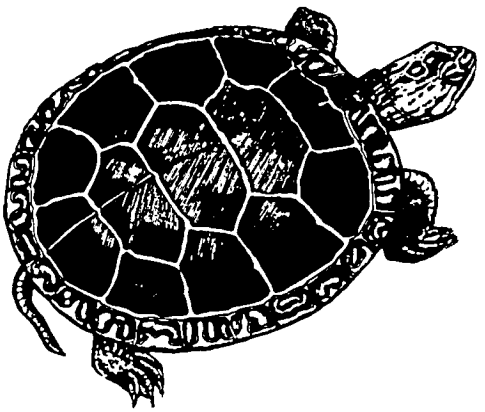
Western Painted Turtle Research at Smith and Bybee Lakes Natural Area Year One Report—1999



Prepared for

Metro Regional Parks and Greenspaces

By

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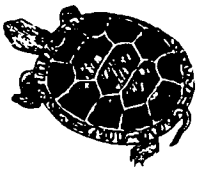

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SUMMARY

In 1999, the Turtle Project of the Northwest Ecological Research Institute (NERI) conducted the first year of a five-year study on the population of western painted turtles (*Chrysemys picta belli*) for Metro Regional Parks and Greenspaces at Smith and Bybee Lakes Wildlife Area in north Portland, Oregon. Data collected at the site during the first year of the study will contribute toward Metro's long-term goal of conserving and protecting the western painted turtle and its habitat.

All research efforts were conducted using Metro's turtle survey and monitoring protocol developed by NERI (1998). Field work was conducted from March through October with the assistance of a large team of trained volunteers supervised by NERI biologists.

Visual and capture-mark-release methods were used to study turtles at the 2250-acre site. Most turtles observed and all turtles live-captured at the site were western painted turtles. In addition, Oregon's other native turtle species the western pond turtle, *Clemmys marmorata marmorata*, was observed along with an introduced species the red-eared slider, *Trachemys scripta elegans.*

Preliminary results provided information on habitat use in all areas of the site. In addition information was collected suggesting an equal male and female gender ratio; the existence of all age classes, adult, juvenile and hatchling; and an estimate of potential population size.

In addition to analyzing the 1999 population data, NERI also proposed changes to the protocol based on field testing. Recommendations for management strategies at the site were also suggested. The goal for the year 2000 field season is to continue the demographics study and initiate research on the nesting behavior of the western painted turtle.

INTRODUCTION

In 1999 a comprehensive five-year research project to study the western painted turtle (*Chrysemys picta belli*) population began at Smith and Bybee Lakes Wildlife Area (SBLWA), managed by Metro Regional Parks and Greenspaces (Metro). A remnant of the once vast lower Columbia River flood plain, the 2250-acre SBLWA is one of the United States' largest urban wetlands (Figure 1; FES, 1987). The area supports a diverse assemblage of resident and migratory wildlife, including red-legged frogs, bald eagles and river otters.

One of its residents, the western painted turtle, is one of only two native freshwater turtle species in the state of Oregon. The western painted turtle is a long-lived species which ranges from the north central United States through the Pacific Northwest. The geographic range of the western painted turtle in Oregon includes the Columbia River Basin and the Willamette Valley south to Eugene. The species is commonly found in ponds, and slow moving streams and rivers. Important habitat features include partly submerged woody structures along with dense mats of aquatic vegetation which are used for basking, foraging and hiding cover.

As with other reptiles, turtles are ectotherms ("cold-blooded") meaning that environmental temperatures control their activity levels. Research suggests that painted turtles are active in water temperatures ranging from 8 to 32 degrees Celsius (Ernst, 1972). Western painted turtles typically nest from May through August (Beilke, pers. comm.; Christens and Bider, 1987; Congdon and Tinkle, 1982). Females dig small flask-shaped nests in sunny, sparsely vegetated upland areas and lay clutches of 4-20 eggs; eggs hatch in 60-90 days (Congdon and Gatten, 1989; Legler, 1954). In the Pacific Northwest, hatchlings may emerge from the nest in the fall, or may overwinter in the nest and emerge the following spring (Beilke, pers. comm.). The species is omnivorous and a study at SBLWA suggests their diet at the site is primarily blue-green algae and invertebrates (Barclay, pers. comm.).

Habitat loss, introduced predatory and competitive species, and previous uncontrolled harvesting of the species have led to a serious decline in population, prompting the Oregon Department of Fish and Wildlife to place the western painted turtle on its Sensitive Species List with critical status. Sensitive-critical species may become threatened or endangered throughout all or a significant portion of their range in the future if immediate conservation actions are not taken.

Research goals were developed in a protocol written by Northwest Ecological Research Institute (NERI) in 1998 to address the status of the species at SBLWA (NERI, 1998). These goals address demographics, nesting, impacts, overwintering, basking and habitat use.

