,250 per acre). Snowberry (Symphoricarpus albus) was the most abundant shrub occurring in 50% of the plots, mountain whitethorn (Ceanothus cordulatus) and gooseberry (Ribes sp.) were both seen in 42% of the plots. Phlox (Polemonium californicum) and purple thistle, (Cirsium vulgare) were the most abundant herbaceous plants, appearing in 27 % of the 1-m^2 (39.4-in^2) plots. Sixty-four percent of the plots contained no herbaceous vegetation at all.

Visual estimates indicated that the first three most predominant plants were white fir (54%), snowbush (38%) and ponderosa pine (31%).

The average percent litter cover was 61%; bare soil was 19%. Slash was found in 92% of the 0.016-ha (0.04-ac) plots with almost three quarters of the plots containing greater than 10% slash cover. There was an average of 165.5 dead and down trees per hectare (67 per acre) of which 39% were of decay class three (Thomas, 1979). Decay classes two and four each contributed between 20 and 30% of the dead and down trees with decay classes one and five contributing less than 8% each. There was an average of 35 old stumps per hectare (14 per acre) with 64% having a diameter less than or equal to 0.9 m (3 ft).

Seventy-seven percent of the fawns captured were found lying beside a stump, a down tree or the base of a tree. Only 2 of the 26 capture locations were found close to a meadow. This distance average 62 m (203 ft).

1980 Habitat Components

Fifty-eight variables were included in the 1980 analysis (Table 6-10). Results of the factor analysis indicate that significant component for the 1980 data (n = 8) fall into three major groups. Each set of components within a group represents a theoretical community likely to be used as fawning habitat. Any combination within each group may appear under natural conditions.

Group I

The aspect was most commonly in the N-NE direction with a slope of approximately 58%. Distances to water and to the nearest road averaged 294 and 125 m (965 and 410 ft), respectively. Slash would likely be absent from this community. The average number of mature trees per

Table 6-10

MEANS OF SIGNIFICANT VARIABLES FOR 1980

Mature Trees	Trees per ha	Trees (per ac)	Height per m	Height (per ft)	dbh per m	dbh (per ft)
White fir	354.9	143.7	16	52	.3	1.1
Incense cedar	9.4	3.8	9	31	.2	.5
Douglas fir	12.3	5.0	11	36	.2	.7
Sugar pine	18.5	7.5	14	47	.2	.8
Seedling/Saplings						
Ponderosa pine	3.2	1.3				
Douglas fir	12.3	5.0				
Black oak	3.2	1.3				
Sugar pine	21.7	8.8				
White fir	182.3	73.8				
Incense cedar	11.4	11.3				

Shrubs	Stems per ha	Stems (per ac)	Percent Canopy
Rose	200.8	81.3	1.9
Snowberry	471.3	190.8	1.5
Raspberry	39.0	15.8	.1
Gooseberry	277.9	112.5	3.9
Herbaceous			
Mullein	1300.7	526.6	.50
Phlox	5003.0	2025.5	.25

Decay Classes	Logs per m	Logs (per ac)	Length per m	Length (per ft)	Diameter per m	Diameter (per ft)
1	15.6	6.3	2.0	7	2.0	.7
2	58.8	23.8	4.6	15	.4	1.3
3	105.0	42.5	5.8	19	.5	1.8
4	52.6	21.3	7.0	23	.7	2.2
5	3.2	1.3	.3	1	.1	1.2

Aspect:	North-Northeast
Percent slash:	57.5
Percent slope:	30.7
Number of stumps:	51.9/ha (21/ac)
Distance to water:	293.6 m (963.4 ft)
Distance to road:	124.5 m (408.5 ft)
Elevation:	1 800.2 m (5,906.3 ft)
Percent litter	57.9
Percent bare soil:	21.5
Percent canopy cover:	41.6
Stump diameter:	1.4 m (4.5 ft)

hectare was 380 (153 per acre). White fir was the predominant mature tree (94%). Incense cedar and Douglas fir (Pseudotsuga menziesii) comprised only 6%. Seedlings and saplings consisted largely of white fir while Douglas fir, incense cedar and sugar pine (Pinus lambertiana) were less predominant. Snowberry average 469 stems per hectare (190 per acre) and was more abundant than gooseberry and rose (Rosa sp.) shrubs which averaged 279 and 205 stems per hectare (113 and 83 per acre), respectively. Phlox was the only significant herbaceous plant found and averaged 4,940 stems per hectare (2,000 per acre). Each hectare averaged 123.5 (50 per acre) dead and down trees and 49.4 (20 per acre) old stumps.

Group II

This community tends to occur at low elevations 1 500-1 800 m (5,000 - 6,000 ft) on N-NE aspects and on slopes of approximately 58%. Canopy cover averaged 42%. The approximate distance to the nearest road was 124 m (407 ft). White fir was the predominant mature tree (356 trees per hectare--144 per acre) with Douglas fir less abundant. Seedlings and saplings observed infrequently were typically Douglas fir and black oak (Quercus kelloggii). Snowberry accounted for 75% of the shrubs; rose was less abundant. Twenty-two percent bare soil was noted and there were approximately 49 (20 per acre) old stumps and 111 (45 per acre) dead and down trees per hectare.

Group III

The few mature trees in this community were incense cedar and sugar pine. Shrubs, although sparse, were typically rose and snowberry. Mullein (Verbascum thapsus) averaged 1,302 stems per hectare (527 per acre). Large stumps (1.4 m--4.5 ft--diameter) were commonly found next to roads.

Miscellaneous Associations

In several areas close to roads, sugar pine (217 trees per hectare--88 per acre) at the seedling and sapling stage were significantly correlated.

1981 Habitat Components

Using spotlights from vehicles was the principal technique for capturing fawns during the 1981 season, creating a bias towards the distance to roads.

Seventy-two variables were included in to the 1981 analysis (Table 6-11). Significant components for 1981 (n = 18) constitutes two basic community groups in addition to several smaller associations.

Group I

This community tends to be found at low elevations (1 500 m {5,000 ft}). White firs were abundant and accounted for 68% of the mature trees. Douglas fir, sugar pine and black oak were also present. Sixty-three percent of the seedlings and saplings were ponderosa pine mixed with black oak and sugar pine. Manzanita (Arctostaphlos viscida) was the main shrub, averaging 27 stems per hectare (11 per acre). Phlox stems averaged 40,000 stems per hectare (16,200 per acre) while squirrel tail grass (Sitanion sp.) was sparse. Class one, dead and down trees, averaged 220 per hectare (89 per acre).

Group II

Seventy percent of the mature trees were ponderosa pine with incense cedar less predominant. White fir (71%) and incense cedar (29%) seedings and saplings averaged 272 trees per hectare (110 per acre). Purple thistle (1,704 stems per hectare--690 per acre) was the only significant herbaceous vegetation. Approximately 17 dead and down trees occurred in each hectare (7 per acre). These were typically class four.

Table 6-11

MEANS OF SIGNIFICANT VARIABLES FOR 1981

Mature Trees	Trees per ha	Trees (per ac)	Height per m	Height (per ft)	dbh per m	dbh (per ft)
White fir	122.0	49.4	11	37	.1	.5
Incense cedar	26.2	10.6	5	16	.2	.7
Douglas fir	26.2	10.6	4	13	.1	.2
Sugar pine	24.7	10.0	6	21	.1	.4
Black oak	6.9	2.8	2	8	0	.1
Ponderosa pine	61.8	25.0	13	44	.3	.9
Seedlings/Saplings						
Incense cedar	78.3	31.7				
White fir	193.4	78.3				
Sugar pine	20.5	8.3				
Ponderosa pine	75.6	30.6				
Black oak	23.2	9.4				
Douglas fir	31.6	12.8				

Shrubs	Stems per ha	Stems (per ac)	Percent Canopy
Manzanita	27.4	11.0	2.2
Snowbush	1 211.0	490.3	12.8
Rose	20.5	8.3	.1
Raspberry	109.9	44.5	.7
Gooseberry	174.9	70.8	1.9
Herbaceous			
Purple thistle	1 701.0	688.7	.3
Phlox	37 822.6	15,312.8	1.2
Mullein	4 402.5	1,782.4	.6
Squirrel tail	17 210.2	6,967.7	1.6

Decay Classes	Logs per ha	Logs (per ac)	Length per m	Length (per ft)	Diameter per m	Diameter (per ft)
1	22.0	8.9	.9	3	.1	.2
5	10.9	4.4	.6	2	.1	.5

Elevation:	1 779.7 (5,838.9 ft)
Stump diameter:	.4 (1.2 ft)
Distance to roads:	48.5 m (159.0 ft)
Number of stumps:	17.8/ha 7.2/ac)

Miscellaneous Associations

Black oak seedlings and saplings averaged 69 trees per hectare (28 per acre) and were associated with mature white fir and black oak. White fir formed the high canopy while black oak formed the intermediate and low tree levels.

Snowbush covered approximately 13% of each plot and was associated with Douglas fir seedlings and saplings. Phlox and squirrel tail grass were also present, each contributing 1 to 2% of the herbaceous cover. The average distance to the nearest road was 48 m (159 ft).

Rose shrub (20 stems per hectare {8 per acre}) was associated with purple thistle and mullein and averaged 1,700 and 4,400 stems per hectare 690 and 1,780 per acre), respectively. Each of these hectare plots typically contained 67 (72 per acre) stumps.

Raspberry and gooseberry were associated and had 111 and 173 stems per hectare (45 and 70 per acre), respectively. Although significant, these two shrub species combined accounted for only 3% of the shrub cover per hectare.

Population Census

We estimated from deer pellet transects that the Thomes Creek herd wintering population ranges from 3,700 to 5,200 animals (Figure 6-1). The apparent low wintering population in 1980-81 was probably because many animals stayed at higher elevations during the winter since it was so mild. In the more severe 1981-82 winter, it appears that the herd moved through the areas containing the pellet transects in October, November, February, and March, and spent the winter at lower elevations in December and January. We now feel that this herd is declining slightly because of high predation. Based on a small sample (n = 35), we found that during the 3-year study

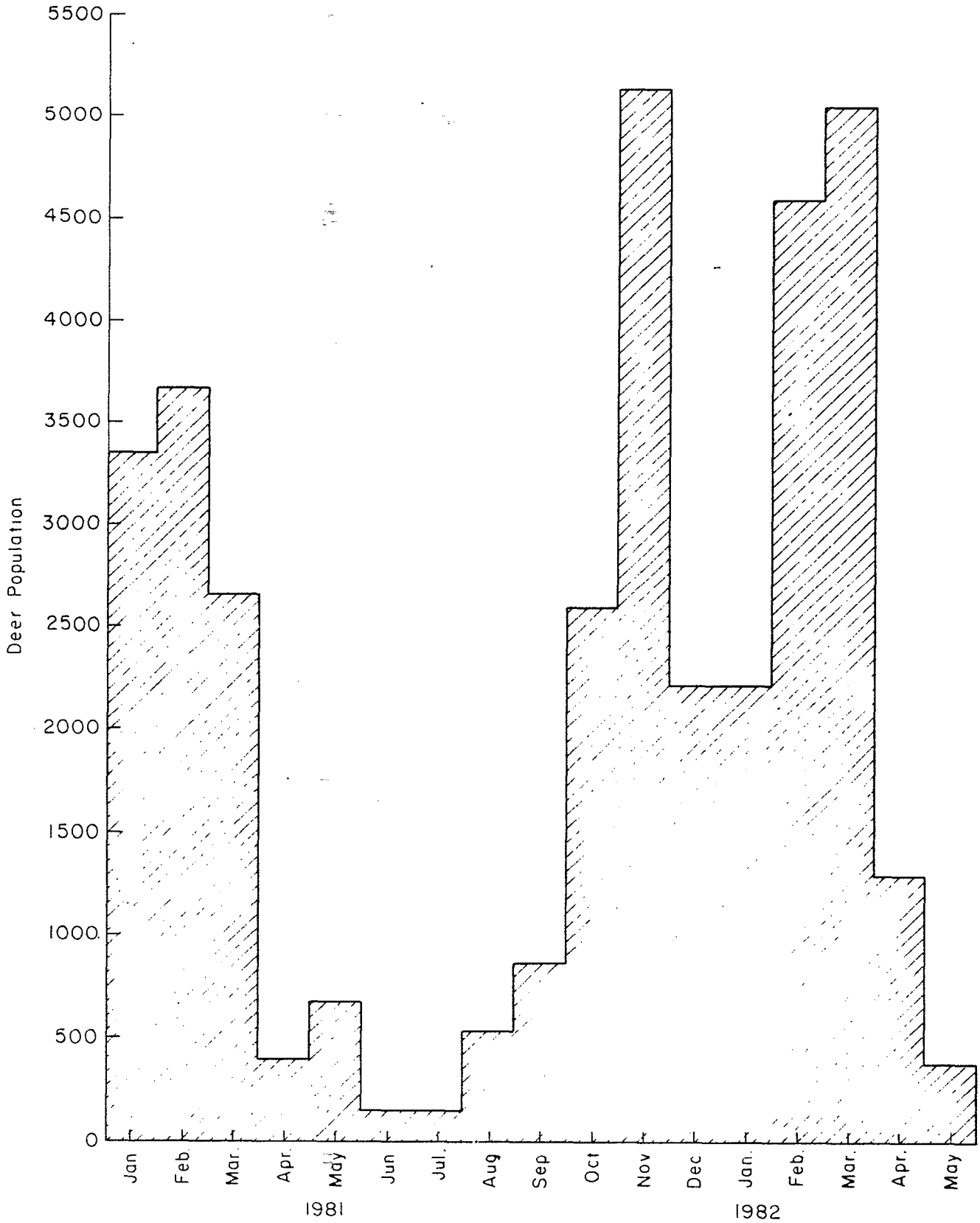

FIGURE 6-1. Estimated deer population from pellet group counts

annual mortality rate of adult does was 34%, while annual recruitment was only 30%. Because of the relatively short term of the study, we do not know if this decline will continue or will reverse.

Health and Reproduction

The breeding period was from November 9 until January 1, with a peak of activity on December 6. A sample of 20 adult does captured in 1982 showed a fertilization rate of 94% and an embryo rate of 181 fawns per 100 does, one of the highest ever recorded for black-tailed deer.

This herd has had no significant dieoffs due to disease. Occasional outbreaks of hoof rot close to livestock activities have been observed in the resident deer range. There are no data indicating serious disease levels in the migratory portion of the herd (Table 6-12).

Postmortems associated with the study show incidence of ecto- and endoparasites common to black-tailed deer in Northwestern California (Table 6-13). The ectoparasites include fleas, hard-bodied ticks, and hippobosid fly larvae. Lungworm, nasal bot fly larvae, and tapeworm cysts associated with abdominal mesentaries are common endoparasites. All deer collected (22) were infected with parasites. The sample exhibited medium levels of lice, botfly, and lungworm. Disease and natural losses accounted for 16% mortality of the collared animals during the study.

Deer losses caused by parasitism and disease are not easily quantified and little information is available about the impact of these factors on the herd. Generally, healthy deer can handle the parasitic load.

Studies have indicated that declines in California deer herds are partly the product of poor winter and transition range conditions with resulting lower fawn survival (Ashcraft, 1974; Rempel,). Data obtained from the early spring collection helped explain overwintering effect on body condition and ovulation rates.

Table 6-12

BLOOD ANALYSIS OF THIRTY-NINE DEER

Accession No.	Tag No.	Date	County	Age/ Sex	Brucellosis	Anaplasmosis Card	Lepto Series	PI-3	BVD	IBR	BT	Selenium	EHD	BT
DB80003	5244	1-5	Tehama	4/F										
0004	5244	1-7	"	4F										
0005	5247	1-7	"	A/F										
0006	5248	1-12	"	1/F										
0007	5251	1-31	"	A/F										
0027	---	4-17	"	2/F										
1001	450 280	2-4	"	A/F	-	+	-	-	-	-	-			
1002	315	2-9	"	A/F	-	+	-	8	-	-	-			
1009	330	3-17	"	A/F							-			
1018	250	4-16	"	A/F	-		-				-	.053		
1418	5582	11-18	"	1½/F	-	-	-	128	-	-	+	-	-	
1419	7821	12-1	"	2½/F	-	-	-	64	-	-	-		-	-
1420	7824	12-6	"	A/F	-	-	-	-	-	-	-		-	+
1421	8051	12-6	"	4/F	-	-	-	-	-	-	-		-	-
1445	5563	12-20	"	1½/M	-	-	-	-	-	-	-		16	-
2006	8259	1-6	"	A/F										
2007	7823	1-10	"	1½/F	-	+	-	8	-	-	-		64	
2041	1	4-26	"	1/F	-		-	16	-	-			-	-
2042	2	4-26	"	6/F	-		-	128	-	-			-	+
2043	3	4-26	"	7/F	-		-	16	-	-			-	-
2044	4	4-27	"	3/F	-		-	16	-	-			-	-
2045	5	4-27	"	2/F	-		-	32	-	-			-	-
2046	6	4-27	"	5/F	-		-	64	-	-			-	-
2047	10	4-27	"	4+/F	-		-	32	-	-			-	-
2048	11	4-27	"	7/F	-		-	32	-	-			-	-
2049	12	4-27	"	4/F	-		-	-	-	-			-	-
2050	13	4-27	"	2/F	-		-	-	-	-			-	-
2051	14	4-27	"	2/F	-		-	16	-	-			-	-
2052	15	4-27	"	3/F	-		-	-	-	-			-	-
2053	16	4-27	"	2/F	-		-	-	-	-			-	-
2054	17	4-27	"	3/F	-		-	-	-	-			-	-
2055	19	4-27	"	6/F	-		-	32	-	-			-	-
2056	20	4-27	"	A/F	-		-	128	-	-			-	-
2057	21	4-27	"	6/F	-		-	32	-	-			-	+
2058	22	4-27	"	6/F	-		-	32	-	-			-	-

Table 6-13. Frequency of Occurrence (f) and Mean Level* of Abundance ($\bar{X}$) of Selected Parasites

Parasite	f (%)	$\bar{X}$
Ectoparasites		
Ticks	72.0	1.25
Keds	81.8	1.55
Lice	22.7	2.20
Fleas	22.7	1.00
Endoparasites		
Tapeworm cysts	63.6	1.57
Nasal botfly larva	54.5	2.25
Hydatid cysts (canine tapeworm)	18.2	1.75
Lungworms	13.6	2.00

*Levels: 0 = negative, 1 = light, 2 = medium, 3 = heavy

One factor seems to be the most important in the decline of habitat quality. Excluding fire from the intermediate range has led to inaccessible stands of decadent chaparral that provide little or no forage value. These changes have probably resulted in changes in seasonal range use, bringing increased pressure on both summer and winter ranges.

Recent developments in habitat improvement include Coordinated Resource Planning (CRP) projects that are gaining widespread acceptance. These programs cooperatively developed and instigated by private landowners and State and Federal land management agencies will greatly benefit the deer herd in future years. A program similar to the Grindstone project in Glenn County is currently being initiated in Thomes Creek.

The Chaparral Management Program authorized under SB 1704 and administered by the California Department of Forestry is also gaining momentum and will benefit the deer herd. Under this program, chaparral lands are

converted or manipulated through prescribed burning on private lands. The 1704 legislation provides for partial State financing and insurance protection for the landowner. Another State proposal is to establish a 150-inmate camp near Paskenta. Reportedly, such a camp is already authorized (Proposition 8, 1982) and of high priority to CDF and the Department of Corrections.

Some habitat improvement is also accomplished by USFS through Knudsen-Vanderberg monies earmarked for habitat rehabilitation in connection with timber sale areas.

Another program, the Sikes Act, began in 1982. The Sikes Act is a cooperative program between the U. S. Forest Service and the Department of Fish and Game using federally appropriated money to plan projects and State-collected energy funds to implement them. This program is cooperatively planned on a five-year basis and has much potential for habitat improvement.

Hunter Harvest

Reported deer kills were highest in 1966 (320 bucks) and lowest in 1974 (53 bucks). Since 1974, the kill has increased steadily (in 1981 - 318) (Figure 6-2).

Because most deer in this herd are migratory, the kill is significantly related to the timing of the season closing date. In the 1960's, a two-buck hunting season extended well into November, allowing considerable time to hunt after deer had migrated from higher inaccessible summer areas. During most of the 1970's, one-buck seasons closed much earlier and often were over before migration began. Kills during these years were very low. There is a strong relationship between deer kills and season closing dates. This relationship provides a method of regulating annual buck harvests by adjusting season closing dates to obtain desired harvest levels.

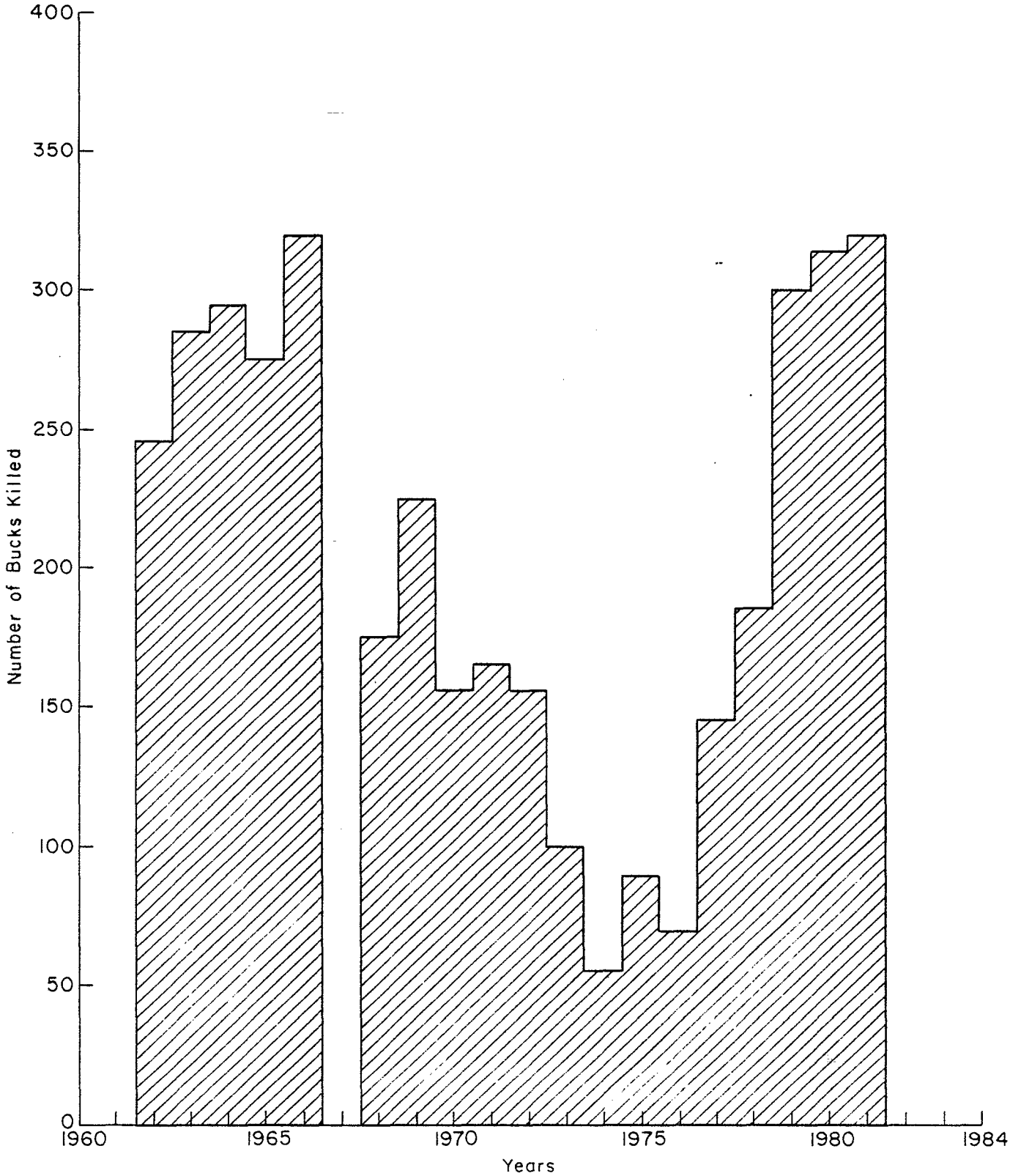

FIGURE 6-2. Buck harvest.

This correlation also indicates that while the herd size has declined since 1960, the decline is not as severe as the drop in reported kills. Prescribed burning of the mid-elevation transitory range should improve deer accessibility during mid-season and reduce the importance of the length of season/total kill relationship.

Although fawn production (Figure 6-3) and the buck/doe ratio (Figure 6-4) are closely related, there is no relationship between them and the buck kill.

Behavior

A small amount of time was dedicated to determining the deer use in each habitat type. The results of these observations indicate that 76% of the time a deer grazes in grassland and 32% of the time it beds in oak-grassland (Table 6-14). These figures show the relative value of habitats which would be lost. Unfortunately, the majority of habitat that would be inundated is oak-grassland and grassland.

Table 6-14. Percentage of Use in Each Habitat
(By visual observations)

No. Observed	Habitat	Activity by Percentage					
		Browsing	Grazing	Traveling	Bedding	Standing	Rutting
70	Chaparral	5.6	54.3	10.0	5.7	24.3	0
341	Oak-Pine	5.6	42.5	15.2	26.7	10.0	0
2,147	Oak-Grassland	0.0	47.5	7.2	32.4	12.8	0
1,327	Grassland	2.0	76.0	7.7	3.5	10.9	0

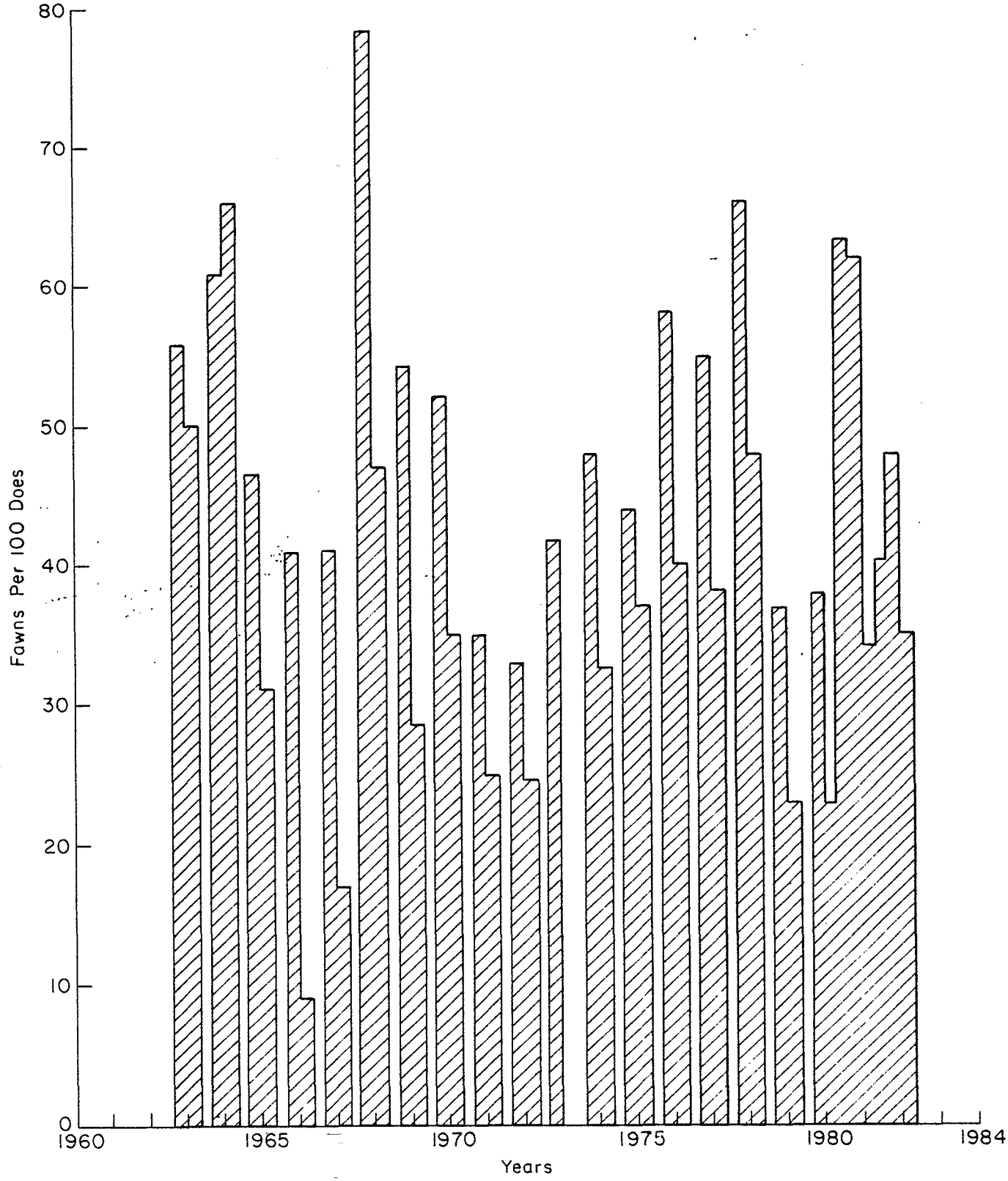

FIGURE 6-3. Late fall and spring fawn doe ratios.