This research is the first comprehensive study of turtles at the entire site. Most previous work was restricted to the ponds and sloughs south of North Marine Drive. Visual surveys were conducted in 1991 and 1992 (Holland, 1994). Visual and capture-mark-release surveys were conducted in 1992 and 1993 (Lev et al, 1994) and by Hayes and Holland in the early 1990s (Holland, pers. comm.). A nutrition study conducted by Barclay (pers. comm.) from 1994 through 1996 included visual, capture-mark-release and nesting surveys. In 1997, surveys of turtle nesting and other terrestrial activity were conducted between the North Marine Drive ponds and the Columbia River (NERI, 1997).

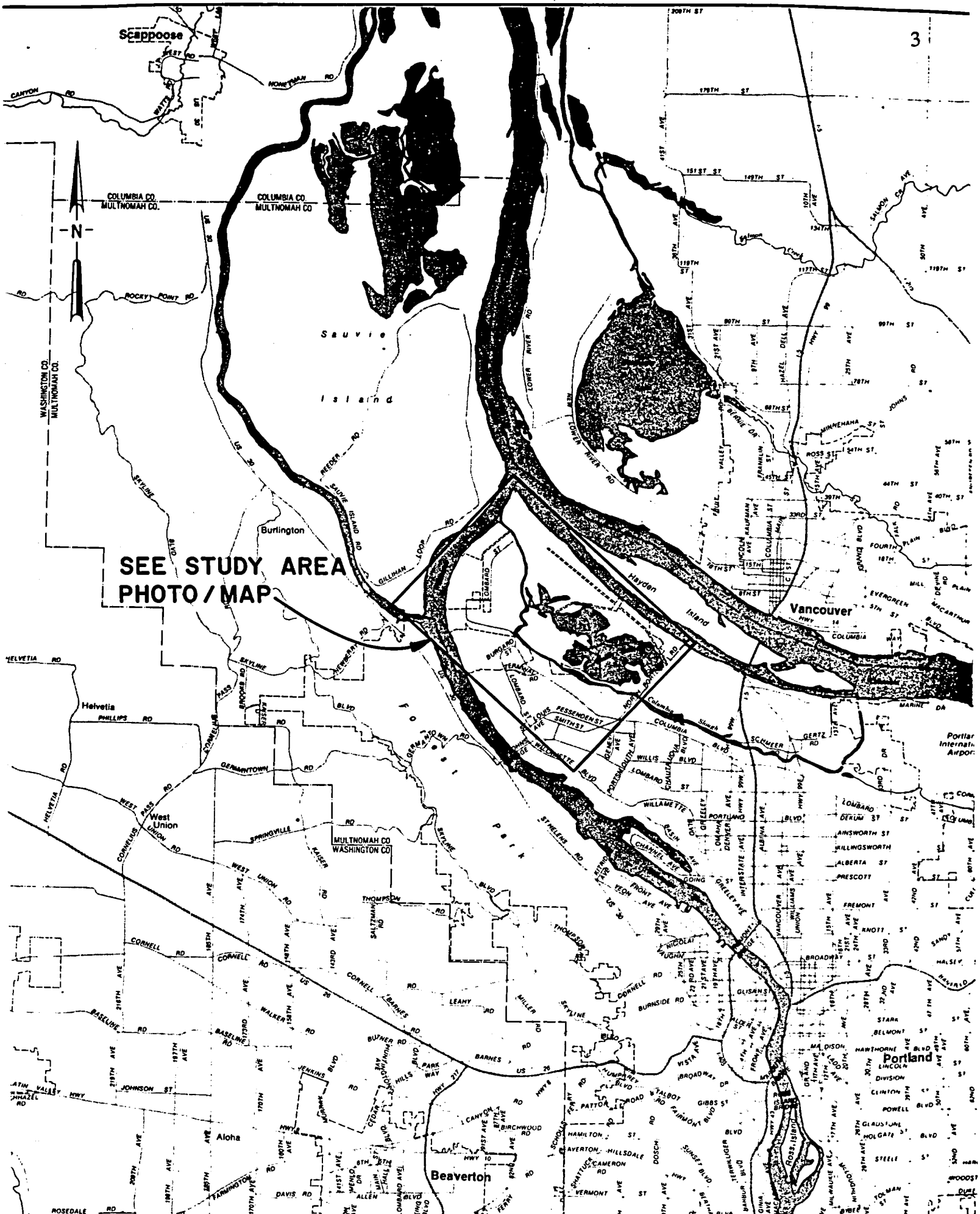


Figure 1. General location of Smith and Bybee Lakes Natural Area within the Portland Metropolitan area.

MANAGEMENT

Northwest Ecological Research Institute

Founded in 1984, NERI is a private, non-profit tax-exempt organization dedicated to furthering the understanding and conservation of wildlife and natural systems. The purpose of NERI is to further knowledge of Pacific Northwest natural history through research, training, and dissemination of information.

The NERI team was comprised of four Associates: Teresa DeLorenzo was project coordinator; Susan Beilke was project consultant; and Denis O'Brien and Stephanie Sackett, field supervisors, managed the volunteer field effort. All team members were involved in volunteer recruitment, training, data collection and management, and report writing.