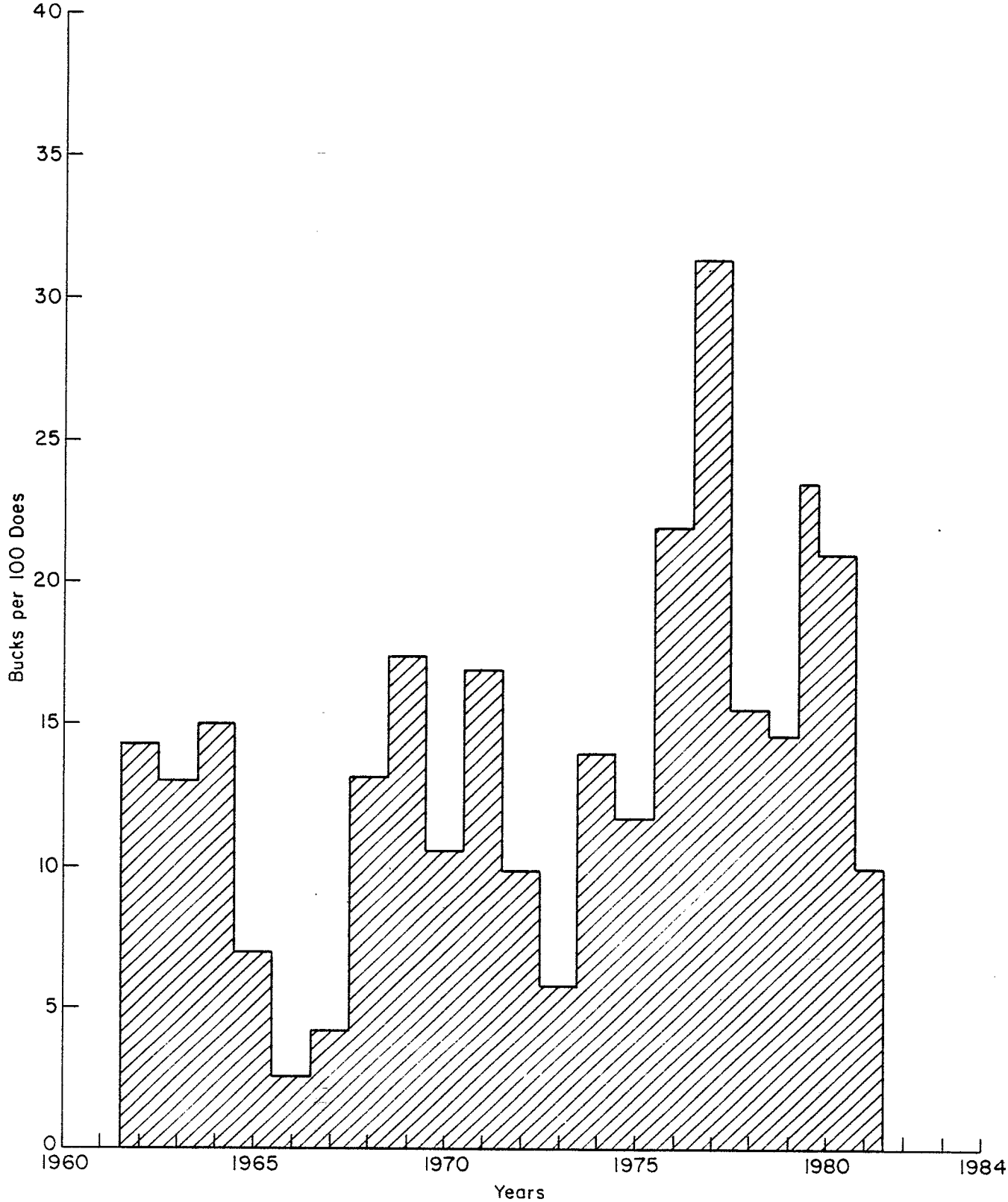

FIGURE 6-4. Late fall buck doe ratios.

Loss of habitat for the Thomes Creek deer herd has not been significant since large acreages of oaks were removed in western Tehama County to increase livestock forage in the 1950's and early 1960's. Much of the conversion area has partially reverted to oaks through stump sprouting. Oak conversion is no longer a large-scale program. Cutting oaks for firewood has significantly increased recently on private land and could reach a level that seriously affects the quality of habitat over large areas.

The proposed Thomes-Newville Project would cause a significant habitat loss (Figure 6-5). If this project is built, 2 638 ha (6,519 ac) or 19% of the herd's winter range would be inundated. This habitat consists of 2 443 ha (6,036 ac) of grassland, 151 (373 ac) of oak-grassland, and 44 ha (110 ac) of chaparral. This habitat loss could be mitigated, however, if deer could be encouraged to winter at higher elevations.

It should be mentioned again that fire history is important in the way in which it has (or has not) shaped the vegetative component of habitat. Traditionally, most of the range naturally burned at fairly short intervals, probably a light ground fire every 10-12 years in the timber and an intense crown fire in the mid-elevation chaparral every 20-35 years. Most of the brush species of this area regenerates primarily by sprouting, indicating an evolutionary adaptation to peridoic fires.

Suppression of all fires began about 1910 and has continued as Federal and State policy. This has naturally resulted in thick stands of decadent or nutritionally poor vegetation and is especially important in the mid-elevation chaparral. The first probable significant effect of fire exclusion on deer was to shift the traditional winter range to lower elevations about 1930.

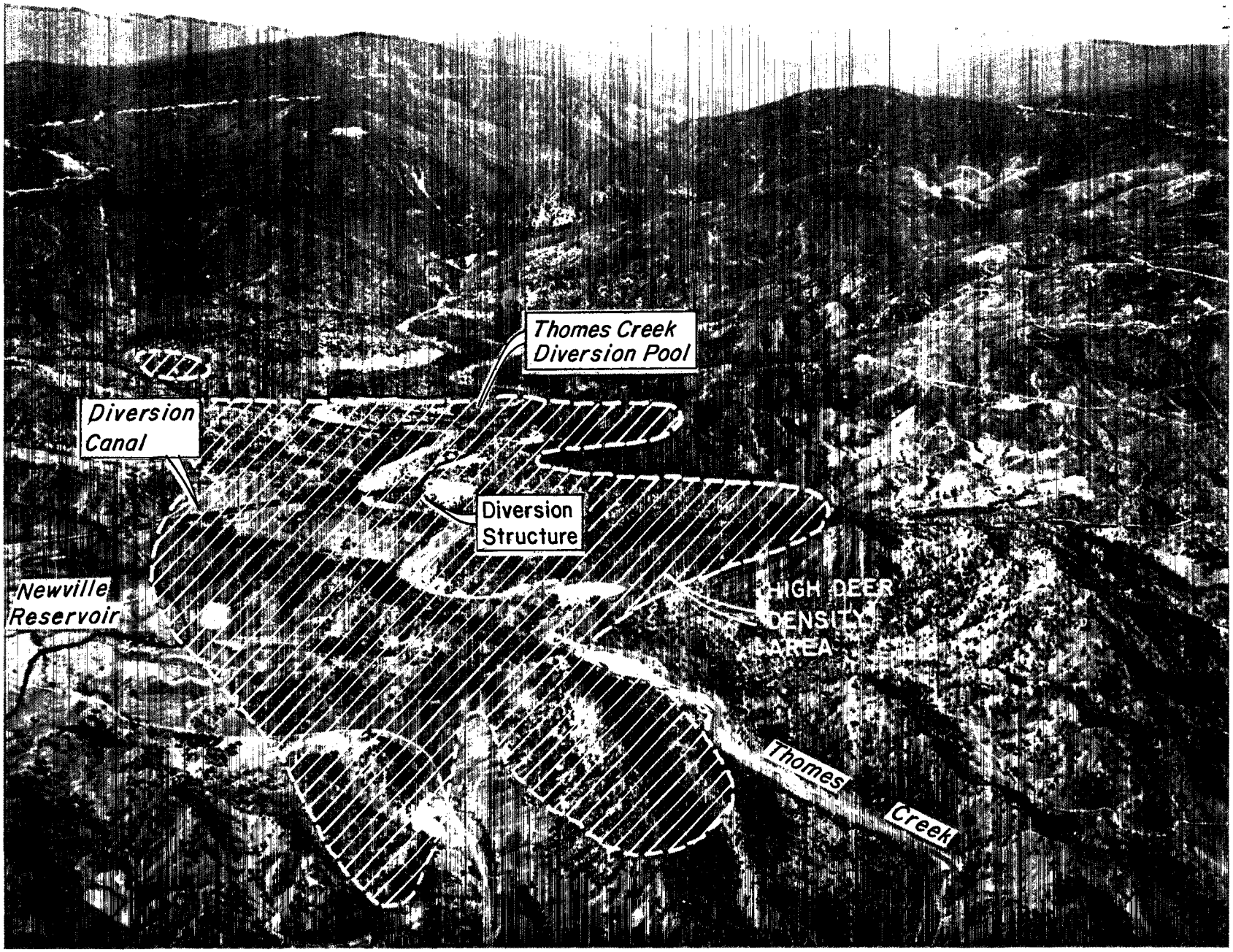

FIGURE 6-5. Area of High Deer Density on Winter Range, Thomes Creek.

C-099816

Fire suppression has lowered the quantity and quality of browse in forested areas. It has probably caused an increase in browsing in conifers, and has resulted in the near elimination of some browse species (Simon, personal communication).

Suppression of fires in oak-grassland has favored weedy grasses such as red brome, foxtail and medusa and may have encouraged the spread of noxious weeds such as star thistle.

The U. S. Forest Service is practicing intensified timber management, including tree improvement, site preparation, regeneration, release, thining and slash modification. Cutting units are kept small and well distributed. Slash is burned or piled before planting, causing brush and forbs to rejuvenate or reestablish quickly. This provides good habitat for 15-20 years, unless it is destroyed by further silvicultural practices such as release, which removes brush to promote tree growth. The Mendocino Forest was harvested historically on a selective basis. Brush and forb establishment and/or rejuvenation has been spotty and the summer range of the Thomes Creek herd is lacking both in quantity of forage and in fawning and escape cover.

The forests are experiencing increased levels of deer browsing in specific locations in conifer plantations to levels that prevent reforestation. The USFS practices mechanical protection for seedlings (plastic tubes) on recognized deer concentration areas. This is an expensive solution and is inherently unsatisfactory as long-term strategy.

Tables 6-17 through 6-22 show the number of acres of different vegetation types currently found throughout the range of the herd.

An 18-page annotated bibliography is included for reference for future work or for completion of this work (Appendix I).

TABLE 6-15

ACREAGE OF VEGETATION TYPES[1/]
for Lake Hollow Deer Herd Range, Tehama Co., CA, 1981.

	Private	USFS	Total	%
Grassland	11,573	3,165	14,738	24.5
Manzanita chaparral	269	1,561	1,830	3.0
Mixed chaparral	318	6,473	6,791	11.3
Chamise chaparral	1,937	3,854	5,791	9.6
Hardwood shrubs	26	2,228	2,254	3.7
Mixed hardwood/grass	2,868	814	3,682	6.1
Blue oak/grass	1,568	82	1,650	2.7
Black oak/grass		110	110	.2
Digger pine/grass	916	138	1,054	1.7
Conifer/grass	171	2,185	2,356	3.9
Mixed hardwood/manzanita	24	305	329	.6
Mixed hardwood/mixed shrub		590	590	1.0
Mixed hardwood/chamise	42	194	236	.4
Mixed hardwood/shrub hardwood		417	417	.7
Blue oak/manzanita	30	95	125	.2
Blue oak/mixed chaparral	626		626	1.0
Blue oak/shrub hardwood	30		30	.1
Black oak/manzanita		113	113	.2
Digger pine/shrub	468	700	1,168	1.9
Conifer/shrub	651	15,695	16,346	27.1
TOTAL [2/]	21,517	38,719	60,236	100

1/ Estimated by planimeter using 1980 USFS Timber Type Maps and 1960 USGS Soil-Vegetation Maps.

2/ Excluding pure conifer stands.

TABLE 6-16

TOTAL ACRES OF MANAGEABLE RANGE [1]

for Lake Hollow Deer Herd Range, Tehama Co., CA, 1981

	Private	USFS	Total
Manageable Range			
Low Risk[2]	2,524	15,053	17,577
High Risk[3]	7,420	23,666	31,086
Total Manageable Range	9,944	38,719	48,663

1/ Estimated by planimeter from 1980 USFS Timber Type Maps and 1960 USGS Soil-Vegetation Maps.

2/ Vegetation types with lower risk of causing fire damage.

3/ Vegetation types with higher risk of causing fire damage.

TABLE 6-17

Manageable Acres of Range[1/], High Risk[2/]
for Lake Hollow Deer Herd Range, Tehama Co., CA, 1981

	Private Land		USFS Land			
	Winter Range	Summer Range	Winter Range	Summer Range	Total	Percent[3/]
Hardwood Shrubs	26	0	1,401	827	2,254	3.7
Hardwood Trees Digger Pine/ Grass	5,352	0	992	152	6,494	10.8
Conifer/Grass	171	0	0	2,185	2,356	3.9
Hardwood Trees Digger Pine/ Shrubs	1,190	30	652	1,762	3,634	6.0
Conifer/Shrubs	651	0	805	14,890	16,346	27.0
Total	7,390	30	3,850	19,816	31,086	51.6

1/ Estimated by planimeter from 1980 USFS Timber Type Maps and 1960 USGS Soil-Vegetation Maps.

2/ Vegetation types with higher risk of causing fire damage.

3/ Percentage of total acreage of vegetation types of Lake Hollow Deer Herd Range (60,236 acres, excluding pure conifer stands).

C-099820

TABLE 6-18

Manageable Acres of Range[1/], Low Risk[2/]
for Lake Hollow Deer Herd, Tehama Co., CA 1981

	Private Land		USFS Land			
	Winter Range	Summer Range	Winter Range	Summer Range	Total	Percent[3/]
Grassland	0	0	2,155	1,010	3,165	5.2
Manzanita Chaparral	269	0	800	761	1,830	3.0
Mixed Chaparral	318	0	4,903	1,570	6,791	11.3
Chamise Chapparal	1,937	0	1,750	2,104	5,791	9.6
Total	2,524	0	9,608	5,445	17,577	29.2

[1/] Estimated by planimeter from 1980 USFS Timber Type Maps and 1960 USGS Soil-Vegetation Maps.

[2/] Vegetation types with lower risk of causing fire damage.

[3/] Percentage of total acreage of vegetation types for Lake Hollow Deer Herd Range (60,236 acres, excluding pure conifer stands).

C-099821

TABLE 6-19

DEER WINTER RANGE
(Acres)

	Private	USFS	Total
Grassland	11,573	2,155	13,728
Manzanita chaparral	269	800	1,069
Mixed chaparral	318	4,903	5,221
Chamise chaparral	1,937	1,750	3,687
Hardwood shrubs	26	1,401	1,427
Mixed hardwood/grasses	2,868	814	3,682
Blue oak/grasses	1,568	82	1,650
Digger pine/grasses	916	96	1,012
Conifer/grasses	171		171
Mixed hardwood/manzanita	24	43	67
Mixed hardwood/chamise	42	162	204
Blue oak/manzanita		95	95
Blue oak/mixed chaparral	626		626
Blue oak/hardwood shrubs	30		30
Digger pine/shrub	468	352	820
Conifer/shrub		805	805
Total 1/	20,836	13,458	34,294 acres

1/ Areas below 3,000-foot contour line

C-099822

TABLE 6-20

SUMMER RANGE
(Acres 1/)

	Private	USFS	Total
Grassland		1,010	1,010
Manzanita chaparral		761	761
Mixed chaparral		1,570	1,570
Chamise chaparral		2,104	2,104
Hardwood shrubs		827	827
Black oak/grass		110	110
Mixed hardwood/grasses			-
Blue oak/grasses			-
Digger pine/grasses		42	42
Conifer/grasses		2,185	2,185
Mixed hardwood/manzanita		262	262
Mixed hardwood/mixed shrubs		590	590
Mixed hardwood/chamise		32	32
Mixed hardwoods/shrub hardwood		417	417
Blue oak/manzanita	30		30
Blue oak/mixed chaparral			-
Blue oak/hardwood shrubs			-
Black oak/manzanita		113	113
Digger pine/shrub		348	348
Conifer/shrub	651	14,890	15,541
Total 2/	681	25,261	25,942 acres

1/ Above 3,000 feet

2/ Does not include pure conifer stands

APPENDIX I

ANNOTATED BIBLIOGRAPHY OF MULE DEER

I. Distribution of Subspecies (Present) (Figure 6-6)

A. Rocky Mountain mule deer (Odocoileus hemionus Rafinesque)
East of crest of Sierra Nevada-Cascade Ranges through Rocky Mountains and intermountain regions. As far north as northern British Columbia and Alberta, south into Arizona and New Mexico (Schmidt, 1978; Taylor, 1956).

B. Columbian black tailed deer (O.h. columbianus Richardson)
Pacific Coast west of Sierra Nevada-Cascade Summit. North from Monterey and Merced Counties, CA to central British Columbia (Taylor, 1956).

C. California mule deer (O.h. californicus Caton)
Southern Sierra Nevada and California Coast Ranges (Taylor, 1956).

D. Southern mule deer (O.h. fuliginatus Cowar)
Riverside County, California south to central Baja California Mexico (Taylor, 1956).

E. Peninsula mule deer (O.h. peninsulae Lydekker)
Southern Baja California, Mexico (Taylor, 1956).

F. Desert mule (O.h. crooki Mearns)
Southern Arizona, New Mexico and Texas to central Mexico (Taylor, 1956).

G. Sitka black-tailed deer (O.h. sitkensis Merriam)
Southeastern coastal Alaska and north coastal British Columbia (Taylor, 1956).

II. Physical Characteristics

A. Pelage

1. Winter - Warm brown to gray brown. Abdomen, throat patches and inside of fore and hind limbs white. Tail white beneath, dark above with black tip. Dark coloration on face; however, often subdued, particularly in female O.h. columbianus. Ears grayish brown outside, grayish white inside; lack black tip in O.h. columbianus (Schmidt, 1978; Taylor, 1956).

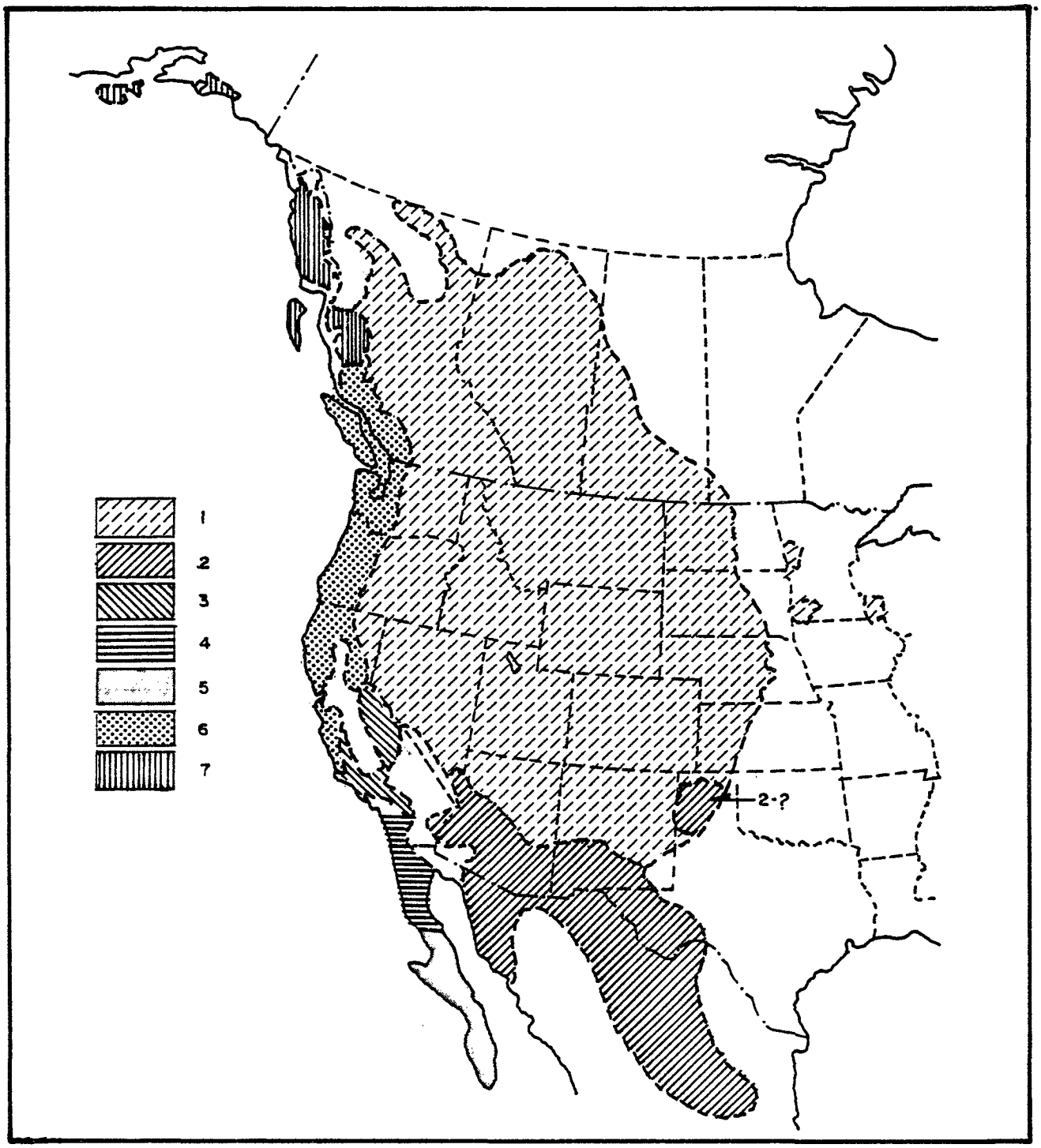

FIGURE 6-6. Geographic range of mule deer subspecies: (1) O.h. hemionus; (2) O.h. crooki; (3) O.h. californicus; (4) O.h. fuliginatus; (5) O.h. peninsulae; (6) O.h. columbianus; (7) O.h. sitkensis. Current documentation was not found for O.h. ermicus and O.h. sheldoni (2b), and O.h. inyoensis (3a) is in doubt.

2. Summer - Appearance of reddish hairs in May. Molt begins first between eyes, progresses to upper neck, back and thighs. Molt complete in bucks and yearling first, then pregnant does in late June (Taylor, 1956; Hodson, 1956).

B. Antlers

1. Measurements - vary with range conditions and nutritional plane.
   (a) Normal adult form dichotomously branched or bifurcate.
   (b) Selective for males (Schmidt, 1978).
   (c) Maximum number of points attained at 6 years (Robinette, 1977).
   (d) Maximum beam diameter attained at 11 years (Robinette, 1977).
   (e) First year spikes 13 inches or less (Robinette, 1977).
   (f) Occur rarely in females (Robinette, 1977; Taylor, 1956).

2. Velvet Shedding
   (a) Occurs August-September. Associated with fall molt, enlargement of testes and seminal vesicles (Robinette, 1977; Taylor, 1956).
   (b) Precipitated by increased testosterone levels (Robinette, 1977; Taylor, 1956).

3. Antler Growth and Dropping
   (a) Growth occurs in March-April. Covered in velvet. Turgid appearance (Robinette, 1977; Taylor, 1956).
   (b) Growth precipitated by increased pituitary output (Taylor, 1956).
   (c) Well developed by June (Robinette, 1950).
   (d) Antlers dropped December-January. Associated with drop in testosterone levels (Taylor, 1956).

C. Dentition

1. Growth and measurement (O.h. columbianus)

(a) Adults possess 32 teeth. Full dentition occurs at:
In general - 24-25 months (Giles, 1971).
Oak Creek, Utah herd - 29 months (Robinette, 1977).
Lake Hollow herd - 40 months (Hodson, 1956).

(b) Dental formula: 0/3, 0/1, 3/3, 3, 3.
First premolar missing (Taylor, 1956).

(c) Tooth eruption in the lower jaw of the mule deer (Giles, 1971). Milk or deciduous tooth - D; adult or permanent tooth - P. Parentheses indicate that tooth is irrupting at that particular time.

	Incisors			Canine	Premolars			Molars		
Age	1	2	3	1	2	3	4	1	2	3
1 to 3 weeks	D	D	D	D	D	D	D	-	-	-
2 to 3 months	D	D	D	D	D	D	D	(P)	-	-
6 months	D	D	D	D	D	D	D	(P)	(P)	-
12 months	P*	DP	D	D	D	D	D	P	(P)	-
18 months	P	P	P	D	D	D	D	P	P	(P)
24 months	P	P	P	P	(P)	(P)	(P)	P	P	(P)
30 months	P	P	P	P	P	P	P	P	P	P

*Replacement and irruption are taking place at this time.

(d) Upper cheek teeth row: less than 75 mm in males; less than 70 mm in females (Taylor, 1956).

(e) Width across palate between upper molars: less than 53 mm in males; less than 46 mm in females (Taylor, 1956).

(f) Diastema less than 80% of alveolar length of lower molar series (Taylor, 1956).

(g) Palatal length less than 70% of alveolar length of upper tooth row (Taylor, 1956).

2. For aging purposes

(a) For less than 30 months-sequence of irruption of teeth in lower jaw (Robinette, 1977; Giles, 1971).

C-099827

(b) Over 30 months - tooth annulation method has supplanted method based on amount of wear on cheek teeth. First permanent molar is sectioned; cementum pad ground and polished; growth annuli counted as darker layers in cementum (McCullough, 1979; Robinette, 1977).

D. Glands - scent producing. Allows individuals to locate one another.

1. Lacrimal gland present and well defined in front of eye. Cleanses and lubricates eye (Taylor, 1956).
2. Tarsal gland marked by tufts of coarse hair at heel joint. Urination on gland results in strong ammonia odor (Taylor, 1956).
3. Metatarsal gland located outside of hindshank; ellipitical area of glandular tissue with raised, hairless ridge over it. Releases pungent, musky odor (Taylor, 1956).
4. Interdigital gland between toes on each foot. Aggregation of oil and sweat glands. Scents animal's tracks allowing for intraspecific location (Taylor, 1956).

E. Body Size

1. Rocky Mountain mule deer bucks (age: 9 yrs) mean weight 241.1 lbs. (Robinette, 1977).
2. Rocky Mountain mule deer does (age: 5 yrs) mean weight 129.8 lbs. (Robinette, 1977).
3. Mean measurements of total length, tail, hind foot, ear and metatarsal gland of adult Odocoileus heminonus columbianus (Taylor, 1956).

Sex	Females N = 14	Males N = 13
Total length	54.0 in	58.0 in
Tail	6.5	6.5
Hind foot	17.25	17.5
Ear	7.75	8.0
Metatarsal gland	2.0	2.0

F. Longevity - maximum potential life span set by teeth

1. Average 9 years in the wild (Taylor, 1956).
2. Semicaptive doe aged 22 years by teeth (Robinette, 1977).

G. Speed - buck clocked at 24 mph (Taylor, 1956).

III. Diseases and Parasites

A. Diseases

1. Foot and mouth disease - occurred 1923. Affected 10 percent of California population. It has not reoccurred (Taylor, 1956).
2. Caseous lyphadenitis - accumulations of pus in lymph nodes, kidneys, body cavity, lungs, liver (Taylor, 1956).
3. Hoof rot - infects throat, feet, viscera. Thrives in alkaline conditions. Linked to overcrowding; can cause significant losses (Taylor, 1956).
4. Anaplasmosis - blood cell parasite (Taylor, 1956).
5. Hemorrhagic septicemia may cause significant losses (Robinette, 1977; Taylor, 1956).
6. Sarcocystitis - protozoan parasite of vertebrate muscle (Taylor, 1956).
7. Skin papillomas and fibromas - initiated by infectious viral process (Robinette, 1977; Taylor, 1956).
8. Peritonitis - result of gunshot to viscera (Taylor, 1956).
9. Other diseases - arthritis, dental abscesses (common), paradontal disease, scabies, ovarian demoid cysts.

B. Parasites

1. Internal
   (a) Lungworm (Dictyocaulus filaria) occurs in all age classes throughout the year. Can cause significant losses especially in fawns that become infested before the first winter migration. Calaveras County, CA: overall incidence 45%; in fawns, 32% (Browning, 1973).
   (b) Yolla Bolly herds had highest incidence in California in 1955 (Hodson, 1956).
   (c) Stomach worm (Trichostrongylus sp.), mesenteric tapeworm (Cysticerius tenuicollis), and muscular tapeworm.

(Cysticercus krabbei) have been shown to cause winter die off (Browning, 1973).

(d) Nasal bots (Cephenemyid sp.) can also cause significant mortality (Browning, 1973).

(e) Other internal parasites - Eyeworm (Thelazid californiensis), sarcosporidia (Sarcocystis sp.), body worm (Setaria yehi), foot worm (Wehrdikmansia cervipedis), hydatids (Echinococcus granulosus) (Browning, 1973).

2. External

Western tick (Dermacentor occidentalis), winter tick (D. albipictus), California tick (Ixodes pacificus), ear tick (Otobiius megnini), flea (Pulex sp.), lice (Trichodeetes tibialis), chigger (Evtrembicula alfreddugesi), hippobascid flies (Lipoptena depressa) (Browning, 1973).

IV. Reproductive Biology and Behavior - stimulated by day length and local habitat phenology.

A. Male Rut

1. Age of first breeding - 18 months (Taylor, 1956).
2. Time of rut - October to December. Begins earlier in northern latitudes. May be associated with cooler weather (Taylor, 1956).
3. Physical effects - increased testosterone levels, swelling of neck and shoulders (November in California), reduced food intake (Schmidt, 1978; Taylor, 1956).
4. Behavioral effects - hyperactivity, belligerence, guttural grunting (Schmidt, 1978).

B. Females and Fawns

1. Breeding

(a) Age of first breeding - 18 months (Taylor, 1956).

(b) Occurs earlier in northern latitudes. Later southern breeding and fawning may be associated with summer precipitation and milder winter instead of warm weather (Smith, 1979; Robinette, 1977).

(c) Peak of estrus only lasts a few hours. If female is not bred, additional estrus cycles occur within 3-4 weeks, almost insuring fertilization (Schmidt, 1978;Robinette, 1977).

2. Conception Dates
   (a) Occurs in December-January for species in general (Taylor, 1956).
   (b) Peak conception for Lake Hollow herd, Tehama County, CA (1954): 12/8-14 (Hodson, 1956).
   (c) Mean conception date for Weaverville herd, Trinity County, California: December 18 (Kie, 1980).
   (d) Mean conception date for California-Oregon Interstate deer: November 19 (Salwasser, 1979).
3. Gestation Period
   Average for Lake Hollow herd: 204 days. (Hodson, 1956).
4. Reproductive Rates
   (a) Number of corpora lutea in ovary indicate potential fawn production. Comparison of number of corpora lutea with number of embryos developing in uterus gives percentage of ova fertilized (Kie, 1980; Hodson, 1956).
   (b) Ovulation rates (number corpora lutea per doe)
      (1) Lake Hollow herd, 1955: 1.76 (Hodson, 1956).
          Statewide, 1963: 1.50 (Calif. DFG).
          Inner California herds: 1.80 (Ashcraft, 1974).
      (2) Affected by forage conditions on migration corridors and winter ranges (Ashcraft, 1974).
      (3) Depressed by increase in adrenocorticotrophic hormone (in dense populations).
   (c) Fertilization rate 93% for Lake Hollow herd (Hodson, 1956); 96% for Weaverville herd (Kie, 1980).
   (d) Fetal litter size - 0 fetuses, 2%; 1 fetus, 37%; 2 fetuses, 60%; 3 fetuses, 1% (Robinette, 1977).
5. Fawning Period
   (a) Occurs in mid-May to July for species in general. One to two fawns per doe (Taylor, 1956).
   (b) Fawning occurs earlier in northern latitudes and higher elevation. Allows for long period of growth before early winter (Robinette, 1977).
      (1) Very early fawns have poor chances for survival. Doe still in poor winter condition. Too little milk.

(2) Very late fawns have poor chances for survival. Peak forage period over. Milk production of doe impaired. Leads to early weaning (Robinette, 1977).

(c) Peak Fawning Dates

Lake Hollow herd (1955): 6/29/-7/5 (Hodson, 1956).

Weaverville herd: 7/11 (Kie, 1980).

California-Oregon Interstate herd: 5/23 (Salwasser, 1979).

6. Pre- and Post-partum Behavior

(a) Doe seeks isolation 1-2 weeks before, during, and 2-3 weeks after parturition. Increasingly aggressive toward own yearling fawn (Robinette, 1977).

(b) Fawning site generally in thick cover, such as Ceanothus sp. with logs. Does usually lay to expel fawn; wander short distance after fawn is licked and dry (Robinette, 1977).

(c) Afterbirth consumed within 1-2 hours of birth. Believed to promote lactation and keep predators from being attracted to placenta (Robinette, 1977).

7. Size of Fawns

(a) Mean weight of Rocky Mountain mule deer at birth, 6.85 lb; 135 days old, 60-70 lbs (Robinette, 1977).

(b) Birth weights for black-tailed deer.

Single births: Males, 7.26 lbs; females, 5.94 lbs.

Twins: Males, 5.94 lbs; females, 5.50 lbs. (Mueller, 1980).

8. Sex Ratio at Birth

(a) 114 males: 100 females Oak Creek, Utah (Robinette, 1977).

(b) 113 males: 100 females (Taylor, 1956).

(c) Higher proportion of males may be indicative of herd in low nutritional state (Robinette, 1977).

9. Fawn Mortality

(a) Summer Mortality

(1) Causes

(1a) Nutrition

Poor nutrition single most important factor. Mortality rates increase with low forage protein content (Robinette, 1977).

C-099832

Forage conditions on migration corridors responsible for 52-77% of fawn loss in North Kings deer herd (Ashcraft, 1974).

(2b) Litter Size

Increased mortality with larger litters; however, most common litter size (2) provides greatest number of survivors (Robinette, 1977).

(3c) Predation

Accounts for approximately 50% of fawn loss. Can be much higher: 71% of fawn mortality on Hanford Reservation, Washington due to coyote predation (Steigers, 1979).

(2) Age

52% of fawn mortality prior to hunt occurs at 0-7 days of age (Robinette, 1977).

Major part of fawn mortality (up to 90%) occurs within the first 45 days of life (Steigers, 1979).

(3) Statistics

(1a) Fawn mortality rates for selected herds.

Calculated from fall fawn/doe ratio.

Tehama County, CA (1972)	88%	
North Kings, CA (1973)	47%	
Devil's Garden (Interstate) (1972)	70%	
Lassen-Washoe, CA (1972)	68%	
Late Hollow, CA (1979)	33%	(Ashcraft, 1974)
Southwest Washington	54%	(Steigers, 1979)
Oak Creek, UT	33%	(Robinette, 1977)

(2b) Fall fawn/doe ratios for local herds

Lake Hollow, Tehama Co.	0.50	(Hodson, 1956)
Mendocino County	0.60	(Kie, 1980)
Weaverville, Trinity Co.	0.65	(Kie, 1980)

(b) Winter Mortality

Average fawn mortality rates for several local herds (1963-1978).

Weaverville	15%	Klamath	20%	Interstate	34%
Whiskeytown	17%	Tehama	29%		

(CFG,).

C-099833

10. Nursing and Feeding
    (a) Deer milk higher in total solids, ash and fat than cow's milk (Taylor, 1956).
    (b) Takes place in morning and evening for 4-15 minutes. Doe uses low call to signal fawns to nurse (Flock, 1974; Robinette, 1977).
    (c) Licking of fawn anal region (Robinette, 1977).
        (1) Promotes urination and defecation
        (2) Promotes suckling
        (3) Prevents feces accumulation in which blowflies lay eggs.
    (d) Foraging begins at 2-3 weeks. Weaning at approximately 4 months (Robinette, 1977).
11. Fawn Behavior
    (a) Can walk unsteadily within minutes of birth. At heel with doe 4-5 days (Robinette, 1977).
    (b) Fawns less than 5 days will drop in their tracks, remain motionless if signalled by surprised doe (Robinette, 1977).
    (c) Select own beds near logs in Ceanothus. Doe beds 20-50 yards away. Twins rarely bed together; usually 10-75 feet apart (Robinette, 1977; Flock, 1974).
    (d) Fawn spots lost 6-8 weeks after birth (Taylor, 1956).
12. Miscellaneous Doe/Fawn Behavior
    (a) Fawn adoption occurs rarely; does usually aggressive toward another doe's fawn. More likely to occur after weaning than before (Robinette, 1977).
    (b) Fawn desertion associated with tagging or collaring fawns immediately after birth. Material attachment strengthened by licking and nursing fawn, and consuming afterbirth (Robinette, 1977; Flock, 1974).

V. Behavior
A. Daily Behavior
1. Feed early morning, late afternoon and night.
2. Spend heat of the day bedded in cover.

C-099834

B. Social Aggregations

Extremely varied

1. Winter - Gregariousness increases. Large groups of both sexes seen before spring migration.
2. Spring - Large bands concentrated on holding areas.
3. Summer - Smallest groups seen during fawning. Yearlings driven off by fawning mothers may join other yearlings, older bucks and nonproductive does.
4. Fall - Deer may group on fall-holding areas. Adult bucks bond together in late summer and fall until breeding season (Robinette, 1977).

C. Home Range

1. Definite summer and winter ranges exist. Same areas used each year.
2. Size - Summer range twice that of winter range. Varies greatly.

   Central Sierra (blacktails): bucks, 90 acres; does, 17 acres (Taylor, 1956).

   Washington: 633.2± 474.4 acres (Steigers, 1979).

   Wisconsin (whitetails): 438.7 acres (Larson, 1978).

   British Columbia (whitetails) 594 acres (Bradley, 1980).

D. Migration

1. Seasonal migrations occur. Upslope movement when herbaceous vegetation dries out on winter range accompanied by greening of higher elevations. Downward movement stimulated by first winter storms (Ashcraft, 1974).
2. Length of migrations - up to 100 miles (Taylor, 1956).
3. Winter Range
   (a) Winter at elevations below 3,000 feet.
   (b) Does and fawns arrive first; followed by bucks. Early November for Lake Hollow herd. Response to storm approach (Hodson, 1956).
   (c) Preceded by several weeks on "holding areas", lower glades (elev. 3,000-5,000 ft) above winter range. Area selected for acorns and dense cover (Hodson, 1956; Rempel,).
   (d) Transitional "holding areas" may be used as winter range during mild winters (Kie, 1980).

C-099835

(e) Once on winter range, Lake Hollow deer feed on grasses and forbs. Compete with livestock. Prevents range recovery (Hodson, 1956).

(f) Critical winter range defined as area deer will concentrate on in severe winters. Occurs once every 4-5 years. Below 3,500 feet. South-facing slope of less than 70%. Improvement of transitional range may take pressure off critical ranges (Trinity County) (Kie, 1980).

4. Summer Range

(a) Summer above 5,000 feet.

(b) Deer arrive in late May when drying occurs on winter and transitional range. Increased insect harassment may be secondary stimulus.

(c) Spend preceding 4-6 weeks on transitional exposed south- and west-facing slopes at 2,000-4,000 feet. Selected for herbaceous feed (Hodson, 1956).

5. Migration Corridors

(a) Drainages followed to and from seasonal ranges. Same trails used each year. Corridor of trails as wide as 3/4 mile (Rempel,).

(b) Pass through transitional "holding areas" (Rempel,).

(c) Critical to herd production limitations.

(1) Spring - Nutritional plane of pregnant doe critical during last 12 weeks of pregnancy when most of fetal growth occurs (Ashcraft, 1974; Rempel,).

(2) Fall - Forage conditions responsible for:

(1a) Ovulation rate in does.

(2b) Possible fawn loss. Responsible for 52-77% of fawn loss (Ashcraft, 1974).

6. Effects of Water Projects

(a) Adverse impacts

(1) Inundation of winter range.

(2) Barrier to migration (Kie, 1980; Calif. DFG, 1963).

(b) Mitigation - resolution of short-term construction impacts.

(1) Construction facilities located in area of lower winter range value.

(2) Reseeding of disturbed area (Bradley, 1980).

C-099836

(c) Compensation - offsets long-term unavoidable damage.

(1) Construction of deer overpasses or underpasses.

(2) Purchase of adjacent parcels. May require intensive manipulation to improve low capacity (Bradley, 1980; Calif. DFG, 1963).

(3) Continuing research on habitat requirements.

(4) Long-term management program (Bradley, 1980).

VI. Nutrition

A. Feeding Habits

1. Feed in early morning and late evening.
2. Browsers and grazers (Taylor, 1956).

B. Food Utilization for Lake Hollow Herd - reflects food availability, plant growth and location of herd.

1. Fall - Acorns and scrub oak utilized heavily.
2. Winter - Grasses and forbs constitute bulk of diet. Chamise secondary.
3. Spring - Mostly grasses and forbs. Some browse species, especially scrub oak and Ceanothus (Hodson, 1956).
4. Summer - Use of browse species increases, especially Ceanothus cordulatus. Grasses and forbs secondary (Hiehle, 1956).

C. Percent Volume of Plants from Stomach Samples Collected on Lake Hollow Winter Range, December 1954-1955.

Chamise (Adenostema fasciculatum)	41%
Scrub oak (leaves) (Quercus dumosa)	4%
Buckbrush (Ceanothus cuneatus)	4%
Toyon (Photinia arbutifolia)	Tr.
Manzanita (Arctostaphylos sp.)	-
Yerba Santa (Eriodictyon californicum)	10%
Mountain mahogany (Cercocarpus betuloides)	-
Blue oak (Quercus douglasii)	Tr.
Willow (Salix sp.)	Tr.
Oak (acorns) (Quercus douglasii)	Tr.
Coffeeberry (Rhamnus californica)	-
Horehound (Marrubium vulgare)	14%
Red stem filaree (Erodium cicutarium)	Tr.

C-099837

Eriophyllum (Eriophyllum sp.)	Tr.
Grass (green) (Gramineae)	22%
Grass (dry) (Gramineae)	4% (Hiehle, 1956)

VII. Predators in Order of Importance

1. Mountain lion able to kill adults and fawns.
2. Domestic dog prey on adults and fawns.
3. Coyote will take adults or fawns. Ineffective predator.
4. Black bear usually take fawns.
5. Bobcat prey on adults and fawns (Taylor, 1956).
6. Raptors prey on young fawns (Robinette, 1977).

VIII. Management and Research Techniques

A. Age Determination

1. Adults

(a) Dentition

(1) Irruption of teeth in lower jaw (Giles, 1971).

(2) Tooth annulations (Giles, 1971).

(b) Weight of eye lens accurate for fawns and yearlings. Eyes stored in 10% formalin several weeks before drying (Robinette, 1977; Giles, 1971).

2. Fawns

(a) Condition of umbilicus

(1) Wet and fresh - Day 1

(2) Scabbed - Day 2

(3) Disappearance of scab - Day 14

(b) Measurement from fleshline to lowest line of post-natal hoof growth (designated by lines or grooves parallel and adjacent to fleshline).

$$\text{Growth (mm)} = 0.66 + 2.2 \cdot (\text{age in days})$$

(c) Presence of soft, semigelatinous yellow pad on hoof indicates age of less than 24 hours.

(d) Presence of gelatinous, yellow pad on dew claws indicates age of less than 24 hours. Withers to black by Day 1. Drops off within 8 days (Neal, 1980).

3. Fetuses can be aged by established developmental characters or crown-rump length (Giles, 1971).

B. Sex Determination

1. Live animals sexed in the flesh by secondary sexual characteristics and gonads.
2. Fetuses sexed by microscopic examination of extra-embyonic membranes for presence of sex chromatin particles next to nuclear membranes. Presence indicates female; absence indicates male (Giles, 1971).
3. Skeleton sexed by presence of tuberosities where ligaments supporting penis attach in the male; absent in female (Giles, 1971).

C. Deer Health and Condition

1. Common indices indicative of nutritional plane.
   (a) Bled carcass weight - BCW
   (b) Eviscerated carcass weight - ECW
   (c) Crown-rump length - CR
   (d) Forehead-rump length - FR
   (e) Hindfoot length - HFL
   (f) Kidney fat index - KFI
   (g) Femur marrow fat index - FMF (firm yellowish-white marrow indicates good helath; red and gelatinous in animals in poor health.) (Giles, 1971).
   (h) Adrenal gland weight
   (i) Number of fetuses (Kie, 1980)
2. Frequency of occurrence of external and internal parasites. See list on pages 6-7 (Kie, 1980).
3. Amount of fat deposition on rump, tail, ribs and brisket (Hodson, 1956).

D. Censusing Techniques

1. Pellet group counts
2. Kelker index
3. Lincoln index
4. Kings Method

5. Winter Trend Counts
6. Drive Counts
7. Temporal Census
8. Track Counts

E. Tagging Techniques
1. Cattle or sheep ear tags
2. Color coded ear streamers
3. Colored plastic collar with elastic insert
4. Radio-telemetry collar (Uses of)
(a) Fawn mortality and behavior
(b) Delineation of summer and winter ranges and migration routes
(c) Size of home range
(d) Habitat use
5. Plastic cylinder bearing serial number imbedded in skin close to base of ear.

F. Trapping Methods
1. Cluster snares
2. Clover single-gate trap
3. Corral traps
4. Injection of drugs
(a) Nicotine salicylate: 8.8 mg/kg
(b) Succinyl choline chloride: 0.04-0.06 mg/kg (Giles, 1971).

G. Range studies and surveys determine amount of forage.

H. Study exclosures determine effects of browsing (Calif. DFG, 1963).

IX. Habitat Improvements

A. Basic Axioms
1. Early stages of plant succession more beneficial than climax vegetation.
2. Mixture of plant communities provides better habitat than single community.
More browse preferable to less browse (Schmidt, 1978).

B. Problems
Mature decadent forage due to elimination of fire. Contains less moisture, minerals, crude protein per unit dry fiber. More crude fiber (Kie, 1980; Calif. DFG, 1963).

C. Improvements

1. Manipulation of brush - requires gentle slope and good soil.

(a) Controlled burns increase forage production.

(1) Ten-year rotational chamise burn program maintains constant supply of quality browse. Ten percent of each square mile burned annually with reseeding of grasses and forbs, rest left for cover. Irregular-shaped burns produce maximum "edge effect" (Longhurst, 1975).

(2) Ceanothus sp. burned every 20 years with no reseeding of grass. Seedling germination enhanced by fire (Kie, 1980).

(b) Bulldozing of dense chaparral stands (Calif. DFG, 1963).

(c) Hand chopping (Calif. DFG, 1963).

2. Logging

(a) Opens up forest canopy, increasing amount of sunlight to ground. Browse production stimulated (Calif. DFG, 1963).

(b) Mitigation of adverse impacts

(1) Small regeneration cuts of less than 20 acres.

(2) Slash left as cover, especially near roads.

(3) Roads closed and seeded after logging completed.

D. Response of Deer to Habitat Manipulation

1. Deer capable of detecting habitat improvement up to one-half mile off home range. Not all deer respond to changes off home range, so 100% utilization of improved forage is not assured (Jordan, 1967).

2. Average densities of different habitats

Chaparral	30 deer/sq. mi.
Wildland burn	44-120 deer/sq. mi.
Scrubland	84-131 deer/sq. mi. (Ashcraft, 1974).

3. Increased carrying capacity of manipulated habitats

(a) Lake County (burned brush) - 20 deer/sq. mi. to 75 deer/sq. mi. (Longhurst, 1975).

(b) Northern Siskiyou County (Wildfire, 1957) - fall fawn/doe ratio increased from 40:100 to 60:100 (Ashcraft, 1974).

(c) Weaverville area (prescribed burns, 1978-1979)

Musser Hill: increase from 43 deer days use/acre (DDU/ac) (1963) to 67 DDU/ac (1980).

Ferry Gulch: increase from 34 DDU/ac to 68 DDU/ac (Kie, 1980).

C-099842

REFERENCES

Ashcraft, Gordon. 1974. Fawn Survival and the Granite Fire. Calif. Dept. Fish and Game. Study plan and guidelines. 15 pp.

-----. Forage Limitations. Summer and Winter Ranges. Calif. Dept. Fish and Game. 3 pp.

Bradley, R. M., E. T. Quirk and G. Woods. 1980. Protecting the White-tailed Deer at the Seven Mile Scheme. Water Power and Dam Construction.

Browning, B. M., R. W. Schulenburg and O. Brunetti. 1973. Railroad Flat Deer Study. Calif. Fish and Game, PR W-52-R Project Report. 49 pp.

California Dept. of Fish and Game. 1963. Outdoor California. Vol. 24(10). 31 pp.

Control Data Corporation and Northwestern University. 1975. SPSS - Statistical Package for the Social Sciences. Minneapolis, Minn.

Flock, Alan, and S. J. Stiver and M. Sevon. 1974. Mule Deer Fawn Survival. Nevada Dept. of Fish and Game. Wildlife Restoration Project W-48-5. Job Progress Report. 11 pp.

Giles, Robert H. (ed.). 1971. Wildlife Management Techniques. The Wildlife Society. Washington, D.C. 633 pp.

Hiehle, Jack L. and Howard R. Leach. 1956. Food habits of the Tehama Deer Herd. Calif. Fish and Game. Wildlife Restoration Project W-25-R. 18 pp.

Hodson, Ernest E. 1956. Two Yolla Bolly Unit Deer Herds. Calif. Dept of Fish and Game. Wildlife Restoration Project W.

Jordan, P. A. 1967. Ecology of Migratory Deer in the San Joaquin River Drainage. University of Calif., Berkeley. Ph.D. dissertation. 278 pp.

Kie, John G., and John W. Menke. 1980. Deer Response to Trinity River Habitat Manipulation. USDA Forest Service, Calif. Dept. of Fish and Game, Trinity River Basin Fish and Wildlife Task Force. A cooperative study. 158 pp.

Larson, Thomas J., O. J. Rongstad and F. W . Terbilcox. 1978. Movement and Habitat Use of White-tailed deer of Southcentral Wisconsin. J. Wildl. Manage. (42(1):113-117.

Longhurst, William M. 1975. Burning Chaparral for Deer Habitat Improvement. Wildland Resources 3(a), University of Calif. Davis, Cooperative Extension. 2 pp.

McCullough, Dale R. 1979. The George Reserve Deer Herd. University of Michigan. 271 pp.

Mueller, C. C. and R. M. F. S. Saddleir. 1980. Birth Weights and Early Growth of captive Mother-raised Black-tailed Deer. J. Wildl. Manage. 44(1):268-271.

Neal, Donald L. 1980. A Study of the Influence of Cattle on Fawn Habitat Use. USDA Forest Service. PSW 1702. A study plan. 38 pp.

Rempel, R. and R. Bertram. North Kings Deer Project. Calif. Fish and Game. 17 pp.

Robinette, W. L., N. V. Hancock and D. A. Jones. 1977. The Oak Creek Mule Deer Herd in Utah. Utah State Division of Wildlife Resources. 148 pp.

Salwasser, Hal. 1979. The Ecology and Management of the Devil's Garden Interstate Deer Herd and its Range. University of Calif., Berkeley. Ph.D. dissertation. 377 pp.

Salwasser, Hal and David Jessup, D.V.M. 1978. "A Methodology for Performing Necropsies and Data Analysis on Road-killed Deer".

Schmidt, John L. and Douglas L. Gilbert (eds.). 1978. Big Game of North America. Stackpole Books, Harrisburg, Pennsylvania. 494 pp.

Smith, Ronald H. and Albert Lecount. 1979. Mortality and Movements of Mule Deer Fawns in Washington. J. Wildl. Manage. 43(3):657-665.

Soil Conservation Service and Forest Service. Soil Survey, Tehama County, California. pp. 32-61. 1967.

Steigers, William D. and Jerran T. Flinders. 1979. Mortality and Movements of Mule Deer Fawns in Washington. J. Wildl. Manage. 44(2):381-389.

Taylor, Walter P. (ed.). 1956. The Deer of North America. Stackpole Company, Harrisburg, Pennsylvania and The Wildlife Management Institute, Washington, D.C. 668 pp.

Thomas, Jack Ward. Wildlife Habitats in Managed Forests. Washington, D.C. 80 pp. 1979.

CHAPTER 7.

REDISTRIBUTION OF MIGRATORY WATERFOWL WINTERING IN THE SACRAMENTO VALLEY

Construction of large surface storage facilities in the Central Valley has resulted in a significant redistribution of waterfowl concentrations on their traditional wintering grounds. Typically, large flocks of ducks and geese are attracted to large open water surfaces. Often, the result of this redistribution is crop depredation on lands adjacent to reservoirs and a decline in hunting success on privately and publicly owned wetland in the vicinity. This decline of hunting success on wetland habitat can have negative implications to the long-term maintenance of these lands as wetland habitat. Presently, the maintenance of much of the remaining wetlands in the Sacramento Valley and their long-term existence depend to a large degree upon a quality waterfowl hunting experience. If by construction of Thomes-Newville Reservoir, waterfowl hunting declined significantly in nearby wetland areas, the stimulus to convert these lands (generally only on privately owned land) to agricultural uses, rather than maintaining them as wetland habitat, could be increased. The result may be a decline in acreage of an already diminished and threatened habitat.

The directors of the Departments of Water Resources and Fish and Game agreed in the fall of 1979 that management plans designed to prevent waterfowl rafting on Los Vaqueros and Glenn Reservoirs would be required as part of planning for these projects.

The intent of this study was to determine, if possible, potential waterfowl use on Thomes-Newville reservoir and to develop management plans designed to alleviate waterfowl concentration.

Method

Evaluation of the potential for a Newville reservoir to attract and hold large waterfowl numbers was determined by surveys, literature review and discussion with the knowledgeable individuals. Black Butte, Stony Gorge, East Park and Indian Valley reservoirs were surveyed by airplane from November 4, 1981 to December 16, 1981. Four surveys were flown and these were fair weather days.

Techniques to alleviate large scale waterfowl rafting were developed by literature search and discussion with knowledgeable individuals.

Results and Discussion

No significant, large scale concentration of waterfowl were observed on the reservoirs surveyed during this study (Table 7-1). East Park reservoir maintained the highest numbers of waterfowl throughout the surveys. Pintail, mallard and Canada geese were the most common waterfowl species observed. On November 4 about 950 Canada geese were counted on East Park Reservoir.

The number of waterfowl observed during this brief study was markedly less than the 250,000 to one million ducks and geese often observed rafting on San Luis reservoir or the thousands of birds observed at Clifton Court, Bethany or Thermalito.

Several factors such as reservoir size and proximity to traditional waterfowl feeding or resting areas probably contribute to waterfowl rafting on reservoirs.

Thomes-Newville would be a significantly larger reservoir than the local reservoirs surveyed. However, reservoir size may not be the determining factor for waterfowl rafting as small reservoirs such as Bethany, Clifton Court and Thermolito often hold large waterfowl numbers (Table 7-2).

TABLE 7-1. Numbers of Waterfowl Observed by Survey Date and Reservoir (Not Including Coots or Cormorants).

	11/4	11/18	12/2	12/16
Black Butte	120	0	450	310
Stony Gorge	80	150	630	517
East Park	1,296	459	1,400	1,205
Indian Valley	230	85	648	600

TABLE 7-2. Surface Area of Selected Reservoirs

	Areas
Thermalito	4,550
Stony Gorge	1,275
East Park	1,820
Black Butte	4,560
Clifton Court	2,500
Bethany	180
San Luis	12,700
Indian Valley	4,000
Thomes-Newville (Proposed)	14,000

Proximity to native wetland or other waterfowl concentration areas may be the deciding factor in predicting waterfowl rafting on reservoirs. Clifton Court and Bethany are within close proximity to the Delta and the Suisun Marsh; San Luis is close to the Grasslands and Thermalito is close to the Butte Basin.

The considerable distance of Thomes-Newville reservoir from the Colusa Basin (the closest traditional feeding and resting area to large numbers of waterfowl) and the results of the very limited aerial survey lead us to believe that waterfowl rafting will not be a significant problem with the Thomes-Newville project.

At times though, under adverse weather conditions or other unknown factors, rafting may occur.

We have considered several potential programs that could be initiated as mitigation in the event a rafting problem occurs.

If mitigation is needed, it would be a project responsibility and must be funded by the project and should be implemented and managed by the DFG.

Actions to curtail or alleviate rafting problems should include, but should not necessarily be limited to the following:

1. Newville Reservoir in its entirety should be open to hunting during the hunting season. (This action should be implemented regardless of a rafting problem.)
2. Encourage waterfowl hunting by establishing and maintaining floating blinds and designating certain shoreline portions of the reservoir as waterfowl blind areas. Allow "mother ships" for scull boaters to moor during the hunting season and promote sculling.

3. As part of a reservoir management plan, seek to establish an attractive winter fishery. Strategically located covered docks anchored offshore with slips for boat tie-ups are one possibility. Fish could be attracted by submerged lights at night and bundles of brush tied beneath the docks would provide a haven (and an attraction) during daylight. These fishing floats would be primarily for recreation and fish enhancement; hence, a non-project cost. The primary benefit for wildlife would be to discourage rafting by increasing boating activity on the reservoirs.

These measures if implemented would aid in curtailing the rafting potential of a Newville Reservoir. Cost estimates for these measures are not known at this time but should be developed if the project is pursued in the future.

CHAPTER 8

PROJECT IMPACTS AND COMPENSATION/MITIGATION SUGGESTIONS

Construction of a Thomes-Newville project would result in the direct loss of 6 080 ha (15,000 acres) of wildlife habitat. Wildlife populations in the project area would be reduced accordingly. Complete assessment of the magnitude of these losses required for full disclosure of project impacts would require analysis of population study data which were recorded and prepared for computer analysis. Although this analysis has not been conducted, considerable additional insights into wildlife concerns originally presented during reconnaissance-level studies have been gained.

The grassland component of habitat which would be lost provides valuable foraging area for raptors such as golden eagles and prairie falcons. Nearby isolated cliffs such as those existing along Rocky Ridge and on Williams Butte provide nesting habitat for these species. Raptors, mammalian carnivores, and prey populations of rodents as well as several species of passerine birds would suffer habitat loss resulting from inundation of the extensive grassland habitat. This habitat loss should be considered an unavoidable impact of the project since the opportunity to compensate such a loss is impractical. The size of the area inundated and the lack of opportunity to create this type of habitat or to improve the carrying capacity of similar habitat in the vicinity are the limiting factors. Some species utilizing grassland habitats may benefit from improvement of habitat diversity and productivity resulting from chaparral management practices as discussed in Chapter 6 and later in this chapter.

Concern was originally expressed during reconnaissance studies that construction of a large reservoir in the Newville area could result in

detrimental redistribution of migratory waterfowl wintering in the Sacramento Valley. Further study indicates this problem should be minimal if it develops at all.

The Thomes-Newville project would create additional habitat for water oriented birds such as grebes and gulls. Additional habitat would also be provided for shorebirds and wading birds such as herons and egrets. The reservoir would provide water for wildlife utilizing habitat surrounding the reservoir during the arid summer period when water is generally a limiting factor in the foothills on the west side of the Sacramento Valley. The provision of water and the possibility of the maintenance of green vegetation along the reservoir margin would be an attraction to wildlife.

Road relocations such as the proposed alignment of the Newville Road between the reservoir and Rocky Ridge would result in a greater incidence of wildlife-automobile interaction. Wildlife losses and hazards to motorists would result. This problem would be amplified to the extent that road design speed is increased due to road condition improvements (such as increased curve radius and road width). Cooperative planning efforts during final design stages should provide for alignment of roads to preclude wildlife conflicts to the greatest possible extent. An example would be the alignment of the Newville Road along the east side of Rocky Ridge.

Canals and conveyance facilities constructed for delivery of water to the reservoir from the diversion structures on Thomes and Stony creeks create a potential hazard to wildlife. Current design and operation criteria for the Thomes Creek conveyance canal precludes any serious wildlife hazard. The Thomes canal transects a deer migration area. Cooperative planning has resulted in the proposal for a wide unlined canal with gently sloping sides. The operation scheme provides for relatively infrequent

high flows in the canal and its design insures that wildlife entering the canal during periods of water diversion should be able to cross safely or escape without problem. Given the current canal design, it was felt that unrestricted movement of deer in this migration area would be a superior alternative to the provision of deer-proof fencing. Deer-proof fencing or a canal design similar to that proposed at Thomes Creek should be incorporated in plans for the Stony Creek conveyance facilities.

Recreation developments around the reservoir would result in the loss of habitat according to the size of the developments and could result in wildlife harassment in sensitive areas. Once again, cooperative planning has resulted in minimizing or eliminating proposed recreation development in critical wildlife areas. The north and northwestern margins of Newville Reservoir along with the area of the Thomes Creek Diversion[1/] facility are migratory deer winter range and migration routes pass through these areas. Low intensity recreation developments only are planned in these areas. Continued coordination should be maintained during final planning for recreation development to insure minimum impact on wildlife.

The endangered southern bald eagle winters in the Thomes Creek area. Likewise, wintering bald eagles are found along Stony Creek and at Black Butte, Stony Gorge and East Park reservoirs. Primary concerns for maintenance of wintering populations of bald eagles in the Thomes-Newville Project area are maintenance of riparian habitat along Thomes and Stony creeks and maintenance of fish populations. Analysis of current operation criteria indicate that riparian habitat will probably not be adversely effected by the project. Maintenance of fish populations in Thomes and

1/ This impact is based on the present design of a very small diversion dam and reservoir on Thomes Creek. A larger facility, such as Paskenta Reservoir, would cause severe losses to wintering deer and should not be considered.

Stony creeks is discussed later in this report. Areas along the Newville Reservoir margin with good perching habitat such as digger pines and larger oak trees should be identified and set aside as protected areas to promote reservoir use by wintering eagles.

Construction of the Thomes-Newville project would result in the loss of approximately 19% of current winter range of the Thomes Creek deer herd. Evidence indicates this impact may be compensated by improving winter range habitat above the reservoir site, much of which is now considered transitional range. Acquisition of privately owned key winter range habitat in the vicinity of the Thomes Creek Diversion and immediately upstream and implementing a management program specifically for deer has the greatest potential for compensation. Size and location of such an area could be determined following analysis of telemetry data as discussed in Chapter 9. Encouragement of the various habitat improvement programs currently under way on public and private lands through continued involvement in the Coordinated Resource Planning Program for Thomes Creek drainage would contribute to restoration of historic deer use patterns. Historically deer wintered above the proposed reservoir site.

Prescribed burning is the habitat management technique with the best potential for application to any lands acquired or managed for deer winter range.

Prescribed burning is the controlled and directed use of fire for the improvement of the land resource. The intent is to increase water yield, decrease the potential for fire, and create more usable forage space for wildlife and livestock.

Prescribed burning can help improve deer habitat. The controlled and rotational use of fire provides deer with a continuing supply of necessary

food and cover material. This results in the maintenance and/or improvement of the health of the deer herd but not necessarily an increase in the size of the herd.

To maintain or improve deer habitat, prescribed burning should result in (1) an increased range diversity, (2) an increase in the production, nutrition, and palatability of vegetation, (3) adequate protective cover, and (4) increased accessibility and maneuverability within the areas managed. These goals can be achieved by modifying existing vegetation. This is done with seasonally timed burns in which the size and shape of the burn area is controlled. Rotational reburns, crushing, chaining, and reseeding following burning are additional means of vegetation manipulation.

The following prescribed burn management guidelines are recommended for deer habitat improvement if deer are to benefit from controlled burns.

Habitat Diversity

Deer benefit from the diversity in habitat that can result from prescribed burning. Vegetation variety, which is important to deer health, usually increases in areas opened by burning. However, opened feeding areas need to be interspersed with cover for escape, loafing, bedding, and feeding. Therefore, when burning south-facing slopes, two-thirds of the area should be opened up for feeding and one-third for cover. On north-facing slopes, where more shelter is needed, one-third of the area should be burned and two-thirds left for cover. Deer require that escape cover be within 100 yards from the center of an opened area. In addition, irregular shaped burns provide an increased perimeter. This makes for more efficient use of an area by maximizing interspersion of food and cover. Also, deer will benefit from the greater vegetal variety, which results from an increased edge.

Size of Burns

Burning a large area should be done in steps over a period of time to maintain a balance between deer use and plant regeneration (Longhurst, 1969). Burning 3-5% of the deer range every year maintains the balance between deer use and plant regrowth. Excessive burning results in brush regrowth beyond the deer's reach much more quickly than with smaller burns. This provides more new forage than deer can consume. Therefore, many small burns creating a mosaic pattern are better than a few large burns.

Ideally 2-4 hectare (5-10 ac) burns are best. Biswell, et al (1952) reported that for density of 3.9 deer/km^2 (10 deer/mi^2), six areas of 2 ha (5 ac) each be burned per 2.6 km^2 (1 mi^2) (adjustment is made accordingly for higher deer density). However, 20-40 hectare (50-100 ac) burns may be more practical on a cost-efficiency basis.

It is unclear how increases in herd size relate to the size of prescribed burn areas with present investigation techniques. However, the size of the treatment area may be related to deer population increases when forage is the limiting factor and the treatment area affects a large portion of the population. This probably requires a treatment affecting over 10% of a deer herd (Ashcraft, DFG).

Site Selection

Small burns scattered throughout brushfields are better habitat than a mosaic formed by repeated burning adjacent to last year's projects. Also, a mosaic with a variety of elevation is better than one without. This provides a greater diversity of improved browse species available to deer.

In general, burns favoring swales, ridges, and saddles benefit deer. Deer can detect range improvements up to 0.8 km (0.5 mi) from an area normally used for daily activities (Jordan, 1967). Therefore, burning preference should be given to those areas within this range.

Areas supporting a combination of grass, brush, and woodland should be given first consideration when selecting areas for burning. These areas have the greatest potential for diversity in habitat. A variety of food and cover types are interspersed in these areas. The grass provides necessary protein. The brush supplies cover and forage material which is especially needed during the dry summer months. Acorns are a staple in the deer diet during fall.

Deer shift from browse to green grass when available in the fall, winter, and spring (Longhurst, 1970). Leopold, et al, (1951) observed that new fawns sought succulent herbage in preference to browse. It is postulated that herbaceous forage significantly affects deer herd productivity and that browse is secondarily important to the welfare of many herds in California (Ashcraft, DFG). Therefore, potential grass and forb producing areas should also be given priority when choosing burn sites to increase the availability and amount of forage for deer. Reseeding these areas with grasses and forbs, following burning, results in a more uniform supply of nutrients for deer throughout the year (Longhurst and Connolly, 1970).

Grass and forb production will increase for a year or two following brushfield burning. To further increase the amount of herbaceous material, stands of manzanita or chamise should be considered for type conversion. The reburning of chamise every 4 years, combined with reseeding, can result in conversion to grassland on suitable sites. Areas with suitable soils and warm, southern aspects should be burned and seeded with forbs and/or grasses to increase herbaceous forage. This would greatly increase the cost which must be examined in view of the benefits expected. Better areas and/or fuel breaks can be seeded with soft chess, domestic rye, or perennial Harding grass. Higher elevations can be seeded with tall fescue,

intermediate wheat and orchard grass. Seeding for annual forbs can be done with burnet, narrow-leaved plantain and creeping types of dryland alfalfa. Some areas could be revegetated with native perennial bunchgrasses (Table 8-1).

Vegetation Selection

Deer require forage that is nutritious, palatable and accessible. Burning mature or decadent plants restores these qualities. Shrubs taller than 1.5 meters (5 ft) should be burned to return vegetation to within the reach of deer. Plants that grow above the height to which deer nromally reach (about 1.35 m (4.5 ft) produce little available browse (Gibbens and Schultz, 1961). Burning rejuvenates existing vegetation by forcing succulent new sprouts to arise from stumps or by stimulating growth of new seedlings through the fire-induced germination of hard-coated seeds. However, burns that leave behind a thicket of scorched stems, which deer find impenetrable, should be avoided. Therefore, crushing is recommended for areas where burns might not carry or the fire hazard is high.

Some plants are more beneficial and/or preferred by deer than others (Table 8-2 and Chart 1). Burning can be used to change the vegetative composition to one more useable by deer. Preferred and staple plants should be increased, whereas undesirable species need to be reduced. For example, manzanita should be decreased to allow for an increase in more nutritious and palatable species.

Seasonal Timing of Burns

Desirable species may be adversely affected by burning at the wrong time of year (Biswell, et al, 1952). Different plant species respond differently to fire. Seasonal timing of burns can encourage one plant

Table 8-1. Native Perennial Grasses for Seeding on Sites in the Northeastern Portion of the California Coastal Range 1/

Low Elevation Sites (below 4,000 - 4,500 ft)

Muhlenbergia rigens (Deer grass)

Riparian sites
Seldom seeds
Vegetative reproduction possible
Seed expensive
Useful as cover

Stipa pulchra (purple needle grass)

Unsuccessful
Seed expensive
Dormancy hardening problems - needs acid treatment to break dormancy
Awns are a problem with mechanical planting

Poa ampla (native bluegrass)

Shady sites, under oaks
Shallow soils
Annual-like yearly growth cycle

Higher Elevation site (above 4,000 ft)

Agropyron pauciflorum (slender wheat grass)

Short-lived perennial
Sensitive to grazing
Inexpensive (< $1 lb) - out-of-state seed source
Frost tolerant

Poa nevadensis (Nevada bluegrass)

Seed from intermountain research station
Frost tolerant

Stipa lemmonii

Long-lived, tough and hardy
Major grass plant of higher elevations
Expensive - need to hand gather
Frost tolerant
Variety "pubescens" - State listed rare

1/ Gymen, Eldon, Range Conservationist, Mendocino NF, Calif., personal communication 2/21/82.

Table 8-2. Forage Species, Their Use by Deer and Response to Fire[1/]

Chamise (Adenostoma fasciculatum)

Staple - Spring; fall
Burn: Sprouts
Early spring to ↓ density
Seed required fire

Buck Brush (Ceanothus cuneatus)

Staple
Burn: Fall
Seeder
Successive fire kills

Deer Brush (Ceathothus intergerrimus)

Good browse - Spring, summer
Deciduous
Burn: Fall
Seeder, may sprout
Seed requires fire

Mountain Mahogany (Cercocarpus betuloides)

Preferred browse - Spring, summer
Burn: Sprouts
Seed fire destroyed
Seed in grassy areas

Scrub Oak (Quercus dumosa)

Staple - Late summer
Tolerant to use
Burn: Sprouts vigorously
October - when high risk

Manzanita (Arctostaphylos spp.)

Undesirable food, except flowers in spring and fall
Provides cover
Burn: Fall burn BAD → ↑ #'s
Most are seeders, some sprout

Interior Live Oak - (Quercus wislizenii)

Acorns - Early fall staple
Provides cover
Burn: Sprouts 1-2 years

Redberry (Rhamnus crocea)

Preferred browse - intolerant
Burn: Sprouts

Silk Tassel (Garrya fremontii)

Preferred - intolerant
Burn: Sprouts

Poison Oak (Toxicodendron diversiloba)

Good browse, especially late summer
Burn: Sprouts vigorously

Chaparral Pea (Pickeringia montana)

Young eaten in spring
Burn: Sprouts

Mountain Whitethorn (Ceanothus cordulatus)

Staple - Summer, fall
Burn: Seeder
Requires fire

Mountain Misery (Chamaebatia foleosa)

Staple
Burn: Sprouts

Oaks (Quercus kelloggii, douglasii, lobata, crysolepsis)

Acorns eaten
Burn: Sprouts

Yerba Santa (Eriodictyon californicum)

Sparingly eaten* - Winter, early spring
Burn: Seeder
Requires fire

*Eaten more when other species unavailable.

1/ Information source: H. H. Biswell, J. H. Gillman, 1961; Brush management in relation to fire and other environmental factors on the Tehama deer winter range. Calif. Dept. of Fish and Game publication 11-61.

Table 8-3. Forage Species, Use by Deer and Response to Fire

	Plant Use						Fire Response				
	Preferred	Staple	Good Browse	Acorns	Cover	Sparingly Eaten	Sprouts	Seeds	Requires Fire	Repeated Fire Kills	Regrowth Period(Years)
Chamise		X					X	X	X		7
Buckbrush		X						X	X	X	
Deer Brush			X					X	X		6
Mountain Whitethorn		X					X	X	X	X	4
Scrub Oak		X					X				
Whiteleaf Manzanita				X	X			X			
Greenleaf Manzanita							X				
Common Manzanita				X				X			
Interior Live Oak			X				X				
Redberry	X						X				
Silk Tassel	X						X				
Poison Oak			X				X				
Chaparral Pea			X				X				
Mountain Misery	X						X				
Yerba Santa						X		X	X		
Oaks					X		X				
Mountain Mahogany		X					X			X	

over another. Some plants respond by sprouting and others by seed germination (Biswell, et al, 1952). Spring burning favors sprouting species. Seed germinating species can compete more effectively against the more vigorous sprouting species if burned in the fall (Table 8-2 and Table 8-3). Therefore, fire must be used judiciously or the desirable nonsprouting species will be diminished (Biswell and Gilman, 1961).

Rotation Periods

Once initial burning is underway, repeated burns may be necessary to maintain the improved vegetal conditions. Rotation intervals are different for each plant species depending upon their rate of regrowth, fire response, and management goals. Reburns should be timed to maintain a satisfactory level of plant productivity (see Table 8-3 for recommended rotations). Sufficient time between reburns is necessary for the palatable nonsprouting species to flower and set seed (Biswell and Gilman, 1961).

Summer Deer Range

Emphasis has been placed on prescribed burn management in lower elevation chaparral. However, although not directly related to this water project, higher elevation summer deer range also needs to be considered to maintain a balance between both ranges. Many workers now believe that the level of nutrition between July and September is the most important factor influencing ovulation and deer herd productivity (Ashcraft, DFG). Therefore, mature and/or decadent stands of mountain whitehorn (Ceanothus cordulatus) should be burned for rejuvenation since it is an important summer food staple for deer (Bertram and Ashcraft, 1979). It will die in 50 years if not exposed to fire. Higher elevation areas can be seeded with suitable grasses and forbs (Table 8-1 - list of native perennial grass possibilities). An added benefit from seeding with palatable forbs is to discourage deer browsing

C-099862

Table 8-4. Recommended Rotation for Prescribed Burn Management of Vegetation

Information Source[1/]	Ashcraft, G.	Biswell, H. H.	Murray, L.	Recommended
Manzanita	If > 30 ac → convert		50 years	Convert
Chamise		10 years	15-20 years	10 years[2/]
Mixed chaparral (Incl. Ceanothus, Mtn. Mahogany, etc.)	50-60 years		35-50 years	20-25 years
Perennial grasses			10 years	10 years
Annual grasses			3 years	3 years
Ceanothus cordulatus (Mtn. Whitethorn)	15-20 years[3/]			15-20 years

---

1/ Ashcraft, G., Associate Wildlife Biologist, Calif., Dept. of Fish and Game; personal communication 2/23/82.

Biswell, H. H. 1974. The potential for controlled burning to mitigate wildlife losses on the Auburn Reservoir area. Report for River Basin Studies, U. S. Fish and Wildlife Service. August 20, 1974.

Murray, Lynn, Resource Officer, Mendocino National Forest; personal communication 2/17/82.

Recommended, Calif. Dept. of Fish and Game, Red Bluff, CA, recommendation 1982.

2/ Ideally, chamise should be burned every 3 years to maintain its maximum nutritional plane. However, conversion to grassland can result. A longer rotation is also necessary to maintain desirable seeder species within chamise stands. With grazing pressure, rest 7 years or 25 years to allow for flowering and seeding of seeder-type species.

3/ Long-term benefits may last 20-25 years under undisturbed forest canopies where regrowth is slower compared with 15-20 years in areas selectively logged or patch cut.

of timber plantations in late spring and summer. Ox-eye daisy (Chrysanthemum leucanthemum) and hawks beard (Crepis capillaris) are two forb possibilities for reseeding. All logging roads not planned for permanent use should be closed down after logging, as specified in the 1976 National Forest Management Act, and seeded to a grass-forb mix to provide herbaceous forage (Kie and Menke, 1980).

Guideline Summary

An ideal habitat is an interspersion of unburned chaparral for escape cover, burned chaparral for nutritious and accessible browse, grassland for necessary protein, and mature oaks for both browse and acorns. This situation can be achieved by following the aforementioned guidelines which are summarized as follows:

1. Diversity is provided by burning different vegetation types, species and elevations.
2. Small 2-4 ha (5-10 ac) and irregular shaped burns which result in an increased edge and interspersion of food and cover are more beneficial to deer.
3. Seasonal timing of burns should be at that time of year most conducive to the regeneration of desirable plant species.
4. Rotation periods should be at intervals which maintain the improved vegetal conditions.
5. Fuelbreaks, chamise chaparral and other suitable burn sites should be seeded with grasses and forbs to increase the herbaceous material available to deer.
6. Suitable areas of manzanita or chamise can be type converted to increase the herbaceous material available to deer.

7. Three to five percent of an area should be burned per year to balance the rate of vegetative regrowth with deer use.
8. Protective cover should be within 90 m (100 yd) from the center of opened areas for more efficient deer use of the area.

LITERATURE CITED

Ashcraft, G. C. Forage limitations - summer or winter range, a compilation in "A Coordinated Deer Management Program and Its Statewide Implications". Calif. Dept. of Fish and Game publication.

Bertram, R. C., Ashcraft, G. 1979. "Prescribed Burning to Regenerate Mountain Whitethorn, Ceanothus cordulatus, For Deer Browse".

Biswell, H. H.; Gilman, J. H. 1961. "Brush Management in Relation to Fire and Other Environmental Factors on the Tehama Deer Winter Range". Calif. Dept. of Fish and Game Bulletin 47(4):357:59.

Biswell, H. H.; Taber, R. D.; Hedrick, D. W.; and Shultz, A. M. 1952. "Management of Chamise Brushlands for Game in the North Coast Ranges". Calif. Dept. of Fish and Game Bulletin 38(4):453:484.

Burcham, L. T. 1949. "Suggestions for Improving Wildlife Habitat in California Brush Ranges". Calif. Dept. of Nat. Res., Division of For. pamph., 2/1949.

Gibbens, R. P.; Schultz, A. M. 1961. "Manipulation of Shrub Form and Browse Production in Game Range Improvement". Calif. Dept. of Fish and Game Publication.

Hodson, E. E. 1956. "Two Yolla Bolly Unit Deer Herds". Calif. Dept. of Fish and Game Publication.

Jordan, P. A. 1967. "Ecology of Migratory Deer in the San Joaquin River Drainage". U. C. Berkeley, PhD Dissertation, 270 pp., in Ashcraft, G. C., Forage Limitations. Calif. Dept. of Fish and Game Publication.

Kie, J. G.; Menke, J. W. 1980. "Deer Response to Trinity River Habitat Manipulation." A cooperative study. University of Calif., Davis. Fish and Wildlife Task Force. 158 pp.

Longhurst, W. M.; Connolly, G. E. 1970. "The Effects of Brush Burning on Deer". Cal-New. Wildlife Trans., 129-148 pp.

O'Bannon, P. 1982. District Fire Management Officer, Corning RD, Mendocino National Forest, Calif. Re: personal communication March 17, 1982.

CHAPTER 9

FUTURE WILDLIFE STUDY NEEDS

The decision to curtail field studies for this project required work to be redirected toward wrapping up work in progress and preparing status reports. The abrupt termination of studies resulted in some wildlife studies being incomplete due to insufficient data. Others are incomplete due to an inability to adequately analyze data which were recorded and prepared for computer analysis.

The first phase of any future wildlife studies at Thomes-Newville should be a thorough analysis of data collected during studies described in this report. Following analysis, determinations should be made on which studies should be continued and what type of additional studies would be required to provide for full disclosure and effective compensation of project impacts.

It is anticipated that no further detailed study of the Thomes Creek Deer Herd is required to adequately describe the resource and probable project impacts. Future work should be directed toward development of specific mitigation measures including identification of potential mitigation lands and measurement of their habitat improvement potential. Site-specific studies would be required to accomplish this task. All efforts should be directed toward compensation of project-induced impacts. Funding estimates for completion of these studies are:

	Months	Cost
Environmental Services Supervisor @ $2,814	1.5	$ 4,300
Associate Wildlife Biologist @ $2,332	6	14,000
Assistant Wildlife Biologist @ $1,935	9	17,400
Personal Service @ 40%		10,700
Graduate Student Assistant @ $1,006	30	30,200
Seasonal Aid @ $725	24	17,400
Equipment and Operating Expenses		10,000
Travel		5,000
Overhead @ 13.3%		14,500
		$113,500

Upon completion of analysis of data collected during the studies summarized in this report and any additional studies deemed necessary, a wildlife habitat management agreement should be prepared between the Department of Fish and Game and the Department of Water Resources.. This agreement would clearly spell out all measures to prevent or minimize project impacts and all measures required to compensate unavoidable impacts. To the extent that measures implemented on Mendocino National Forest lands could be credited as partial compensation for project impacts, the U. S. Forest Service should be included in the agreement. The agreement would clearly define the responsibilities of each agency and a wildlife planning and evaluation team would be formed wherein each agency would be represented. The provisions of the wildlife habitat agreement should be integrated to the greatest possible extent with the objectives of the Coordinated Resource Plan currently being developed and implemented for the Thomes Creek area.

CHAPTER 10. FISHERIES

METHODS

Resident Fishes

Reservoir Site and Downstream Areas

Streams potentially inundated by the proposed Newville Reservoir as well as downstream areas of Thomes and Stony creeks were sampled for resident fishes.

Selected sections of these streams were blocked by nets at each end to prevent fish from entering or leaving the enclosure. Sections varied in length from 10 to 42 m (33 to 138 ft). Fish were captured by backpack electrofishing. Fork lengths of fish were measured to the nearest millimetre, and weights were determined to the nearest gram by water displacement (weight of fish in grams is equivalent to cc's of water displaced). The surface area of each station was measured.

Population number, biomass estimates, and 95% confidence intervals for each species were developed by using the two-pass method of Seber and LeCren (1967).

Seven sections were sampled in streams within the Newville Reservoir site. These include North Fork Stony, Salt, and Heifer Camp creeks (Figure 10-1). Ten sections in Stony Creek and 15 in Thomes Creek were sampled (Figures 10-2 and 10-3).

Sacramento Suckers and Squawfish

Juveniles

To capture juvenile and larval Sacramento sucker, Catostomus occidentalis, and squawfish, Ptychocheilus grandis, migrating to the Sacramento, a funnel net

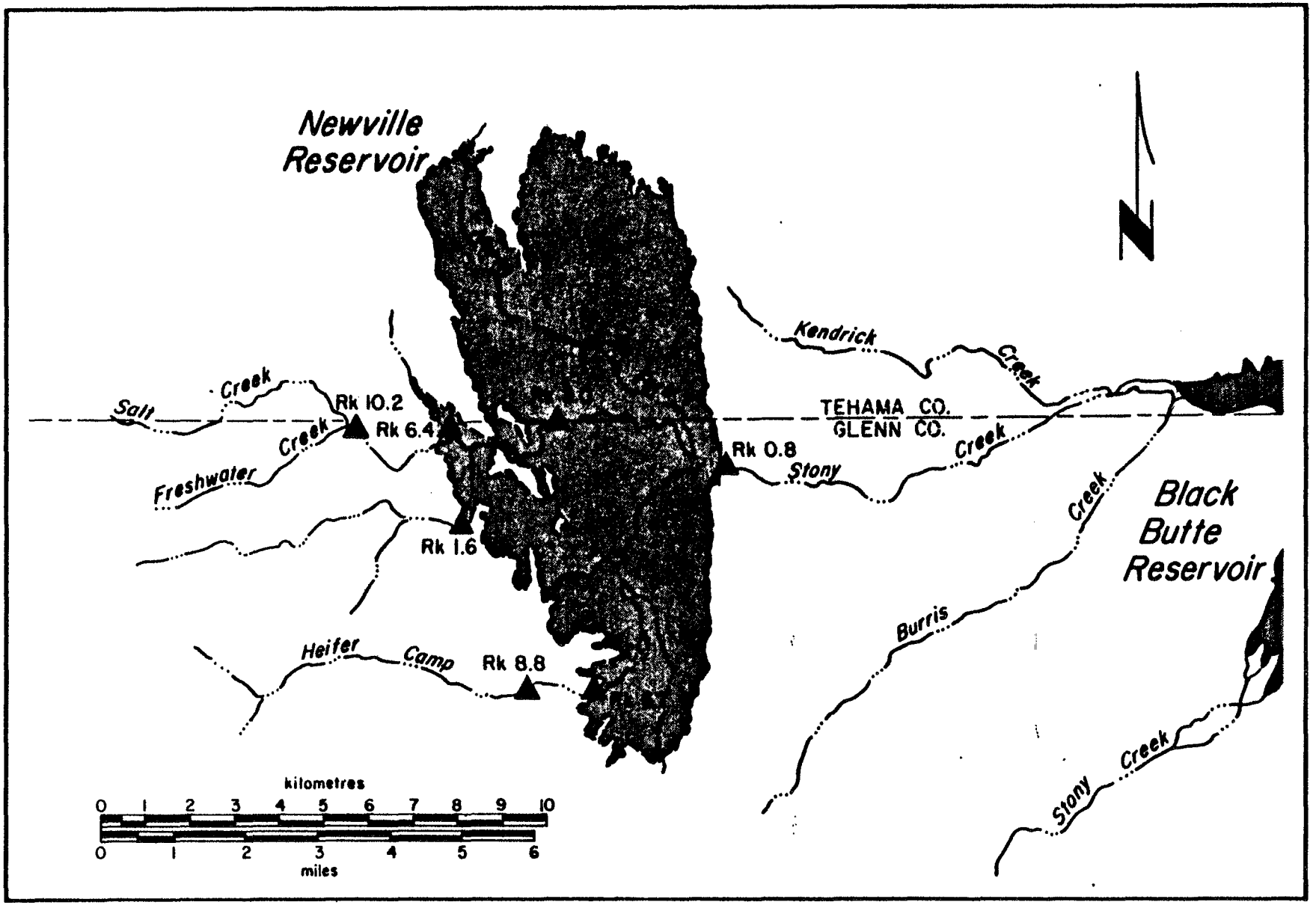

FIGURE 10-1. Sample locations for resident fishes in streams within the Newville Reservoir site.

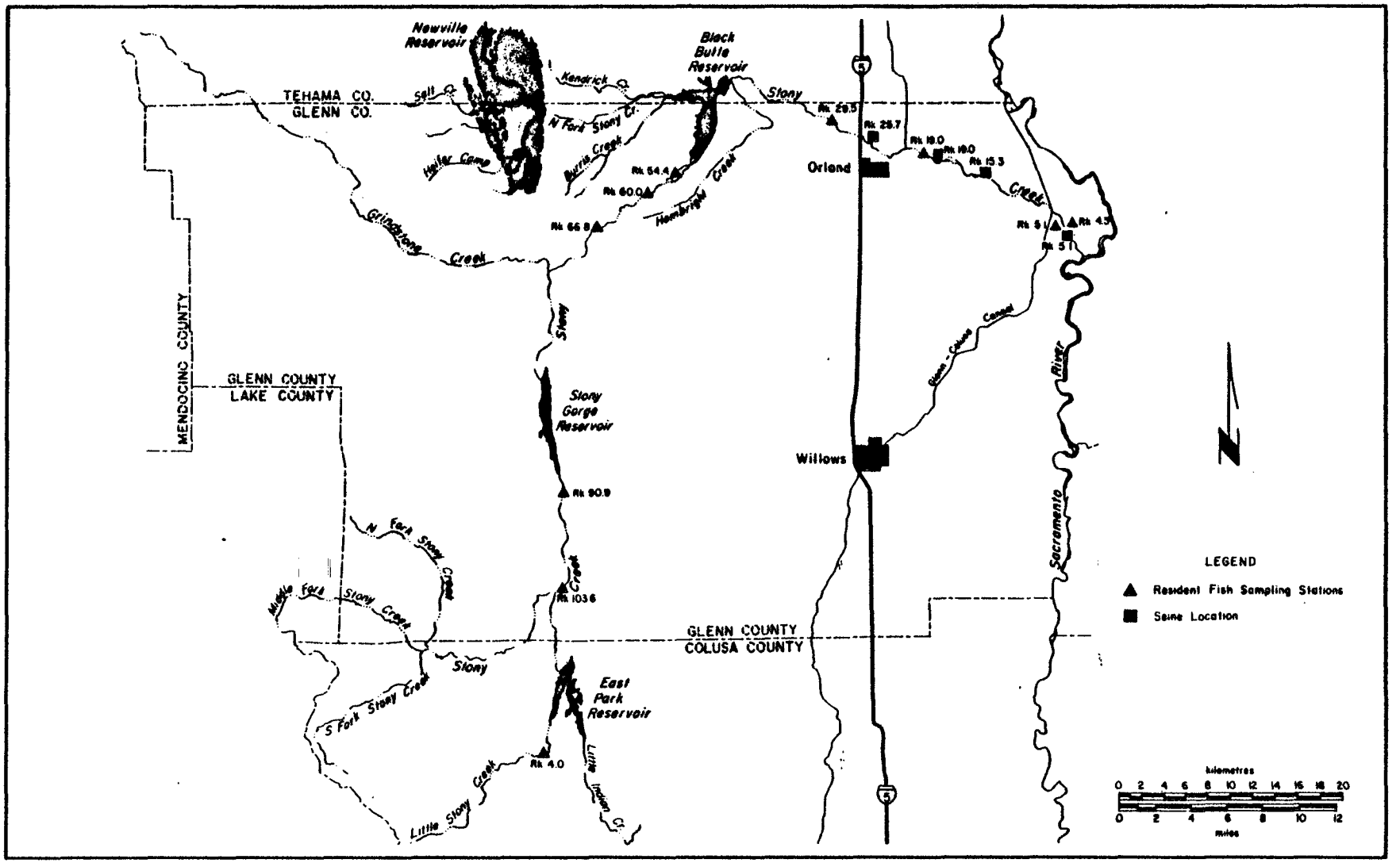

FIGURE 10-2. Sample locations for fishes in Stony Creek.

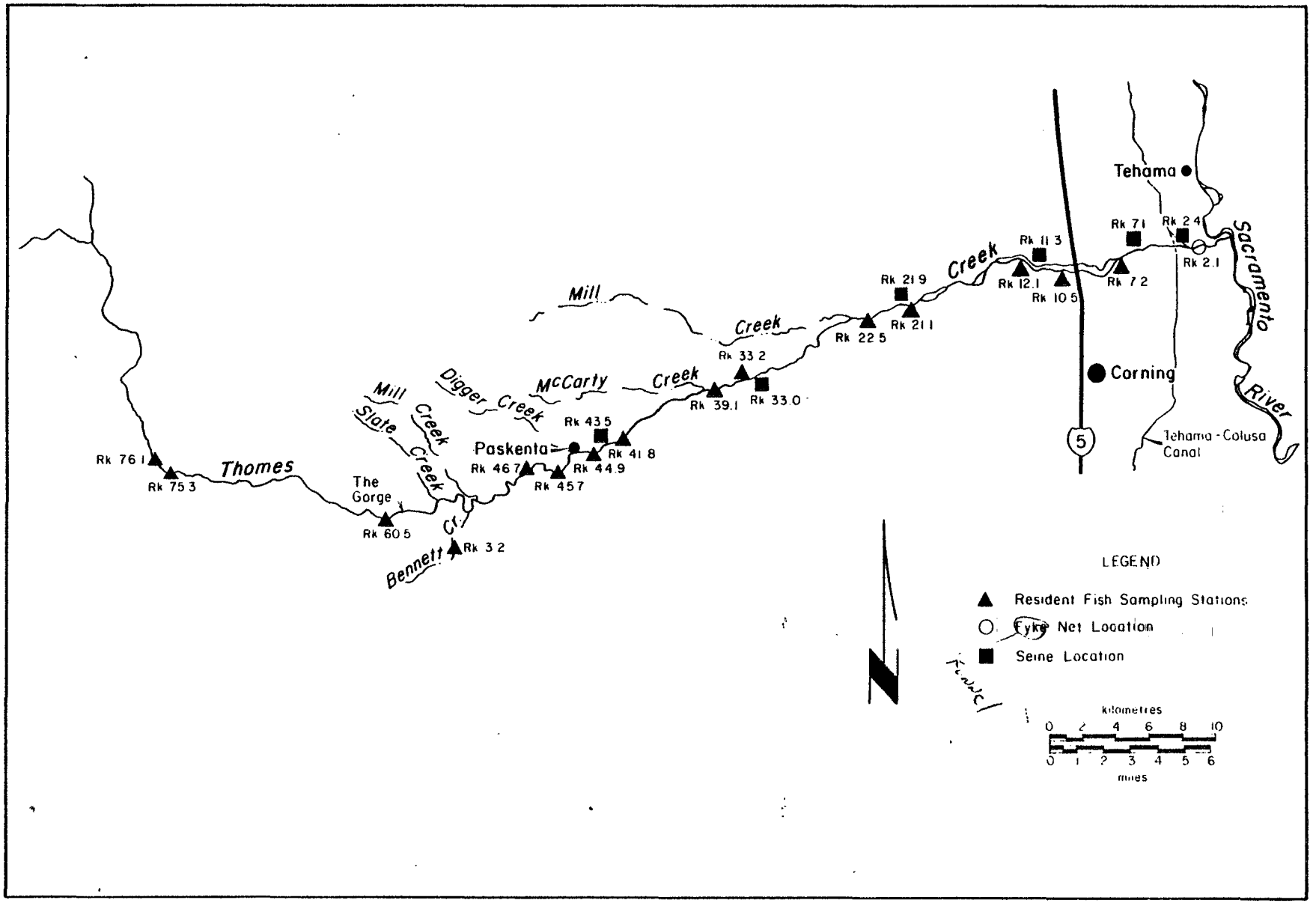

FIGURE 10-3. Sample locations for fishes in Thomes Creek

constructed of 0.8 mm (0.03 in.) oval mesh netting mounted on a 0.3 m x 0.6 m (0.01 in. x 0.02 in.) square metal tubing frame was placed in the creek near the mouth of Thomes Creek RK 1.9 (RM 1.2).[1/] A perforated aluminum box 0.5 m x 0.5 m x 1.0 m (1.6 ft x 1.6 ft x 3.3 ft) was attached to the cod end of the net to receive captured fish. The net was fished 24 hours per day during weekdays from January to June, 1981.

The captured fish were identified, counted, and measured (fork length) to the nearest millimetre.

Adults

To estimate the population of spawning Sacramento suckers and squawfish, adult fish were captured in Thomes Creek between RK 1.9 and RK 44.3 (RM 1.2 and RM 27.6) and in the lower 2 km (1.2 mi) of Mill Creek, a tributary at RK 24 (RM 14.9)(Figure 10-3). From December, 1980 through June, 1981, 17 samples were taken at 10-day intervals.

Fish were captured by drift electrofishing from a rubber raft. A 3.7 m (12 ft) Avon rubber raft was retrofitted with a Smith-Root Type VII electroshocker. The battery and electroshocking unit were placed inside an ice chest and secured to the raft's rowing frame. Probe arrays were constructed of 2 mm (0.08 in.) stainless steel cable and attached to the bow of the raft and fished at a depth of 1.5 m (4.9 ft).

Each fish was weighed to the nearest 8 g (0.3 oz) and fork lengths were measured to the nearest millimetre.

Each fish was marked with a Floy spaghetti tag and released. The tag was inserted under the dorsal fin and tied in a loop. The method of Jolly-Seber (Seber 1973) (Appendix 1) was used to determine the population estimates for Sacramento suckers while the Schaefer method (Ricker 1975) (Appendix 2) was used to estimate the population of Sacramento squawfish.

1/ RK is river kilometre, RM is river mile.

Juveniles

The juvenile chinook salmon, Oncorhynchus tshawytscha, emigration from Stony and Thomes creeks was monitored for three years, 1980 to 1982. Two methods of sampling were employed: seining in selected areas and funnel netting at a fixed location.

1. Seining

Six sample stations were chosen in Thomes Creek between the mouth and Paskenta, while four sample stations were chosen in Stony Creek between the mouth and Interstate 5 (Figure 10-2). Each station was seined once weekly, February through June, with a 15 m (50 ft) delta mesh seine.

2. Funnel Netting

Funnel nets were used in Thomes Creek only. Irregular and frequent floodflow releases from Black Butte Reservoir made it impractical to funnel net in Stony Creek.

Two funnel nets were used in Thomes Creek. One was placed in the main stem at RK 2.4 (RM 1.5) and another near the confluence of the discharge canal from the Tehama-Colusa Canal (Figure 10-3).

The nets were fished continuously from Monday to Friday and were removed during weekends or during high water. Each net was checked daily (morning and again in late afternoon). The funnel net in the main stem was fished from February through May, while the funnel net in the discharge channel was fished from January to March. Funnel nets were used during the 1981 and 1982 seasons only.

Fish captured by seine and funnel net were identified, weighed by water displacement, and measured (fork lengths) to the nearest millimetre.

C-099874

Adults

We counted the carcasses of the adult fish to estimate the number of fall-run chinook salmon in Stony and Thomes creeks. Counts were taken once per week from November through January, 1980-81 and 1981-82 in Thomes Creek and December through February, 1981-82 in Stony Creek.

Each carcass was tagged by fastening a number 3 hog ring to its mandible. Tick marks were notched into the hog rings with wire cutters to identify the appropriate week of tagging. The sex and fork length of each carcass was noted. The location of each carcass was recorded and each carcass was placed back in the water in the same area where it was tagged. Tagged fish that were recovered on successive surveys were cut in half to avoid recounts.

Stony Creek was surveyed for carcasses between the mouth and the North Diversion Dam RK 32 (RM 20)(Figure 10-2). Thomes Creek was surveyed between the mouth and Paskenta RK 43.2 (RM 27) and in a channel from the discharge point of the Tehama-Colusa Canal to its confluence with Thomes Creek RK 2.2 (RM 1.4) (Figure 10-3).

The 1980-81 spawning escapement estimate for Thomes Creek was calculated with the method of Schaefer (Ricker 1975), while the 1981-82 estimates for both Stony and Thomes creeks were estimated with the Peterson method (Ricker 1975) (Appendix 3).

On June 13, 1979, and August 18, 1980, Thomes Creek was surveyed to enumerate spring-run salmon and summer-run steelhead, Salmo gairdneri. The area surveyed was the 1.6 km (1.0 mi) section from the gorge RK 59.5 (RM 37) to the ford at Hatch Flat RK 58.1 (RM 36). Each pool was examined by snorkel diving. All fish were identified and their size range and relative abundance estimated.

No habitat suitable for spring-run salmon and summer steelhead exists; therefore, no survey was conducted in Stony Creek.

Historical estimates for fall-run chinook salmon for both Stony and Thomes creeks were compiled from DFG salmon spawning stock reports (Reavis,1981).

RESULTS AND DISCUSSION

Resident Fishes

Newville Reservoir Site

Six species of fish, two game species and four nongame species, were captured in streams potentially inundated by the Newville Reservoir (Table 10-1). Rainbow trout were captured in sections of streams above the inundation line where the water is cool and cover is abundant. California roach, Sacramento squawfish, Sacramento sucker, carp, and green sunfish were captured in sections of streams below the inundation line. California roach, Sacramento squawfish, and Sacramento sucker were more abundant species while carp and green sunfish are relatively uncommon (Tables 10-2 and 10-3).

The stream portions within the inundation area are used primarily for spawning and rearing by nongame species (mainly the minnow family, Cyprinidae), although some green sunfish were observed spawning during the late spring in nonflowing areas of stream. It is likely that during high water adult Cyprinids ascend these tributaries from Black Butte Reservoir to spawn.

Upper Salt Creek RK 10.2 (RM 6.3) supports a population of wild rainbow trout. Nongame fishes were not found in this area and because of a waterfall at RK 8.5 (RM 5.3) migratory Cyprinids cannot ascend the creek. This waterfall is not in the inundation area. However, if a larger Newville Reservoir is built, the waterfall could be flooded, which would allow nongame fishes to swim upstream. This may reduce the wild trout populations because of competition with nongame fishes.

TABLE 10-1. Resident Fishes of Streams Within the Newville Reservoir Site

Common Name	Scientific Name	Creek		
		Salt	North Fork Stony	Heifer Camp
Rainbow trout	Salmo gairdneri	X		X
California roach	Lavinia symmetricus	X	X	X
Sacramento squawfish	Ptychocheilus grandis	X	X	X
Carp	Cyprinius carpio		X	
Sacramento sucker	Catostomus occidentalis	X	X	X
Green sunfish	Lepomis cyanellus	X		

C—099877

TABLE 10-2. Population Estimates and 95% Confidence Intervals (in Parentheses) for Fishes Caught in Selected Sections of Streams Within the Newville Reservoir Site

Species	North Fork Stony Creek	Salt Creek				Heifer Camp Creek	
	RK 0.8 1/	RK 3.0	RK 6.4	RK 10.2	RK 1.9 2/	RK 6.7	RK 8.8
Rainbow trout	-	-	-	47 (44-50)	1 (1-1)	-	8 (7-9)
California roach	4 (4-4)	116 (110-121)	526 (493-559)	-	996 (950-1043)	-	120 (102-139)
Sacramento squawfish	12 (0-23)	-	8 (3-14)	-	33 (28-37)	69 (67-71)	14 (8-19)
Carp	1 (1-1)	-	-	-	-	-	-
Sacramento sucker	≥2	28 (25-30)	62 (61-64)	-	-	12 (9-14)	1 (1-1)
Green sunfish	-	13 (0-33)	-	-	-	-	-

1/ Measured from Newville Road Bridge.

2/ Station is located on an unnamed tributary at RK 0.6 of main stem Salt Creek. River kilometre is measured from confluence of main stem.

C-099878

TABLE 10-3. Biomass Estimates (g/m^2) for Fishes Caught in Selected Sections of Streams Within the Newville Reservoir Site

Species	North Fork Stony Creek RK 0.8 1/	Salt Creek RK 3.0	Salt Creek RK 6.4	Salt Creek RK 10.2	Salt Creek RK 1.9 2/	Heifer Camp Creek RK 6.7	Heifer Camp Creek RK 8.8
Rainbow trout	-	-	-	41.9	1.9	-	2.1
California roach	0.1	-	6.1	-	89.7	-	8.1
Sacramento squawfish	0.9	100.3	2.7	-	11.3	162.0	11.7
Carp	16.3	-	-	-	-	-	-
Sacramento sucker	≥.01	18.0	1.7	-	-	62.7	0.9
Green sunfish	-	3.8	-	-	-	-	-

1/ Measured from Newville Road Bridge.

2/ Station is located on an unnamed tributary at RK 0.6 of mainstem Salt Creek. River kilometre is measured from confluence of mainstem.

Downstream Areas

Stony Creek - Twenty-eight species of fishes were observed in Stony Creek (Table 10-4). We developed population and biomass estimates for 22 of these species (Tables 10-5 and 10-6). Nine species were gamefishes and 13 were nongame fishes. Largemouth bass and bluegill were the most abundant gamefishes below Black Butte Reservoir and channel catfish and white catfish were the most abundant gamefishes above. Sacramento squawfish and suckers were found in all stations throughout Stony Creek and were the most abundant and had the highest biomass for all species of fish. Prickly sculpin were found in all sections but made up a very small portion of the total biomass.

Most of the nongame fishes that were caught in the reach below Black Butte Reservoir were juveniles indicating that this reach serves mainly as a spawning and rearing area. Adult Sacramento suckers, Sacramento squawfish, California roach, and hardhead annually migrate from the Sacramento River into Stony Creek to spawn. Juveniles that do not emigrate immediately after hatching remain to rear until the following rainy season when water flows to the mouth. Other gamefishes such as largemouth bass and smallmouth bass, bluegill, and green sunfish were also observed spawning in backwater areas of Stony Creek. These adult fish may have migrated upstream from the Sacramento River, or washed downstream from Black Butte Reservoir or may reside throughout the year in the creek.

Thomes Creek - Twenty-two species of fishes were observed in Thomes Creek (Table 10-7). We developed population and biomass estimates for 14 of these species (Tables 10-8 and 10-9). Four species were gamefishes and 10 were nongame fishes. Rainbow trout was the most abundant fish above the Gorge, while Sacramento squawfish, Sacramento suckers, hardhead, California roach, and speckled dace were the more common fishes below.

TABLE 10-4. Resident Fishes of the Stony Creek Drainage [1/]

Common Name	Scientific Name
Pacific lamprey	Lampetra tridentata
Threadfin shad[2/]	Dorosoma petenense
Rainbow trout	Salmo gairdneri
Carp	Cyprinus carpio
Goldfish	Carassius auratus
Golden shiner	Notemigomus crysoleucus
Sacramento blackfish[2/]	Orthodon microlepidotus
Hardhead	Mylopharodon conocephalus
Sacramento squawfish	Ptychocheilus grandis
Hitch	Lavinia exilicauda
California roach	Lavinia symmetricus
Speckled dace	Rhinichthys osculus
Sacramento sucker	Catostomus occidentalis
Channel catfish	Ictalurus punctatus
White catfish	Ictalurus catus
Brown bullhead[2/]	Ictalurus nebulosus
Black bullhead[2/]	Ictalurus melas
Mosquitofish	Gambusia affinis
Threespine stickleback[2/]	Gasterosteus aculeatus
Black crappie	Pomoxis melas
White crappie	Pomoxis annularis
Green sunfish	Lepomis cyanellus
Bluegill	Lepomis machrochirus
Redear sunfish[2/]	Lepomis microlophus
Largemouth bass	Micropterus salmoides
Smallmouth bass	Micropterus dolomieu
Tule perch	Hysterocarpus traski
Prickly sculpin	Cottus asper

1/ Excludes resident fishes in streams within the Newville Reservoir site.

2/ Observed during surveys but population estimates were not determined.

C-099881

TABLE 10-5. Population Estimates and 95% Confidence Intervals (in Parentheses) 1/ for Fishes Caught in Selected Sections of Stony Creek

Species	River Kilometre Location of Sample Section									
	4.5	5.1	19.0	29.5	54.4	60.0	66.8	90.9	103.6	4.0 2/
Threadfin shad	-	-	-	≥2	-	-	-	-	-	-
Carp	-	8 (0-18)	-	-	9 (8-10)	-	-	≥2	-	-
Goldfish	-	8 (3-14)	-	-	-	-	-	-	-	-
Hardhead	4 (4-4)	18 (12-24)	-	-	4 (0-11)	-	-	≥3	18 (15-21)	-
Hitch	51 (47-55)	80 (50-100)	≥2	54 (40-69)	4 (4-4)	-	-	≥1	-	-
Sacramento squawfish	44 (43-46)	70 (63-77)	8 (0-18)	146 (130-162)	190 (178-203)	221 (219-224)	9 (5-13)	378 (368-388)	373 (371-376)	22 (19-24)
California roach	-	-	-	9 (5-13)	-	110 (107-113)	4 (0-11)	302 (291-313)	375 (372-377)	398 (391-405)
Speckled dace	-	-	10 (9-11)	-	-	686 (672-699)	302 (298-306)	5 (2-7)	587 (552-621)	-
Sacramento sucker	53 (36-70)	124 (81-168)	28 (25-32)	81 (71-91)	136 (99-173)	13 (10-15)	5 (2-7)	234 (226-242)	273 (271-275)	≥28
Channel catfish	-	12 (11-13)	1 (1-1)	-	-	177 (172-182)	38 (37-40)	-	-	-
White catfish	-	2 (2-2)	-	-	29 (26-31)	60 (56-64)	-	-	-	-
Mosquitofish	-	-	-	-	3 (3-3)	-	-	-	-	-
Threespine stickleback	-	-	-	-	-	-	-	-	≥3	-
Black crappie	-	16 (0-78)	-	≥1	-	-	-	-	-	-
White crappie	-	-	-	9 (5-13)	1 (1-1)	-	-	-	-	-
Green sunfish	≥4	16 (15-18)	-	≥2	13 (0-33)	11 (8-13)	-	≥2	-	≥2
Bluegill	-	33 (32-35	-	-	≥4	-	-	-	-	-
Largemouth bass	-	31 (31-31)	-	4 (0-11)	3 (3-3)	-	-	-	-	-
Smallmouth bass	-	9 (8-10)	-	≥1	-	-	-	-	-	-
Tule perch	-	5 (3-7)	-	9 (0-35)	-	-	-	≥4	5 (2-7)	-
Prickly sculpin	7 (7-7)	4 (4-4)	90 (90-90)	≥1	≥12	222 (217-227)	8 (7-9)	12 (11-13)	203 (197-209)	8 (7-9)

1/ Excludes fishes caught in stream within the Newville Reservoir site.

2/ Sample section located on Little Stony Creek. River kilometre measured from Lodoga Road Bridge upstream.

TABLE 10-6. Biomass Estimates (g/m^2) for Fishes Caught in Selected Sections of Stony Creek 1/

Species	River Kilometre Location of Sample Section									
	4.5	5.1	19.0	29.5	54.4	60.0	66.8	90.9	103.6	4.0 2/
Threadfin shad	-	-	-	≥0.1	-	-	-	-	-	-
Carp	-	8.4	-	-	6.7	-	-	≥15.9	-	-
Goldfish	-	3.8	-	-	-	-	-	-	-	-
Hardhead	0.4	6.8	-	-	1.8	-	-	≥0.07	1.8	-
Hitch	3.0	7.2	0.06	3.0	0.3	-	-	≥0.2	-	-
Sacramento squawfish	10.0	5.5	0.2	4.9	5.2	10.3	0.2	20.5	44.0	1.3
California roach	-	-	-	0.05	-	2.9	0.05	11.0	15.4	6.7
Speckled dace	-	-	0.1	-	-	12.1	2.3	0.05	8.7	-
Sacramento sucker	27.8	26.1	9.6	20.2	93.9	1.8	0.3	25.6	76.9	5.5
Channel catfish	-	14.1	0.02	-	-	6.4	0.5	-	-	-
White catfish	-	0.2	-	-	3.9	7.6	-	-	-	-
Mosquitofish	-	-	-	-	0.01	-	-	-	-	-
Threespine stickleback	-	-	-	-	-	-	-	-	0.006	-
Black crappie	-	1.8	-	0.4	-	-	-	-	-	-
White crappie	-	-	-	3.0	0.9	-	-	-	-	-
Green sunfish	≥0.2	0.3	-	≥0.4	0.7	0.4	-	≥0.2	-	≥0.9
Bluegill	-	1.6	-	-	≥0.1	-	-	-	-	-
Largemouth bass	-	3.1	-	0.3	0.6	-	-	-	-	-
Smallmouth bass	-	3.4	-	0.1	-	-	-	-	-	-
Tule perch	-	0.2	-	1.3	-	-	-	≥0.3	0.6	-
Prickly sculpin	0.02	0.01	2.6	0.01	≥0.1	4.2	0.3	0.2	4.9	0.3

1/ Excludes fishes caught in streams within the Newville Reservoir site.

2/ Sample section located on Little Stony Creek.
River kilometre measured from Lodoga Road Bridge upstream.

C-099883

TABLE 10-7. Resident Fishes of Thomas Creek

Common Name	Scientific Name
Pacific lamprey[1/]	Lampetra tridentata
Rainbow trout	Salmo gairdneri
Carp	Cyprinus carpio
Goldfish	Carassius auratus
Golden shiner[1/]	Notemigomus crysoleucus
Hardhead	Mylopharodon conocephalus
Sacramento squawfish	Ptychocheilus grandis
Hitch	Lavinia exilicauda
California roach	Lavinia symmetricus
Speckled dace	Rhinicthys osculus
Sacramento sucker	Catostomus occidentalis
Channel catfish[1/]	Ictalurus punctatus
White catfish[1/]	Ictalurus catus
Brown bullhead[1/]	Ictalurus nebulosus
Mosquitofish[1/]	Gambusia affinis
Threespine stickleback[1/]	Gasterosteus aculeatus
Green sunfish	Lepomis cyanellus
Bluegill	Lepomis machrochirus
Largemouth bass	Micropterus salmoides
Smallmouth bass[1/]	Micropterus dolomieu
Tule perch	Hysterocarpus traski
Prickly sculpin[1/]	Cottus asper

1/ Observed during surveys but population estimates were not determined.

TABLE 10-8. Population Estimates and 95% Confidence Intervals (in Parentheses) for Fishes Caught in Selected Sections of Thomes Creek

Species	River Kilometre Location of Sample Section														
	2.2	10.5	12.1	21.1	22.5	33.2	39.1	41.8	45.7	44.9	46.7	60.5	75.3	76.1	3.2 1/
Rainbow trout	-	-	-	-	-	-	-	-	-	-	-	7 (7-7)	62 (53-71)	57 (54-60)	2 (2-2)
Hitch	-	-	-	-	-	-	-	-	1 (1-1)	-	-	-	-	-	-
California roach	8 (8-8)	-	25 (21-26)	38 (38-38)	5 (5-5)	27 (27-27)	9 (8-10)	63 (58-67)	≥50	19 (14-24)	10 (9-11)	-	-	-	194 (177-212)
Hardhead	67 (67-67)	10 (10-10)	-	88 (84-92)	27 (24-30)	1 (1-1)	-	-	90 (7-173)	-	-	-	-	-	-
Sacramento squawfish	35 (34-36)	6 (6-6)	1722 (1714-1730)	836 (811-861)	378 (331-425)	232 (220-244)	83 (33-133)	153 (136-170)	468 (390-546)	138 (119-158)	67 (59-74)	255 (235-275)	-	-	10 (10-10)
Speckled dace	-	-	≥1	-	-	136 (125-147)	118 (101-135)	25 (0-143)	1464 (0-5474)	58 (42-74)	10 (9-11)	-	-	-	20 (5-35)
Goldfish	1 (1-1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carp	1 (1-1)	179 (165-194)	-	-	≥2	-	-	-	-	-	-	-	-	-	-
Sacramento sucker	16 (13-19)	-	196 (191-200)	58 (56-59)	36 (0-89)	21 (21-23)	≥9	≥9	44 (34-54)	19 (16-21)	≥5	132 (119-146)	-	-	-
Bluegill	-	-	1 (1-1)	-	5 (2-7)	-	-	-	-	-	-	-	-	-	-
Green sunfish	≥2	10 (1-19)	-	20 (15-24)	25 (0-84)	-	-	-	-	-	-	-	-	-	-
Largemouth bass	-	5 (3-7)	-	≥1	10 (7-13)	-	-	-	-	-	-	-	-	-	-
Tule perch	-	-	1 (1-1)	≥1	-	-	-	-	-	-	-	-	-	-	-
Prickly sculpin	2 (2-2)	-	-	-	1 (1-1)	-	-	-	-	-	-	-	-	-	-

1/ Sample section located on Bennett Creek.
River kilometre measured from confluence of Thomes Creek upstream.

TABLE 10-9. Biomass Estimates (g/m^2) for Fishes Caught in Selected Sections of Thomes Creek

Species	River Kilometre Location of Sample Section														
	2.2	10.5	12.1	21.1	22.5	33.2	39.1	41.8	44.9	45.7	46.7	60.5	75.3	76.1	3.2 1/
Rainbow trout	-	-	-	-	-	-	-	-	-	-	-	0.2	1.4	3.2	6.9
Hitch	-	-	-	-	-	-	-	-	-	0.05	-	-	-	-	-
California roach	0.6	-	0.7	0.2	0.06	0.2	0.2	1.7	.6	≥0.9	0.01	-	-	-	7.5
Hardhead	22.9	0.5	-	2.5	4.5	0.4	-	-	-	1.0	-	-	-	-	-
Sacramento squawfish	53.2	1.3	7.2	3.7	24.4	5.9	0.4	3.1	2.0	21.2	1.1	2.4	-	-	3.9
Speckled dace	-	-	≥.0001	-	-	0.9	2.5	0.2	0.5	8.8	0.1	-	-	-	1.5
Goldfish	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carp	2.9	14.5	-	-	≥4.2	-	-	-	-	-	-	-	-	-	-
Sacramento sucker	1.2	-	1.5	0.9	2.9	4.9	≥0.01	≥0.5	1.1	2.1	≥0.2	5.3	-	-	-
Bluegill	-	-	.001	-	0.8	-	-	-	-	-	-	-	-	-	-
Green sunfish	≥0.6	0.4	-	0.9	3.2	-	-	-	-	-	-	-	-	-	-
Largemouth bass	-	0.9	-	≥0.2	1.6	-	-	-	-	-	-	-	-	-	-
Tule perch	-	-	0.02	≥0.01	-	-	-	-	-	-	-	-	-	-	-
Prickly sculpin	0.4	-	-	-	0.02	-	-	-	-	-	-	-	-	-	-

1/ Sample section located on Bennett Creek.
River kilometre measured from confluence of Thomes Creek upstream.

Most of the nongame fishes that were caught in the reach below the Gorge were juveniles indicating that this reach serves mainly as a spawning and rearing area. Adult Sacramento suckers, Sacramento squawfish, California roach, and hardhead annually migrate from the Sacramento River into Thomes Creek and its tributaries to spawn. Juveniles that do not emigrate immediately after hatching remain to rear until the following rainy season when water flows to the mouth.

In addition, Thomes Creek below Paskenta usually dries up except for a few residual pools scattered along the streambed during the late summer, making it impossible for resident adult fish to live throughout the summer months. Some adult gamefishes such as largemouth bass and smallmouth bass, bluegill, and green sunfish ascend the creek from the Sacramento River during the late spring and early summer to use these pools as spawning areas.

Suckers and Squawfish

Juvenile Emigration

The emigration of juvenile Sacramento suckers and squawfish from Thomes Creek to the Sacramento River was continuous throughout the sample period.

Larval suckers were first observed in the upper reaches of the main stem and tributaries in late April, but none was caught near the mouth until mid-May. The emigration at that time increased rapidly until the weekly funnel net catch peaked at over 7,500 fish during the first week of June (Figure 10-4). After the first week of June, catches diminished rapidly but emigration continued for about four weeks until there was no measurable discharge at the mouth of Thomes Creek.

Larval and post-larval squawfish were first observed in the upper reaches in mid-May, but none was caught near the mouth until late May. During mid-June,

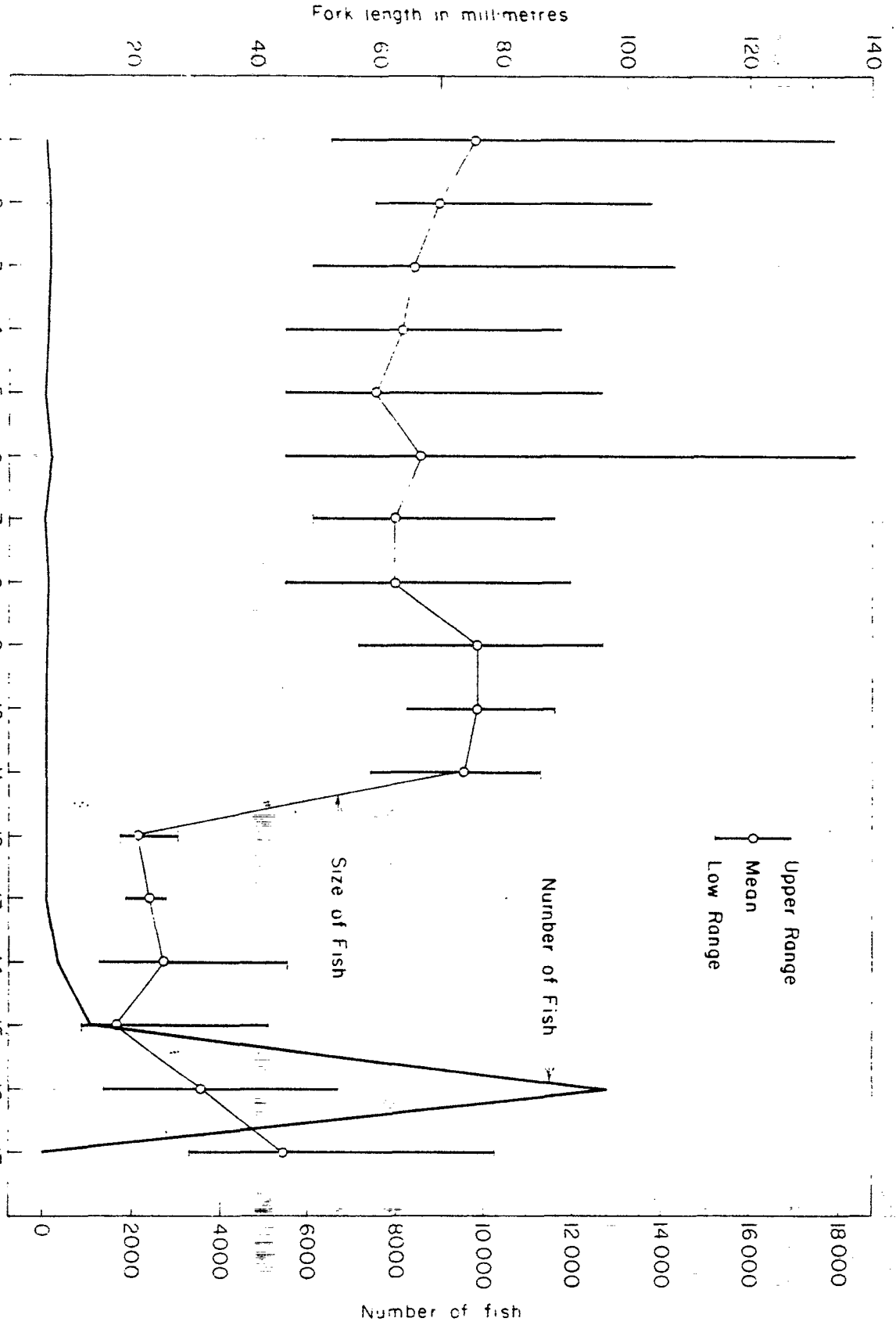

FIGURE 10-4. Weekly funnel net catches of juvenile Sacramento squawfish emigrating from Thomes Creek to the Sacramento River, 1981.

C-099888

juvenile squawfish emigration peaked at over 12,000 fish (Figure 10-5). Emigration rapidly declined until the end of June at which time discharge at the mouth ceased.

A majority of juvenile and larval suckers and squawfish emigrate from Thomes Creek immediately before summer; however, many are forced to remain due to the lack of sufficient flow that would allow passage downstream. Our survey for resident fishes shows that mainly juvenile fish are present during the summer months and that very few suckers and squawfish older than one year are present.

Adults

Sacramento Suckers - The first adult Sacramento sucker was captured and tagged on December 10, 1980. The first tagged sucker to be recovered was on December 30, 1980. Based on the Jolly-Seber method, the population for this time period was estimated at 440 fish (Table 10-10). Estimates for the migration rose continuously until the last week of February, at which time the estimate peaked at over 240,000 fish. The last fish was tagged on May 28, 1981, for a total of 2,081 fish tagged, while the last tagged fish to be recovered was on May 27, 1981, for a total of 41. The cumulative population estimate for the migration totaled 350,000 fish.

Sacramento Squawfish - One hundred thirty adult Sacramento squawfish were tagged from December 17, 1980 to May 13, 1981 (Table 10-11). Eight of these tagged fish were recovered, the first on January 13, 1981, and the last on June 15, 1981. The population estimate totaled 372 adult fish (Table 10-12).

These estimates were considerably lower than expected. Sampling efficiency for squawfish decreased as water clarity improved during late spring. Squawfish are generally less susceptible to electroshocking than suckers; they can also swim faster to avoid capture. Based on surveys taken on foot and by raft, we felt that a population in excess of 10,000 fish would be more reasonable.

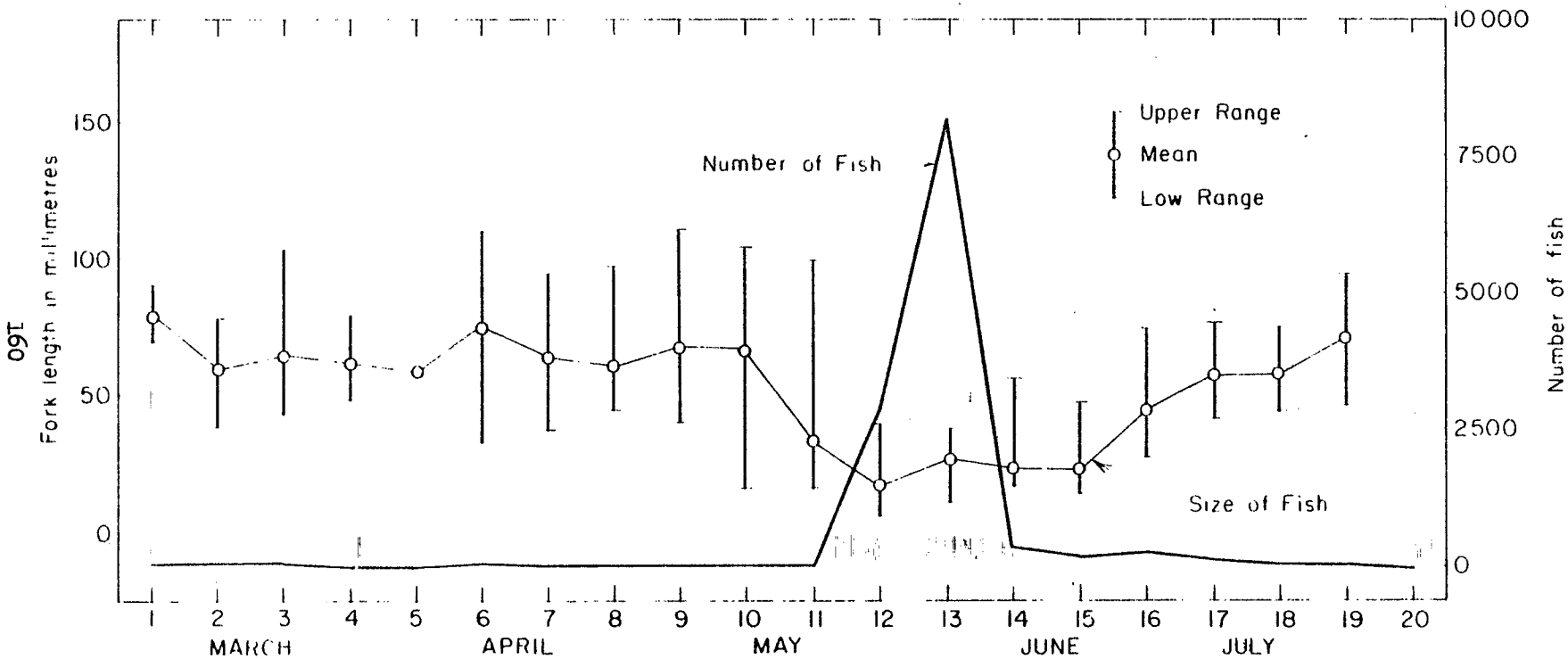

FIGURE 10-5. Weekly funnel net catches of juvenile Sacramento suckers emigrating from Thomes Creek to the Sacramento River, 1981

TABLE 10-10. Jolly-Seber (1973) Estimates of the Spawning Population of Sacramento Suckers from Thomes Creek

Sample Period Ending (i)	Estimates: Population Before i ($\hat{N}i$)	Estimates: Tag Ratio ($\hat{p}i$)	Estimates: Tags in Population ($\hat{M}i$)
12-09-80	0	0	0
12-19-80	0	0	0
01-08-81 1/	440	0.0455	20
01-18-81	715	0.0937	67
01-28-81	8,808	0.0151	133
02-17-81 2/	22,083	0.0048	106
02-27-81	3,634	0.0333	121
03-09-81	241,481	0.0027	652
03-19-81	55,000	0.0106	583
03-29-81	1,938	0.1094	212
04-08-81	41,168	0.0274	1,128
04-18-81	8,818	0.0330	291
04-28-81	1,548	0.0588	91
05-08-81	5	0.2000	1
05-18-81	13	0.3077	4
05-28-81	10	0.1000	1
06-07-81	0	0	0

1/ Includes sample period 12-29-80

2/ Includes sample period 02-07-81

TABLE 10-11. Summary of Tagging and Recovery of Sacramento Squawfish in Thomes Creek, Fall-Winter 1980-81

Recovery Period Ending (j)	Tagging Period (i) 12/09	12/19	01/08	01/18	01/28	02/07	02/17	02/27	03/09	03/19	03/29	04/08	04/18	04/28	05/08	05/18	05/28	06/07	06/17	Tagged Fish Recovered (Rj)	Total Fish Recovered (Cj)	Cj/Rj
12/09/80																				0	0	0
12/19/80																				0	7	∞
01/08/81																				0	7	∞
01/18/81		1		2																3	14	4.67
01/28/81																				0	8	∞
02/07/81																				0	0	0
02/17/81																				0	0	0
02/27/81																				0	2	∞
03/09/81																				0	7	∞
03/19/81																				0	21	∞
03/29/81																				0	1	∞
04/08/81										1		1								2	16	8.0
04/18/81																				0	18	∞
04/28/81										1										1	25	25.0
05/08/81				1																1	2	2.0
05/18/81																				0	10	∞
05/28/81																				0	0	0
06/07/81																				0	0	0
06/17/81													1							1	0	0
Tags Recovered (Ri)	0	1	0	3	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	8	138	
Total Tagged (Mi)	0	6	7	11	8	0	0	2	7	19	1	15	17	25	2	10	0	0	0	130		
Mi/Ri		6	0	3.67	∞	0	0	∞	∞	9.5	∞	15	17	∞	∞	∞	0	0	0			

TABLE 10-12. Calculated Estimates of Sacramento Squawfish in Thomes Creek, Fall-Winter 1980-81

Recovery Period Ending (j)	Tagging Period (i)																			
	12/09	12/19	01/08	01/18	01/28	02/07	02/17	02/27	03/09	03/19	03/29	04/08	04/18	04/28	05/08	05/18	05/28	06/07	06/17	TOTAL
12-09-80																				0
12-19-80																				0
01-08-81																				0
01-18-81		28		34																62
01-28-81																				0
02-07-81																				0
02-17-81																				0
02-27-81																				0
03-09-81																				0
03-19-81																				0
03-29-81																				190
04-08-81										76		120								196
04-18-81																				0
04-28-81										237										237
05-08-81				7																7
05-18-81																				0
05-28-81																				0
06-07-81																				0
06-17-81																				0
TOTAL	0	28	0	41	0	0	0	0	0	303	0	120	0	0	0	0	0	0	0	372

Juveniles

1980 Emigration - Thirteen juvenile chinook salmon were captured by seining during the 1980 sample period (Table 10-13). These fish were caught in the lowermost stations RK 2.4 and 7.1 (RM 1.5 and 4.4) from March 20 to May 24, 1980.

In addition, seven juvenile steelhead trout were captured (Table 10-14). Four of these fish were probably from Coleman National Fish Hatchery. They had rounded fins and deformed dorsal fins which are characteristic of hatchery grown fish. Juvenile salmonids from the Sacramento River commonly ascend tributaries (Richard Hallock, DFG, pers. comm.).

1981 Emigration - Six juvenile chinook salmon were captured by seining during the 1981 sample period (Table 10-13). These fish were captured in the lowermost station RK 2.4 (RM 1.5) on March 11 and April 20, 1981.

In addition, five juvenile steelhead were captured (Table 10-14). All of these fish were captured in the lowermost station. One of these fish was from Coleman National Fish Hatchery.

Two hundred six juvenile chinook salmon were captured by funnel netting in Thomes Creek, 20 from the main stem and 186 from the discharge canal (Table 10-15).

The catches from the main stem occurred over a nine-week period beginning the first week of March and ending the first week of May. Salmon from these catches ranged in size from 69 to 90 mm (2.7 to 3.6 in.) fork length. Except for the time at which the emigration occurred, no real descriptive trends can be derived from these data. These fish, however, appear to be much larger than expected for fall-run fish spawned in Thomes Creek. We suspect that they may be fish that had been spawned earlier in the main stem Sacramento River and moved upstream into Thomes Creek. It is common for juvenile salmonids from the

TABLE 10-13. Size, Capture Date and Location of Juvenile Chinook Salmon Seined from Thomes Creek, 1980 and 1981

Date of Capture	Location (River Kilometre)	Temperature °C	Fork Length (mm)	Weight (g)
03-20-80	2.4	8.5	68	2.75
03-24-80	2.4	9.5	67	2.5
03-24-80	2.4	9.5	70	3.5
03-27-80	2.4	12.5	73	4.0
03-31-80	7.1	14.5	78	4.0
04-03-80	7.1	12.0	45	1.0
04-07-80	7.1	13.5	45	.75
04-17-80	2.4	16.0	95	6.0
04-17-80	2.4	16.0	96	6.0
04-17-80	7.1	14.0	59	2.5
04-24-80	7.1	14.5	82	7.5
04-24-80	7.1	14.5	70	3.5
04-24-80	7.1	14.5	70	3.5
03-11-81	2.4	15.0	118	17.0
03-11-81	2.4	15.0	122	19.0
03-11-81	2.4	15.0	99	12.5
03-11-81	2.4	15.0	105	11.5
03-16-81	2.4	12.2	79	5.0
04-20-81	2.4	14.4	59	2.0

TABLE 10-14. Size, Capture Date and Location of Juvenile Steelhead Trout from Thomes Creek, 1980 and 1981

Date of Capture	Location (River Kilometre)	Temperature °C	Fork Length (mm)	Weight (g)
03-20-80	2.4	8.5	173[1/]	40
03-27-80	11.3	14.0	163[1/]	46
04-07-80	173.5	12.5	173[1/]	75
04-11-80	7.1	12.5	89	6.5
04-11-80	11.3	12.5	161[1/]	65
04-17-80	2.4	16.0	196	75
04-21-80	2.4	12.5	201	225
03-11-81	2.4	15.0	169	42.0
03-11-81	2.4	15.0	138	23.5
03-11-81	2.4	15.0	159	34.0
03-11-81	2.4	15.0	110	11.5
03-16-81	2.4	12.2	177[1/]	50

1/ Dorsal fins of these were deformed and other fins rounded and frayed. These fish are probably from Coleman National Fish Hatchery.

C-099896

TABLE 10-15. Funnel Net Catches of Juvenile Chinook Salmon from Thomes Creek

Sample Period Ending	Number of Fish	Length (mm) $\bar{X}_{fl}$	Length (mm) Range	Length (mm) Standard Deviation	Temperature Range (°C)
		Hall Road (RK 2.4) 1981-82			
02-07-81	0	-	-	-	8.0- 9.4
02-14-81	0	-	-	-	8.0- 9.4
02-21-81	0	-	-	-	8.3- 9.4
02-28-81	0	-	-	-	8.3-10.0
03-07-81	7	69.4	-	-	10.0-12.2
03-14-81	0	-	-	-	12.0-15.0
03-21-81	1	71.0	-	-	10.0-12.2
03-28-81	1	56.0	-	-	11.1-15.0
04-04-81	3	87.7	86-90	2.1	10.0-11.7
04-11-81	0	-	-	-	11.1-15.0
04-18-81	Fyke net removed due to high water				11.1-12.1
04-25-81	7	74.5	69-83	6.8	13.9-17.2
05-02-81	1	69.0	-	-	14.4-20.0
05-09-81	0	-	-	-	15.6-21.7
Total	20				
		Discharge Canal 1981			
02-07-81	0	-	-	-	7.0- 8.5
02-14-81	0	-	-	-	7.0- 8.5
01-21-81	1	35.0	-	-	7.0- 8.5
02-28-81	126	33.9	30-38	2.2	9.4-11.1
03-07-81	44	33.8	31-37	1.6	10.6-11.7
03-14-81	7	33.6	31-36	1.9	10.6-12.2
03-21-81	8	33.3	31-35	1.4	10.6-12.2
03-28-81	0	-	-	-	
Total	186				
		Discharge Canal 1982			
01-02-82	1	38.0	-	-	5.6-11.1
01-09-82	1	32.0	-	-	6.7- 7.8
01-23-82	-	-	-	-	6.7- 7.8
01-30-82	-	-	-	-	6.7- 8.3
02-06-82	-	-	-	-	7.2- 8.9
02-13-82	-	-	-	-	7.2- 8.3
02-20-82	16	33.0	28-37	3.0	11.1-12.2
02-27-82	29	36.0	34-37	1.0	9.4-11.1
03-06-82	4	35.0	33-35	1.0	10.6-11.7
03-13-82	64	35.0	25-38	2.0	10.6-11.7
03-20-82	117	35.0	32-40	2.0	10.0-12.2
03-27-82	122	37.0	33-40	1.6	12.2-16.1
03-30-82	30	38.0	35-40	1.0	10.0-12.2
Total	384				

Sacramento River to swim upstream into tributaries (Richard Hallock, DFG, pers. comm.)

Juveniles captured in the discharge channel were probably spawned there. The presence of live adults, carcasses, and redds in the channel together with the presence of juveniles there is strong evidence that successful spawning occurred there.

The emigration of juvenile chinook salmon from the discharge canal occurred from late February through the third week of March at which time the discharge was terminated by the U. S. Bureau of Reclamation (USBR), and no water flowed to the main stem. Fish ranged in size from 30 to 38 mm (1.2 to 1.5 in) fork length, indicating newly hatched fish. These fish were of the fall-run spawn. Although the emigration was halted by lack of flow, it could have continued if discharge had been extended. In response to the lack of flow, DFG Regional personnel rescued in excess of 3,000 juvenile salmon.

1982 Emigration - No juvenile chinook salmon or steelhead was captured by seining or funnel netting in the main stem of Thomes Creek during the 1982 sample period.

Three hundred and eighty-four juvenile chinook salmon were captured by funnel netting in the discharge canal from the Tehama-Colusa Canal (Table 10-15). The first fish was captured during the first week of January, but the bulk of the emigration did not occur until the third week of February. The emigration continued until March 30, 1982, at which time the discharge was terminated by the USBR.

Adults

1980-81 Fall-Run Estimate - Fifty-nine chinook salmon carcasses were tagged during 12 surveys of Thomes Creek. Twenty-three of these carcasses were recovered (Table 10-16). From these data we estimated that 155 salmon spawned in Thomes Creek during the sample period (Table 10-17). Forty-two fish (71%) were females while 17 fish were males (29%). This represents a male-female ratio of 1:2.5.

C-099898

TABLE 10-16. Summary of Tagging and Recovery of Chinook Salmon Carcasses in Thomes Creek, Fall and Early Winter, 1980-81

Recovery Period	Tagging Period: Nov 17-21	Nov 24-28	Dec 1-5	Dec 8-12	Dec 15-19	Dec 22-26	Dec 29-31	Jan 5-9	Jan 12-16	Jan 19-23	Tags Recovered	Total Fish Recovered
Nov 10-14											0	0
Nov 17-21											0	1
Nov 24-28											0	2
Dec 1-5		1									1	20
Dec 8-12			4								4	15
Dec 15-19		1	4	3							8	20
Dec 22-26			2								2	13
Dec 29-31						5					5	8
Jan 5-9					1						1	1
Jan 12-16					1		1				2	2
Jan 19-23											0	0
Jan 26-30											0	0
Tags Recovered	0	2	10	3	2	5	1	0	0	0	23	82
Total Tagged	1	2	19	11	12	11	3	0	0	0	59	

TABLE 10-17. Calculated Estimates of Chinook Salmon Carcasses in Thomes Creek, Fall and Early Winter 1980-81

Week of Recovery (j)	Week of Tagging (i)									
	1	2	3	4	5	6	7	8	9	Total
1										0
2										0
3		20								20
4			28.5							28.5
5		2.5	19.0	27.5						49.0
6			24.7							24.7
7						17.6				17.6
8					6					6
9					6		3			9
Total	0	22.5	72.2	27.5	12	17.6	3	0	0	154.8

TABLE 10-18. Distribution of Chinook Salmon in Thomes Creek, Fall and Early Winter, 1980-81

Reach	River Kilometres	Carcasses	Live Fish	Redds
Mouth to Richfield	0 to 7.1	1	4	5
Richfield to Rawson Road	7.1 to 11.3	0	0	1
Rawson Road to Henleyville	11.3 to 21.9	1	0	3
Henleyville to Flournoy	21.9 to 33.0	0	0	0
Flournoy to Paskenta	33.0 to 43.5	0	0	0
Tehama-Colusa Canal Outlet Channel		57	86	95 1/
Total		59	90	103

1/ Includes recounted redds.

Live fish were first observed in the creek November 11, 1980, but no carcass was tagged until 9 days later. The last carcass was recovered on January 12, 1981. Fifty-seven (97%) of the fish recovered were located in the Tehama-Colusa Canal outlet channel. Only two fish (3%) were recovered in the main stem. These fish were located between RK 3 (RM 1.9) and RK 12 (RM 7.5) (Table 10-18); however, observation of six redds and four live fish indicate that there was some spawning activity in areas below Henleyville.

1981-82 Fall-Run Estimate - Thirty-eight chinook salmon carcasses were tagged during 10 surveys of Thomes Creek. Twenty of these carcasses were recovered. From these data we estimated that 167 salmon spawned in Thomes Creek during our sample period (Table 10-19). Twenty-two fish (58%) were females while 16 fish were males (42%). This represents a male-female ratio of 1:1.4.

All of the fish recovered were located in the Tehama-Colusa Canal outlet channel. No live fish or redd was seen in the main stem.

1955-1979 Fall-Run Estimates - Very little information on the historic chinook salmon runs was available in DFG reports. Only seven reports list survey efforts. In 1957, the fall-run escapement estimate was 25, and in 1975 the estimate was 170 fish (Mahoney 1958, Hoopaugh 1978). For years of survey 1959, 1960, 1964, 1965, and 1976 the fall-run estimate was zero (Mahoney 1960, 1962; Menchen 1965, 1966; Hoopaugh 1978).

1979-1980 Spring-Run Estimates - No anadromous salmonid was seen during the June 13, 1979 or August 18, 1980 spring-run surveys. Numerous resident trout were seen in area of survey which may indicate that habitat for spring-run chinook salmon or summer steelhead may exist. Surface water temperatures generally approach 25 C (77 F) in these areas, but cooler water 15-20 C (59-68 F) can be found near the bottom of larger pools.

TABLE 10-19. Thomes Creek 1981-82 Chinook Salmon Spawning Escapement

Sample Period (Ending)	Total Fish Recovered (C)	Total Fish (M)	Number Recovered (R)	n
11-07-81	0	0	0	0
11-14-81	1	1	0	2
11-21-81	7	7	0	56
11-28-81	No survey due to turbid and high water.			
12-05-81	No survey due to turbid and high water.			
12-12-81	No survey due to turbid and high water.			
12-19-81	9	4	5	6.7
12-26-81	No survey due to turbid and high water.			
01-02-82	No survey due to turbid and high water.			
01-09-82	No survey due to turbid and high water.			
01-16-82	No survey due to turbid and high water.			
01-23-82	7	7	0	56
01-30-82	21	14	7	38.5
02-06-82	10	4	6	6.3
02-13-82	3	1	2	1.3
02-20-82	0	0	0	0
02-27-82	0	0	0	0
Total	58	38	20	167

Juveniles

1980 Emigration - During the 1980 sample period, 181 juvenile chinook salmon were captured by seining (Table 10-20). Most of these were caught in the lowermost station RK 5.1 (RM 3.2). Only two fish were captured upstream at RK 15.3 (RM 9.5). Fish were first captured during the second week of February while the last fish was captured during the first week of May.

1981 Emigration - During the 1981 sample period, 73 juvenile chinook salmon were captured by seining (Table 10-20). Most of the fish were captured in the lowermost station RK 5.1 (RM 3.2). Three fish were captured upstream at RK 20.9 (RM 13). Fish were first captured during the third week of February while the last fish were captured during the second week of April.

1982 Emigration - During the 1982 sample period, only four juvenile chinook salmon were captured by seining (Table 10-20). Two fish were captured during January at RK 15.3 (RM 9.5) and two were captured at RK 5.1 (RM 3.2) during the first week of April.

Adults

1981-82 Fall-Run Estimate - Thirty-six chinook salmon carcasses were tagged during five surveys. Two of these were recovered. From these data we estimate that 393 salmon spawned in Stony Creek during the sample period (Table 10-21). Twenty-five (69%) fish were females while eleven (31%) were males. This represents a male-female ratio of 1:2.3.

Most of the spawning activity was located in the reach between Interstate 5 bridge RK 26.1 (RM 16.2) and the North Diversion Dam RK 32.0 (RM 19.9). At least 35 redds and 29 carcasses were counted in this area (Table 10-22).

TABLE 10-20. Seine Catches of Juvenile Chinook Salmon from Stony Creek

Date of Capture	Location (River Kilometre)	Number of Fish	Length (mm) $\bar{X}_{fl}$	Length (mm) Range	Length (mm) Standard Deviation	Temperature (°C)
			1980			
02-13-80	5.1	55	42.0	34- 91	7.9	11.5
02-26-80	5.1	9	52.4	36-116	24.4	10.5
03-03-80	5.1	6	42.7	40- 45	2.3	12.0
03-11-80	15.3	1	71.0	-	-	12.5
03-19-80	5.1	2	45.5	45- 46	0.7	12.0
03-25-80	5.1	30	45.2	39- 55	6.3	15.5
03-25-80	15.3	1	39.0	-	-	13.0
03-28-80	5.1	11	48.5	41- 61	9.2	15.0
04-01-80	5.1	50	48.7	39- 65	6.6	13.0
04-08-80	5.1	9	52.6	47- 63	5.7	15.0
04-22-80	5.1	1	78.0	-	-	15.0
05-05-80	5.1	6	75.7	70- 84	5.9	21.0
	Total	181				
			1981			
02-18-81	5.1	2	47.0	42- 52	7.1	11.7
02-24-81	20.9	3	45.0	43- 48	2.6	11.0
03-05-81	5.1	4	52.3	51- 56	2.5	11.0
03-11-81	5.1	48	51.1	41- 68	7.0	12.0
03-17-81	5.1	2	53.5	47- 60	9.2	14.4
03-25-81	5.1	10	64.1	51- 73	6.3	15.6
04-14-81	5.1	4	76.0	65- 81	7.4	18.9
	Total	73				
			1982			
01-11-82	15.3	1	89.0	-	-	7.8
01-26-82	15.3	1	78.0	-	-	7.8
03-02-82	5.1	2	42.5	42- 43	0.7	11.7
	Total	4				

TABLE 10-21. Stony Creek 1981-82 Chinook Salmon Spawning Escapement

Sample Period (Ending)	Total Fish Recovered (C)	Total Fish Tagged (M)	Number Tags Recovered (R)	$\hat{n}$ 1/
12-12-81	4	4	0	20
12-19-81	34	32	2	373
12-26-81				
01-02-82	No Survey Due to Turbid and High Water			
01-09-82	No Survey Due to Turbid and High Water			
01-16-82	No Survey Due to Turbid and High Water			
01-23-82	0	0	0	0
01-30-82	0	0	0	0
02-06-82	0	0	0	0
Total	38	36	2	393

1/ Petersen estimate (Ricker, 1975)

TABLE 10-22. Distribution of Chinook Salmon Carcasses, Redds and Live Fish in Stony Creek, December 10, 1981, to February 6, 1982

Reach	River Kilometres	Carcasses	Live Fish	Redds
Mouth to Highway 45	0 to 4.8	0	0	0
Highway 45 to Highway 32	4.8 to 14.7	2	1	6
Highway 32 to Interstate 5	14.7 to 26.1	5	6	6
Interstate 5 to North Diversion Dam	26.1 to 32.0	29	28	35
Total		36	35	47

1955-1980 Fall-Run Estimate - Only two previous surveys were made for fall-run chinook salmon in Stony Creek. For years 1957 and 1967, the estimates were zero (Mahoney 1958, Menchen 1968).

LITERATURE CITED

Hoopaugh, D. A., ed. 1978. King (chinook) salmon spawning stocks in California's Central Valley, 1975. Calif. Fish and Game, Anad. Fish. Br. Admin. Rept. No. 77-12. 29 p.

———— 1978. King (chinook) salmon spawning stocks in California's Central Valley, 1976. Calif. Fish and Game, Anad. Fish. Br. Admin. Rept. No. 78-19. 28 p.

Mahoney, J. 1958. 1957 king salmon spawning population estimates for the Sacramento-San Joaquin River systems. Calif. Fish and Game, Marine Res. Br. Admin. Rept. 18 p.

———— 1960. 1959 king salmon spawning population estimates for the Sacramento-San Joaquin River systems. Calif. Fish and Game, Marine Res. Br. Admin. Rept. 13 p.

———— 1962. 1960 king salmon spawning population estimates for the Sacramento-San Joaquin River systems. Calif. Fish and Game, Marine Res. Br. Admin. Rept. No. 62-1. 13 p.

Menchen, R. S., ed. 1965. King (chinook) salmon spawning stocks in California's Central Valley, 1964. Calif. Fish and Game, Marine Res. Br. Admin. Rept. No. 65-2. 17 p.

———— 1966. King (chinook) salmon spawning stocks in California's Central Valley, 1965. Calif. Fish and Game, Marine Res. Br. Admin. Rept. No. 66-6. 22 p.

———— 1968. King (chinook) salmon spawning stocks in California's Central Valley, 1967. Calif. Fish and Game, Marine Res. Br. Admin. Rept. No. 68-6. 27 p.

Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Canada, Fish. Res. Bd. Bull. (191). 382 p.

Seber, G. A. F. and E. D. LeCren. 1967. Estimating population parameters from catches large relative to the population. J. Animal Ecology 36(3):631-643.

Seber, G. A. F. 1973. The Estimation of Animal Abundances. Macmillan Publishing Co., Inc. New York. 654 p.

C-099908

APPENDIX I

The Population Estimation Method of Jolly-Seber
(Seber, 1973)

$$\hat{M}_i = \frac{R_i \; z_i}{r_i} + m_i \quad (1)$$

where, $\hat{M}_i$ = total number of marked fish in the population before time t_i,

R_i = number of marked fish released after the ith sample,

r = number of marked fish from the release of R_i fish which are subsequently recaptured,

m_i = number of marked fish caught in the ith sample,

z_i = number of different fish caught before the ith sample which are not caught in the ith sample but are caught subsequently,

$$\hat{\rho}_i = m_i/n_i \; \underline{1/} \; (\text{or } \hat{M}_i/\hat{N}_i) \quad (2).$$

where, $\hat{\rho}_i$ = tag ratio

$$\hat{N}_i = \hat{M}_i/\hat{\rho}_i \quad (3)$$

where, $\hat{N}_i$ = Population estimate just before time t_i, $\hat{M}_i$ from (1) and $\hat{\rho}_i$ from (2).

$$\hat{\Phi}_i = \frac{\hat{M}_{i+1}}{\hat{M}_i - m_i + R_i} \quad (4)$$

where, $\hat{\Phi}_i$ = probability of survival from time t to t + 1, $\hat{M}_i$ from (1).

$$\hat{\beta}_i = \hat{N}_i + 1 - \left[\hat{\Phi}_i \; (\hat{N}_i - n_i + R_i)\right] \quad (5)$$

where, $\hat{\beta}_i$ = number of new fish (recruits) joining the population in the interval from time t_i to time $t_i + 1$,

n_i = number of fish caught in the ith sample, $\hat{N}_i$ from (3), $\hat{\Phi}_i$ from (4).

1/ Assumes: $m_i/n_i \simeq \hat{M}_i/\hat{N}_i$

APPENDIX II

The Population Estimation Method of Schaefer
(Ricker, 1975)

$$N = \Sigma N_{ij} = \Sigma \left(R_{ij} \cdot \frac{Mi}{Ri} \quad \frac{Cj}{Rj}\right) - n$$

where, Mi = number of fish marked in the ith period of marking.

Cj = number of fish caught and examined in the jth period of recovery.

Rij = number of fish marked in the ith marking period which are recaptured in the jth recovery period.

Ri = total recaptures of fish tagged in the ith period.

Rj = total recaptures during the jth period.

n = total carcasses recovered.

APPENDIX III

The Population Estimation Method of Peterson
(Ricker 1975)

$$N = \frac{M\ (C + 1)}{R + 1}$$

where, M = total number of fish tagged.

C = total number of fish recovered.

R = number of tagged fish recoveries.

CHAPTER 11. AMPHIBIAN AND REPTILE SURVEY

METHODS

From April 1981 through May 1982, Department of Fish and Game (DFG) employees conducted surveys to determine which amphibian and reptile species exist within the proposed reservoir site and in the surrounding area. A further goal of the survey was to estimate population sizes among the various species found. Survey methods included pitfall trapping, night driving, ground searches, and searches of aquatic habitats.

Pitfall Trapping

Plastic 19.0 l (5.0 gal) buckets or 1.4 kg (3 lb) coffee cans, buried until their open end was level with the soil surface formed the pitfall traps used in this survey. Square plywood roofs supported by wooden legs approximately 7.5 cm (3 in) above the soil surface topped each trap (Figure 11-1). The plywood roofs functioned as lures, attracting animals underneath them to what appeared to be an area of cover. Once beneath the roof, the momentum generated by its dash for cover carried an individual over the edge and into entrapment within the buried bucket or can. The roofs also prevented livestock and people from stepping into the traps.

Both the buckets and cans were cylindrical. Buckets measured 27.5 cm (10.8 in) inside diameter and varied from 30.5 cm (12.0 in) to 36.5 cm (14.0 in) in depth. Their plywood roofs had 41.0 cm (16.0 in) sides. Coffee cans measured 15.5 cm (6.1 in) inside diameter and were 17.5 cm (6.9 in) deep. Coffee can traps were constructed by burying one can with both lids removed above another with its bottom lid intact. This resulted in doubling the trap depth to 35.0 cm (13.8 in). The plywood roofs for these traps had 30.5 cm (12.0 in) sides.

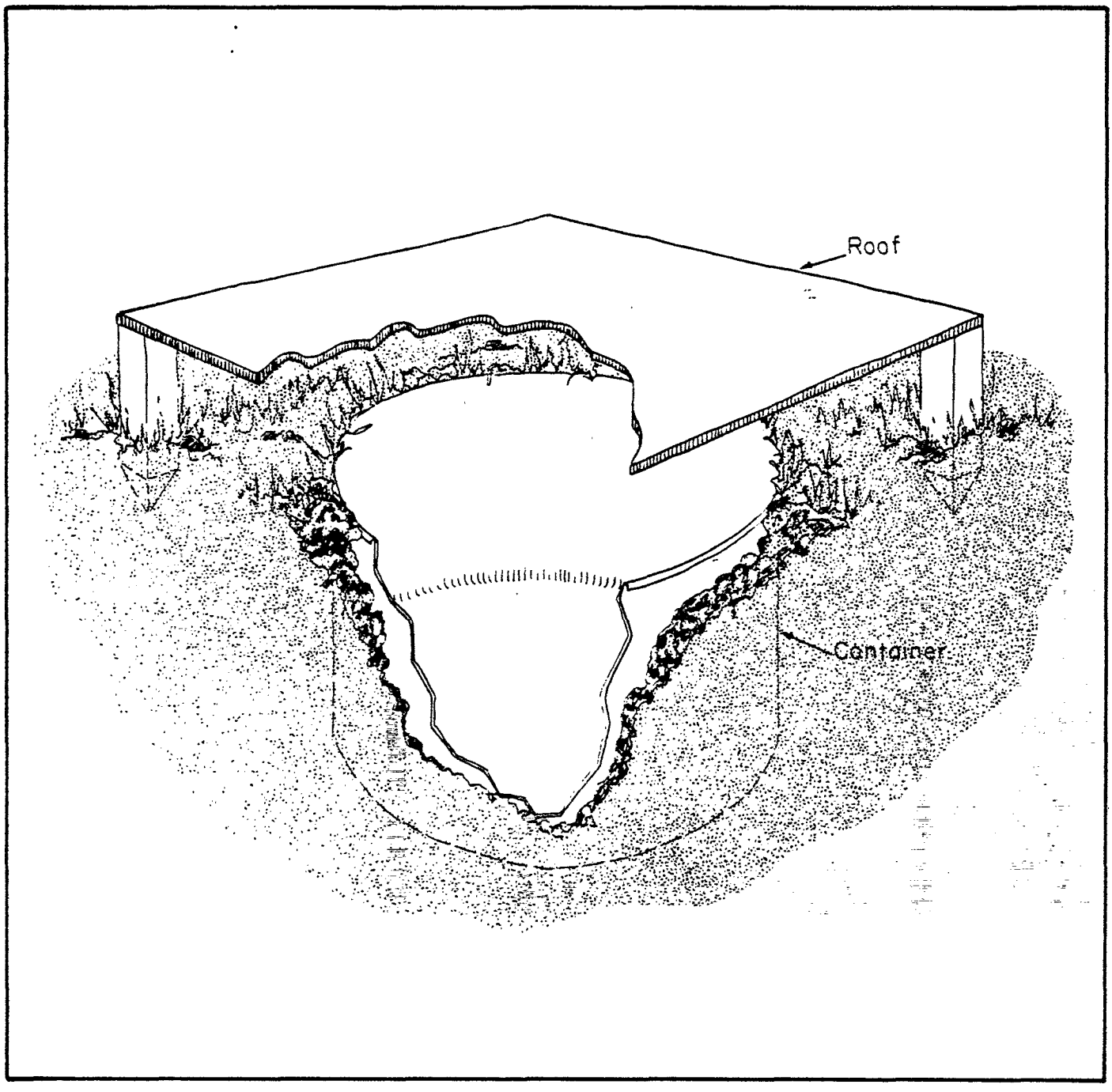

FIGURE 11-1. Pitfall trap used to capture amphibians and reptiles in the Thomes-Newville Project area.

C-099912

Two hundred nine traps were installed during the course of the survey. This total consisted of 79 bucket traps and 130 can traps. The trapping effort included placement of traps within each of the major habitat types found within the project site and surrounding areas. Grassland, oak savannah, pine-oak woodland, chaparral, and riparian areas comprised the major habitat types selected for pitfall trap installation (Figure 11-2).

Pitfall traps were checked four times per week from spring through early fall. During late fall and winter, traps were checked at least once per week. The increased frequency of trap checking during the warmer seasons coincided with increased terrestrial activity of many amphibian and reptile species. Captured amphibians and lizards were marked by clipping their toes in a predetermined sequence to obtain population estimates based on recaptures of marked individuals.

Night Drives

This method of observation involved operating a motor vehicle at speeds from approximately 24 to 40 km/h (15 to 25 mi/h), while observing and recording amphibian and reptile specimens found on a road or the shoulder. Routes followed on night drives included roads both within the project boundaries and roads in surrounding areas (Figure 11-3). Night drives occurred on an average of six times per month. Routes were travelled in both directions.

Ground Searches

Ground searching employed the techniques of looking under rocks and logs, visual identification of specimens from a distance and capture of specimens for in-hand identification using standard techniques as described by Stebbins (1966).

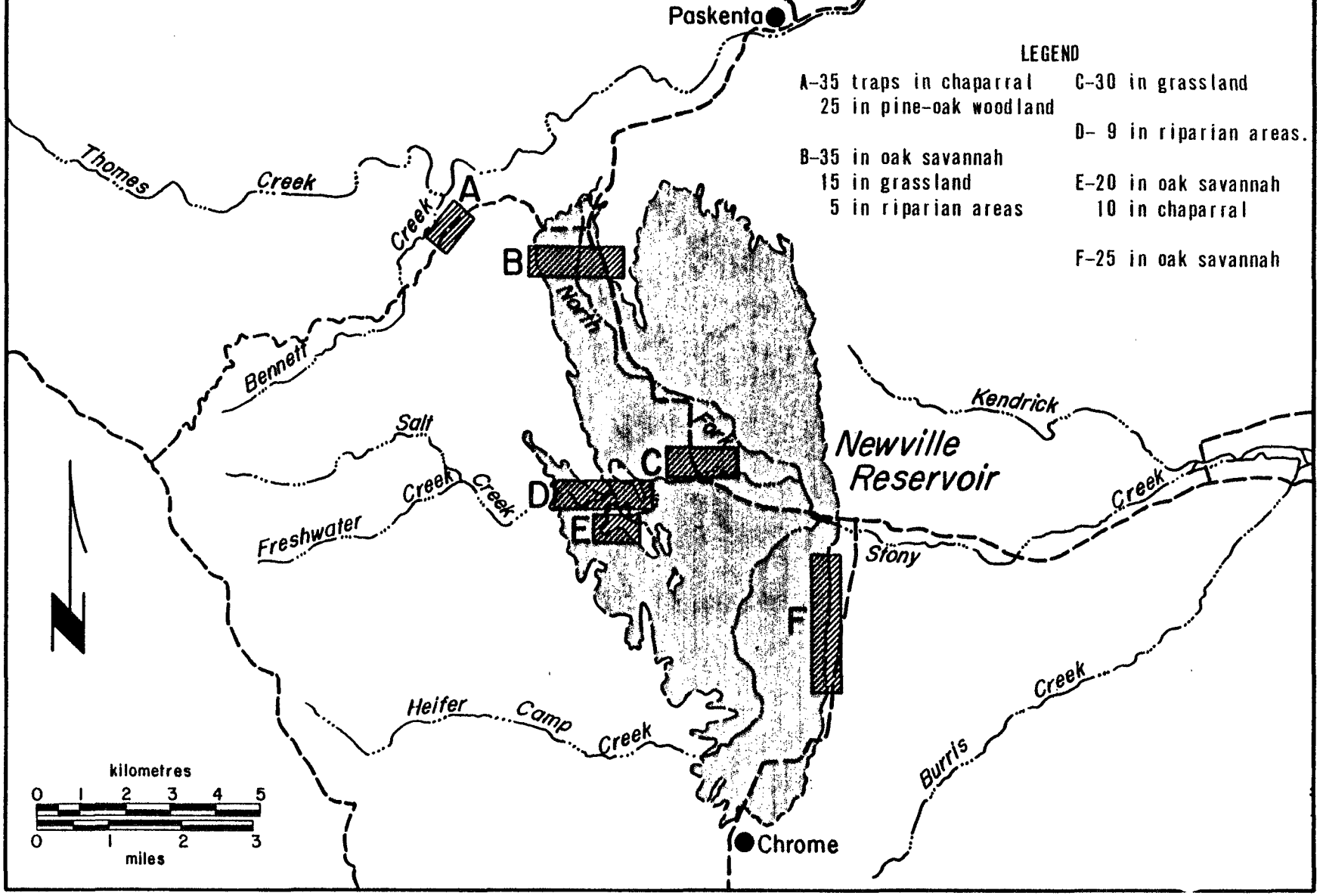

FIGURE 11-2. Approximate locations of pitfall traps used to capture amphibians and reptiles in the Thomes-Newville Project area.

C-099914

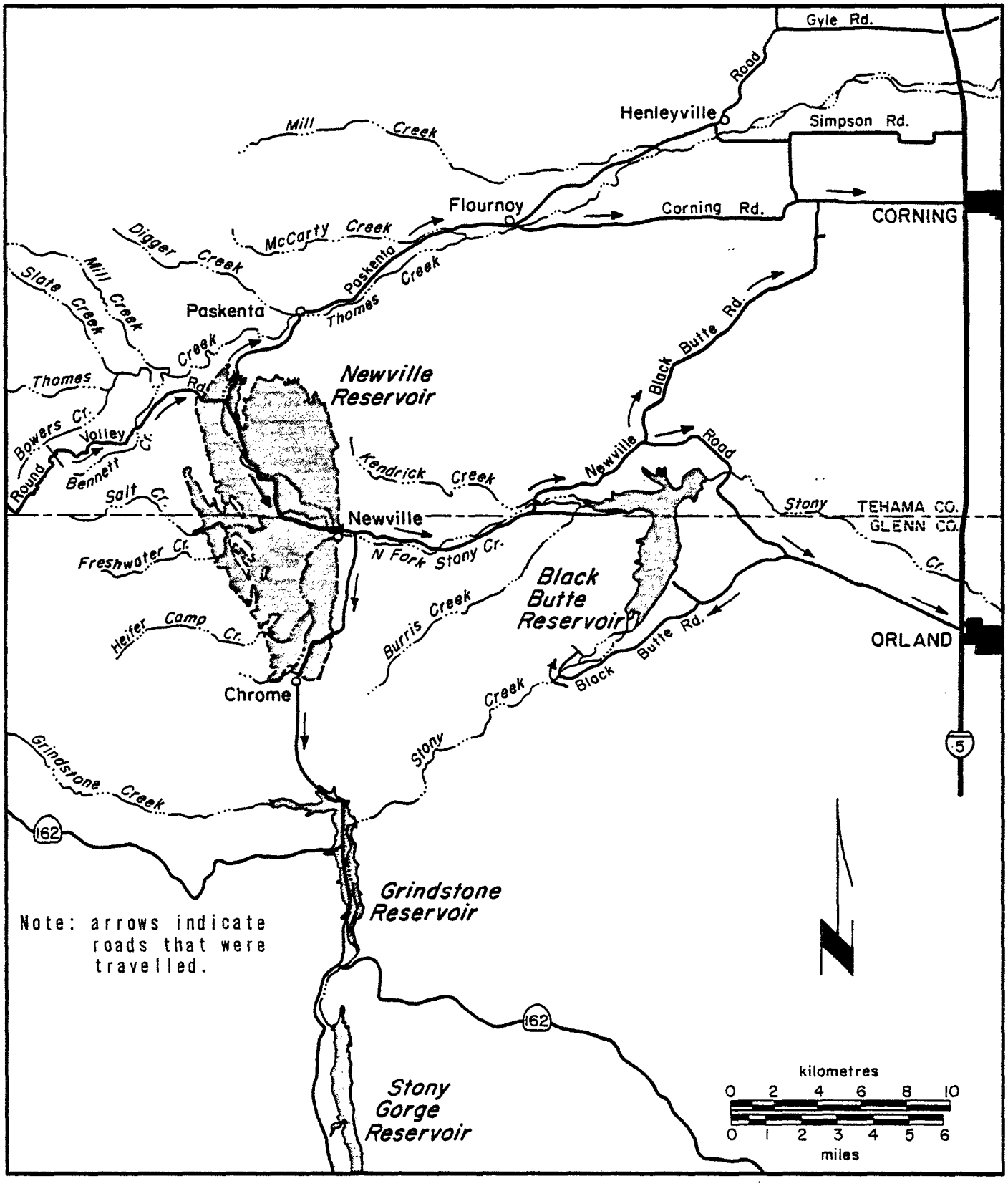

FIGURE 11-3. Roads travelled during night drive search for amphibians and reptiles in and around the Thomes-Newville Project area.

Searches of Aquatic Habitats

Searches of aquatic habitats included visual observations of animals on shore or in shallow water. Hand-held dip nets were used to capture animals near the shore. The study also included seining stock ponds and ephemeral pools in the project area using a 15 m (50 ft) beach seine.

RESULTS

This survey produced observations of 22 amphibian and reptile species which occur within the habitats composing the project area and surrounding areas (Table 11-1). No estimate of population sizes was possible because of the small number of recaptures which occurred during pitfall trapping.

Ground searching proved to be the most successful method of observation in terms of the number of species it produced (Table 11-2). This method accounted for 90.9% of all species found. Night driving yielded 63.6%, followed by pitfall trapping and searches of aquatic habitats, each of which produced 40.9% of all species found.

Pitfall traps tended to be selective for amphibians, lizards, and smaller snakes, such as the sharp-tailed snake. Larger snakes, because of their length, could easily avoid falling into the traps. This trapping method failed to provide any amphibian or reptile species not found by at least one other collection method.

Time limitations and access problems prevented use of the beach seine except on one occasion during April 1982. A stock pond with a surface area of approximately 0.04 ha (0.1 ac) located adjacent to Newville Road about 0.4 km (0.25 mi) south of the bridge near the Tehama-Glenn County line was seined during April 1982. One seine haul yielded 1,371 Pacific treefrog tadpoles and two western spadefoot toad tadpoles. Several adult bullfrogs were observed, but no adult or larval salamanders were found.

TABLE 11-1. Amphibian and Reptiles Species Found in the Thomes-Newville Project Area and Surrounding Areas (X - found in this habitat type)*

Species	Grassland	Chaparral	Oak Savannah	Pine-Oak Woodland	Riparian	Stream	Standing Water
Black salamander, *Aneides flavipunctatus*				X			
California slender salamander, *Batrachoseps attenuatus*	X	X	X	X			
Western spadefoot, *Scaphiopus hammondi*	X		X				X
Western toad, *Bufo boreas*	X	X	X	X	X	X	X
Pacific treefrog, *Hyla regilla*	X	X	X	X	X	X	X
Foothill yellow-legged frog, *Rana boylei*					X	X	X
Bullfrog, *R. catesbeiana*					X	X	X
Western pond turtle, *Clemmys marmorata*					X	X	X
Sagebrush lizard, *Sceloperus graciosus*		X					
Western fence lizard, *S. occidentalis*	X	X	X	X	X		
Western skink, *Eumeces skiltonianus*	X	X	X				
Western whiptail, *Cnemidophorus tigris*		X	X	X			

*This table is based on field observations and is not intended to imply that a particular species is restricted to only those habitats in which it was observed during this survey.

C—099917

TABLE 11-1 (continued)

Species	Grassland	Chaparral	Oak Savannah	Pine-Oak Woodland	Riparian	Stream	Standing Water
Southern alligator lizard, *Gerrhonotus multicarinatus*	X	X	X	X	X		
Western racer, *Coluber constrictor*	X	X	X		X		
Sharp-tailed snake, *Contia tenuis*	X	X					
Common kingsnake, *Lampropeltis getulus*	X	X	X	X			
Striped racer, *Masticophis lateralis*	X	X					
Gopher snake, *Pituophis melanoleucus*	X	X	X	X	X		
Western aquatic garter snake, *Thamnophis couchi*					X	X	
Western terrestrial garter snake, *T. elegans*	X		X		X	X	X
Common garter snake, *T. sirtalis*	X				X	X	X
Western rattlesnake, *Crotalus viridis*	X	X	X	X	X	—	—
Total Number of Species Observed	15	14	13	10	13	8	8

TABLE 11-2. Observation and Capture Methods Which Proved Successful for Each of the Amphibian and Reptile Species Found in the Thomes-Newville Project Area and in Surrounding Areas.

Species	Observation/Capture Method			
	Pitfall Trapping	Night Driving	Ground Searching	Searches of Aquatic Habitats
Black Salamander			X	
California slender salamander	X		X	
Western spadefoot	X	X	X	X
Western toad		X		X
Pacific treefrog	X	X	X	X
Foothill yellow-legged frog		X	X	X
Bullfrog		X		X
Western pond turtle			X	X
Sagebrush lizard			X	
Western fence lizard	X	X	X	
Western skink	X		X	
Western whiptail	X		X	
Southern alligator lizard	X	X	X	
Western racer		X	X	
Sharp-tailed snake	X		X	
Common kingsnake		X	X	
Striped racer		X	X	
Gopher snake		X	X	
Western aquatic garter snake			X	X
Western terrestrial garter snake	X	X	X	X
Common garter snake		X	X	X
Western rattlesnake		X	X	

Although no amphibian or reptile species listed as rare or endangered appear to occur in the project area, three species considered of special concern by the State because of habitat losses occurring throughout their ranges were found. Western spadefoot toads complete their reproductive cycle in both temporary and permanent ponds found throughout the inundation area. Foothill yellow-legged frogs and western pond turtles occur in the streams coursing through the reservoir site.

DISCUSSION

We believe this survey has found most, if not all the different amphibian and reptile species occurring within the reservoir site and surrounding areas. Two notable exceptions, the ringneck snake, Diadophis punctatus, and the night snake, Hypsiglena torquata, may occur here, based on habitat descriptions and range maps presented in Stebbins (1966). The survey failed to find either of these species, although they may have been found had the study continued through the spring of 1983 as planned.

The combination of survey methods proved adequate for their purpose. Ground searching, searching of aquatic habitats, and night driving accounted for all the species found. These methods seem well suited for a short-term survey such as this, since they allow a great deal of territory to be covered in a brief period of time. Although accurate estimations of amphibian and reptile species are difficult or impossible to make using these methods, they do appear to provide an accurate qualitative inventory of which species are present.

The pitfall trapping method required a relatively large amount of preparation time compared to the results it produced. Approximately three man-months were spent obtaining materials and installing traps.

C-099920

Had the survey continued through the summer of 1982 and spring of 1983, enough recaptures of marked individuals may have occurred to have made population estimates for some species.

Perhaps future studies of this sort, faced with uncertain funding should concentrate mostly on finding which species are present using methods requiring less preparation time.

C-099921

LITERATURE CITED

Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. 279 pp.

CHAPTER 12. INVERTEBRATES

METHODS

During 1982, Department of Fish and Game personnel searched the project area and surrounding areas to determine which terrestrial invertebrate species were present. Collections took place during April, May and the first week of June, 1982. Collecting techniques included netting, soil sampling and collecting individual specimens by hand. The original study plan included other standard collecting methods and provided that collections be made for a full year. However, we were limited in June 1982 in the use of additional methods and limited in collecting effort to slightly over two months.

Netting

Netting is a common method used for capturing invertebrates, particularly insects. The collecting tool used in this method is a sturdy, hand-held net similar in many respects to a butterfly net. A collector may seek an individual specimen and swing at it or may sweep the net back and forth in front as he or she traverses an area (Borror, et al. 1981). Quite often, the latter routine involves sweeping the net through vegetation as, for example, when sampling a grassland habitat.

The study plan called for netting in all the major terrestrial habitats found in the project site and surrounding areas. These included grassland, oak savannah, pine-oak woodland, chaparral and riparian areas.

Soil Sampling

Soil sampling provides a means for collecting invertebrates occupying niches in leaf litter and underground. Leaf litter and soil were removed to a depth of 10 cm (4 in.) from 0.1 m^2 (1.1 ft^2) plots in all the major habitat types. These samples were transported from the field to the laboratory where invertebrate specimens were separated from their substrate, keyed, and preserved.

Hand Collections

Hand collections of specimens included turning rocks and logs, looking among the flowers and foliage of plants and searching the ground for specimens. This collection method was also planned for all the major habitat types.

Keying and Preserving

Collected specimens were keyed, in most cases to family, using the facilities of California State University, Chico. Keyed specimens were preserved using standard methods for preserving invertebrates.

RESULTS

The abbreviated study yielded specimens representing six classes of invertebrates (Table 12-1). Included in this total were 62 families representing 10 orders in the class Hexapoda (insects).

Of the 72 taxa collected, netting accounted for 69.4% of the total, followed by hand collection and soil sampling, accounting respectively for 40.3% and 11.1% (Table 12-2). Because some taxa, for example Ixodidae, Gryllidae and Rhinotermitidae, were taken by more than one method, the sum of these figures exceeds 100%.

C-099924

TABLE 12-1. Terrestrial Invertebrates Collected in and Around the Thomes-Newville Project Area (Specimens Keyed to Family in Most Cases)[1]

- Phylum Arthropoda
  - Subphylum Chelicerata
    - Class Arachnida
      - Order Araneae - spiders
        - Ctenzidae - Trapdoor spiders
        - Theridiidae - Comb-footed spiders
      - Order Acari - Mites and ticks
        - Ixodidae - Hard ticks
      - Order Pseudoscorpinonida - Pseudoscorpions
  - Subphylum Crustacea
    - Class Malacostraca
      - Order Isopoda
        - *Oniscus asellus* - Sowbug
  - Subphylum Uniramia
    - Class Diplopoda - Millipedes
    - Class Chilopoda - Centipedes
      - Order Lithobiomorpha
      - Order Scolopendromorpha
      - Order Geophilomorpha
    - Class Symphyla - Symphylans
    - Class Hexapoda - Insects
      - Order Collembola - Springtails
        - Isotomidae
        - Entomobryidae
        - Sminthuridae
      - Order Diplura - Diplurans
        - Campodeidae
        - Japygidae
      - Order Orthoptera - Crickets, grasshoppers, etc.
        - Acrididae - Short-horned grasshoppers
        - Gryllacrididae - Wingless, long-horned grasshoppers
        - Gryllidae - Crickets
        - Blattidae - Cockroaches
      - Order Isoptera - Termites
        - Rhinotermitidae - Soil termites
      - Order Hemiptera - Bugs
        - Pentatomidae - Stink bugs
        - Scutelleridae - Shield-backed bugs
        - Coreidae - Burrower bugs
        - Alydidae - Broad-headed bugs
        - Lygaeidae - Seed bugs
        - Reduviidae - Assassin bugs
        - Miridae - Leaf bugs
      - Order Neuroptera-Alderflies, dobsonflies, lacewings, etc.

1/ Phyletic sequence follows that of Borror, et al. (1981).

C-099925

Hemerobriidae - Brown lacewings
Chrysopidae - Common and green lacewings
Myrmeleontidae - Antlions

Order Coleoptera - Beetles
Carabidae - Ground beetles
Histeridae - Hister beetles
Silphidae - Carrion beetles
Scarabaeidae - Scarab beetles
Buprestidae - Wood-boring beetles
Elateridae - Click beetles
Lampyridae - Fireflies
Cantharidae - Soldier beetles
Cleridae - Checkered beetles
Coccinellidae - Ladybird beetles
Tenebrionidae - Darkling beetles
Meloidae - Blister beetles
Chrysomelidae - Leaf beetles

Order Lepidoptera - Butterflies, moths
Coleophoridae - Casebearers
Pyralidae - Snout moths, grass moths
Hesperiidae - Skippers
Pieridae - Whites, sulfurs, orange-tips
Lycaenidae- Coppers, hairstreaks, blues, harvesters, and metalmarks
Nymphalidae - Brush-footed butterflies
Satyridae - Satyrs, wood nymphs, and arctics
Danaidae - Milkweed butterflies

Order Diptera
Tipulidae - Crane flies
Tabanidae - Horse flies, deer flies
Asilidae - Robber flies
Acroceridae - Small-headed flies
Bombyliidae - Bee flies
Phoridae - Humpbacked flies
Syrphidae - Flower flies
Sciomyzidae - Marsh flies
Anthomyiidae - Anthomyiid flies
Muscidae - Muscid flies (house fly)
Calliphoridae - Blow flies

Order Hymenoptera
Tenthredenidae - Common sawflies
Ichneumonidae - Ichneumons
Chrysididae - Cuckoo wasps
Multillidae - Velvet ants
Pompilidae - Spider wasps
Vespidae - Paper wasps, yellow jackets, hornets
Eumenidae - Mason and potter wasps
Sphecidae - Sphecid wasps
Anthophoridae - Cuckoo, digger, and carpenter bees
Apidae - Honey, bumble, and euglossine bees

TABLE 12-2. Invertebrates Captured in and Around the Thomes-Newville Project Area, Listed by Habitat Type and Capture Method.

Taxon	Grassland	Oak Savannah	Pine-Oak Woodland	Chaparral	Riparian
Phylum Arthropoda					
Subphylum Chelicerata					
Class Arachnida					
Order Araneae					
Ctenzidae				H	
Theridiidae	H[1/]				
Order Acari					
Ixodidae	N[1/]			H	
Order Pseudoscorpinonida				S[1/]	
Subphylum Crustacea					
Class Malacostraca					
Order Isopoda					
Oniscus asellus				H	
Subphylum Uniramia					
Class Diplopoda				H	
Class Chilopoda					
Order Lithobiomorpha				H	
Order Scolopendromorpha				H	
Order Geophilomorpha				H	
Class Symphyla				S	
Class Hexapoda					
Order Colembola					
Isotomidae				S	
Entomobryidae				S	
Sminthuridae				S	
Order Diplura					
Campodeidae				S	
Japygidae				S	
Order Orthoptera					
Acrididae		N		N	
Gryllacrididae				H	
Gryllidae	H			H	H
Blattidae				H	
Order Isoptera					
Rhinotermitidae	H			H	

1/ N = Netting, H = Hand Collection, S = Soil Sample

C-099927

TABLE 12-2 (Continued)

Taxon	Grassland	Oak Savannah	Pine-Oak Woodland	Chaparral	Riparian
Order Hemiptera					
Pentatomidae				N	
Scutelleridae	N			N	
Coreidae				N	
Alydidae	N				
Lygaeidae	H			H	
Reduviidae	H				
Miridae				N	
Order Neuroptera					
Hemerobriidae	N				
Chrysopidae	N				
Myrmeleontidae			H		
Order Coleoptera					
Carabidae	H			H	
Histeridae	H				
Silphidae					H
Scarabaeidae	N				H
Buprestidae				N	
Elateridae	H			H	
Lampyridae	N				
Cantharidae	N				
Cleridae	H			H	
Coccinellidae	N				
Tenebrionidae			H		
Meloidae	N				
Chrysomelidae				N	N
Order Lepidoptera					
Coleophoridae				S	
Pyralidae	N				
Hesperiidae	N				
Pieridae	N				
Lycaenidae	N				
Nymphalidae	N				
Satyridae	N	N			
Danaidae	N				
Order Diptera					
Tipulidae	N				
Tabanidae	N				
Asilidae	N			N	
Acroceridae				N	
Bombyliidae	N				
Phoridae	N				
Syrphidae	N				
Sciomyzidae	N				
Anthomyiidae	N				
Muscidae	N				
Calliphoridae	S				

TABLE 12-2 (Continued)

Taxon	Grassland	Oak Savannah	Pine-Oak Woodland	Chaparral	Riparian
Order Hymenoptera					
Tenthredenidae	N				
Ichneumonidae	N	N			
Chrysididae				N	
Multillidae				N	
Pompilidae	N				
Vespidae	N			N	
Eumenidae	N				
Sphecidae	N				
Anthophoridae	N				
Apidae	N				

Grassland produced 61.1% of the taxa captured, chaparral 50.0%, riparian areas 5.6%, oak savannah 4.2% and pine-oak woodland 1.4%. Again, these figures sum to over 100% because some taxa occurred in more than one habitat.

DISCUSSION

The results of this collecting effort provided only a glimpse of the variety of terrestrial invertebrate populations present in and around the project area. The list is not complete and additional sampling should be accomplished for full disclosure in the EIR process.

The tables presented do not imply that one capture technique is better than any other or that the habitats in which the different classifications were captured are the only ones in which they occur. Rather, they present the results of a much-shortened collecting effort which possessed the potential for making a much more accurate assessment of invertebrate populations had it continued.

Although the collecting effort, in the short time allotted it, produced no species of concern, at least two such species may occur in the project area and downstream. The land snail, Trilobopsis techamana, and the Wilbur Springs shore bug, Saldula usingeri, may occur. In the event that planning for this project resumes, efforts should be made to determine their occurrence here prior to formulating a mitigation plan. Field sampling should continue through a full spring and summer at the same intensity as this study to adequately describe major insect groups and to search for species of concern.

REFERENCES

Borror, D. J., D. M. DeLong and C. A. Triplehorn. 1981. An introduction to the study of insects, 5th ed., Saunders College Publishing, San Francisco, CA 827 pp.

CHAPTER 13. PROJECT IMPACTS/MITIGATION SUGGESTIONS

INVERTEBRATES, AMPHIBIANS AND REPTILES

Creation of a reservoir would have several deleterious impacts on amphibians, reptiles, and terrestrial invertebrates occupying the area.

Inundation of streams destroys habitat for species adapted to a stream existence. One such species of concern is the foothill yellow-legged frog.

Inundation destroys the unique habitat provided by ephemeral pools. The western spadefoot toad depends on such habitat to complete its breeding cycle. Pacific treefrogs also may complete their reproductive cycle in temporary pools.

Inundation would destroy riparian habitat and species occurring in such habitat. The land snail, should it occur in the project area, could be affected by such habitat reduction.

Finally, inundation of terrestrial habitat reduces populations of species adapted to life on land. This category of species includes most herpetofauna and terrestrial invertebrate species occurring in the area.

Perhaps the best form of mitigation for losses which would be suffered by herpetofauna and invertebrate populations would be in terms of habitat. The purchase of land to mitigate losses among wildlife populations could prove beneficial to herpetofauna and invertebrate populations found there. As these lands are managed for the benefit of wildlife populations, managers should search for opportunities to provide improved habitat for herpetofauna and invertebrates.

Newville and Tehenn Reservoir Sites

The Newville and Tehenn reservoirs on North Fork Stony Creek could inundate approximately 80.5 km (50 miles) of perennial and intermittent streams. These streams are used primarily by roach, suckers and squawfish that migrate from Black Butte Reservoir to spawn and rear. The Tehenn Dam site would prevent these fish from migrating upstream while the filling of both reservoirs would eliminate the flowing stream habitat that is needed for spawning.

No mitigation for these fishes would be needed since the reservoir would create sufficient suitable habitat for adults and for rearing juveniles while the remaining free-flowing streams above the reservoirs would be used for spawning.

Stream reaches above the Newville Reservoir that support wild rainbow trout would not be inundated if the current engineering plan is followed. These trout could become accessible to anglers.

Thomes Creek Diversion

The Thomes Creek Diversion would inundate about 1.6 km (1 mile) of stream now used by suckers, hardhead squawfish and dace for spawning and rearing. Some resident rainbow trout are found in this area as well. In addition the diversion would eliminate access to all existing habitat for spring-run chinook salmon in Thomes Creek.

No mitigation for lost nongame fish habitat would be necessary, since the reservoir would provide adequate habitat for nongame fishes. The 1.6 km (1 mile) section lost on Thomes Creek could be partially mitigated by creating habitat downstream in the mouth of Slate and Mill creeks. These

streams have small amounts of cold water all year near their confluences, but the discharge is so small that it should be augmented by cold water piped from the diversion.

Stony Creek (below Black Butte)

No impacts are anticipated since project water would be transported out-of-stream in a specially designed canal adjacent to main stem Stony Creek.

Thomes Creek (downstream diversion)

The planned Thomes diversion would potentially divert all but 1.4 m^3/s (50 ft^3/s) into Newville Reservoir. Reduction of flows would result in a decrease in the quantity of spawning and rearing habitat for both game and nongame fishes.

Nongame fishes, mainly suckers, squawfish, hardhead, roach, and dace, migrate in large numbers to spawn and rear in the main stem and tributaries of Thomes Creek. A reduction of flow to 1.4 m^3/s (50 ft^3/s) would represent about 10% of the average natural discharge during winter and early spring. It is during these times that squawfish and suckers migrate into Thomes Creek to spawn. During spring dace and hardhead migrate upstream to spawn. A regimen of 1.4 m^3/s (50 ft^3/s) could impair fish passage and provide less habitat for spawning and rearing. Mitigation measures have not been considered to date for these losses.

Few fall-run chinook salmon were observed spawning in the main stem during the study period. However, the available spawning habitat would be virtually eliminated by decreased flows. Mitigation could include an option such as rehabilitation and maintenance of gravels and provision of a stable flow regime in the outlet channel of the Tehama-Colusa Canal. This option could probably have an enhancement element added to it.

CHAPTER 14. FUTURE FISHERIES STUDY NEEDS

1. Develop a detailed management program for reservoir fishes.
2. Prepare a plan to maintain suitable gamefish habitat along the reservoir edge.
3. Determine impacts and opportunities for improvement of new operation of Black Butte, Stony Gorge and East Park reservoirs.
4. Evaluate the effects of an exchange of water developed by the Thomes-Newville project with water in the Tehama-Colusa Canal on adult chinook passage and juvenile chinook survival at Red Bluff Diversion Dam.
5. Complete study to determine the effects of various flows on fish habitat in Stony and Thomes creeks. Develop stream management programs.
6. Complete survey of threatened invertebrates, amphibian and reptile species.
7. Determine post-project study requirements.
8. Summation of manpower and costs:

Position	Salary (per Month)	Effort (Months)	TOTAL
Environmental Services Supervisor	$2,814	3.0	$ 8,442
Associate Fishery Biologist	2,332	4.0	9,328
Fishery Biologist (B)	1,935	16.0	30,960
Personal Services @ 30%			14,619
Graduate Student Assistant	1,006	16.0	16,100
Seasonal Aides	725	24.0	17,400
Travel and Operating Expenses			30,000
Overhead @ 13.3%			16,870
TOTAL			$143,720