Volunteer Recruitment and Training

Given the size of the site and budget constraints, the research effort relied heavily on trained and supervised volunteers with oversight by experienced turtle experts. NERI and Metro worked together to recruit and train volunteers for the field season. Three evening orientation meetings in the winter of 1999 were conducted for 146 people interested in the project. In early spring 1999 six, three-hour field training sessions were conducted for a 128 people. Volunteers were taught field research techniques and safety procedures. During the field season 90 volunteers worked at least one day. Volunteers ranging in age from 18 to late 70s, including students, professionals, and outdoor enthusiasts, donated over 4000 hours.

MATERIALS AND METHODS

Smith and Bybee Lakes Wildlife Area

The study site covers most of the 2250-acre system of interconnected shallow lakes, wetlands and associated uplands located on the lower Columbia River flood plain near its confluence with the Willamette River (Figure 2). *Prior to 1930, these lakes and wetlands experienced bi-seasonal inundation during the freshets of the Columbia and Willamette Rivers. During summers, significant portions of the lake beds were exposed. Over the past century, human activities have extensively altered the hydrology of the lakes. Attenuation of the seasonal flow began in the 1930s with changes in the volume of upstream water input. Since the early 1980s, the installment of a fixed outflow structure has maintained a minimum water level in the lakes which has prevented significant exposure of the lake beds during most summers. Much of the area previously subject only to seasonal inundation now is inundated year-round* (Lev, et al. 1994).

The entire site is surrounded by intensive industrial development and heavily used rail and road transportation facilities. As an urban wetland, SBLWA experiences moderate recreational use by fishers, hikers and boaters.

To facilitate the research effort, the protocol divides the site into four subareas (Figure 3):

Bybee Lake (Figure 4) is the smaller of two lakes at the site. The adjacent uplands of Bybee Lake include forested areas of Oregon ash (*Fraxinus latifolia*), willow species (*Salix* spp.), and black cottonwood (*Populus balsimifera*). The herbaceous vegetation primarily consists of reed canary grass (*Phalaris arundinacea*) and also includes leafy beggarticks (*Bidens* sp.), creeping lovegrass (*Eragrostis hypnoides*), ovate spike rush (*Eleocharis ovata*), Columbia sedge (*Carex aperta*), and red-rooted flat sedge (*Cyperus erythrorhizos*). The northern section of Bybee Lake consists of three coves and a small slough. Aquatic vegetation in Bybee Lake includes water smartweed (*Polygynum* spp.), *Elodea canadensis,* small amounts of algae and introduced coontail (*Ceratophyllum demersum).* Extensive woody structure, primarily willow, occurs along most of the margins of Bybee Lake.

The Ponds and Sloughs (Figure 5) are located immediately south of North Marine Drive. Narrow bands of mixed deciduous forest habitat occur along the margins of the ponds and sloughs. Between the north edge of the ponds and sloughs and North Marine Drive, the open upland habitat consists of sparsely vegetated (clover, grasses and other introduced species) sand fill. Aquatic vegetation includes smartweed (*Polygynum* spp.), *Elodea canadensis,* duckweed (*Lemna* spp.), yellow pond lily (*Nuphar lutea* spp.) and introduced coontail (*Ceratophyllum demersum*). Algae was present in approximately 25 percent of the aquatic habitat. Much of the aquatic vegetation occurs in dense mats. Moderate amounts of woody structure, including willow, ash and cottonwood, occur along some of the margins of the ponds and sloughs.

Smith Lake (Figure 6) is the largest body of water at the site and is surrounded by forested areas of ash, willow, and cottonwood. The herbaceous assemblage includes leafy beggarticks (*Bidens* sp.), creeping lovegrass (*Eragrostis hypnoides*), ovate spike rush (*Eleocharis ovata*), Columbia

sedge (*Carex aperta*), red-rooted flat sedge (*Cyperus erythrorhizos*), and reed canary grass. Aquatic vegetation includes native and introduced *Polygonum* spp. Very little algae was noticed in 1999. Woody structure also occurs in much of the lake.

4. Ramsey Lakes and Columbia Slough (Figure 7) are located in the northwest portion of the SBLWA. The Port of Portland created the three lakes and four islands of Ramsey Lakes as a wetland mitigation site in 1988. Vegetation along the lakes varies from mature stands of deciduous forest to patches of scrub/shrub or areas with introduced invasive species such as, reed canary grass, purple loosestrife (*Lythrum salicaria*) and Himalayan blackberry (*Rubus discolor*). The southernmost section includes a large area of Pacific willow (*Salix lasiandra*). Vegetation on the islands consists primarily of reed canary grass. The aquatic vegetation includes water smartweed and small amounts of algae. There are limited amounts of woody structure in the lakes.

Vegetation along the Columbia Slough includes a narrow band of deciduous forested habitat with reed canary grass as the dominant herbaceous vegetation. There are small amounts of aquatic vegetation and woody structure in the slough. The Columbia Slough water levels are subject to tidal influence.

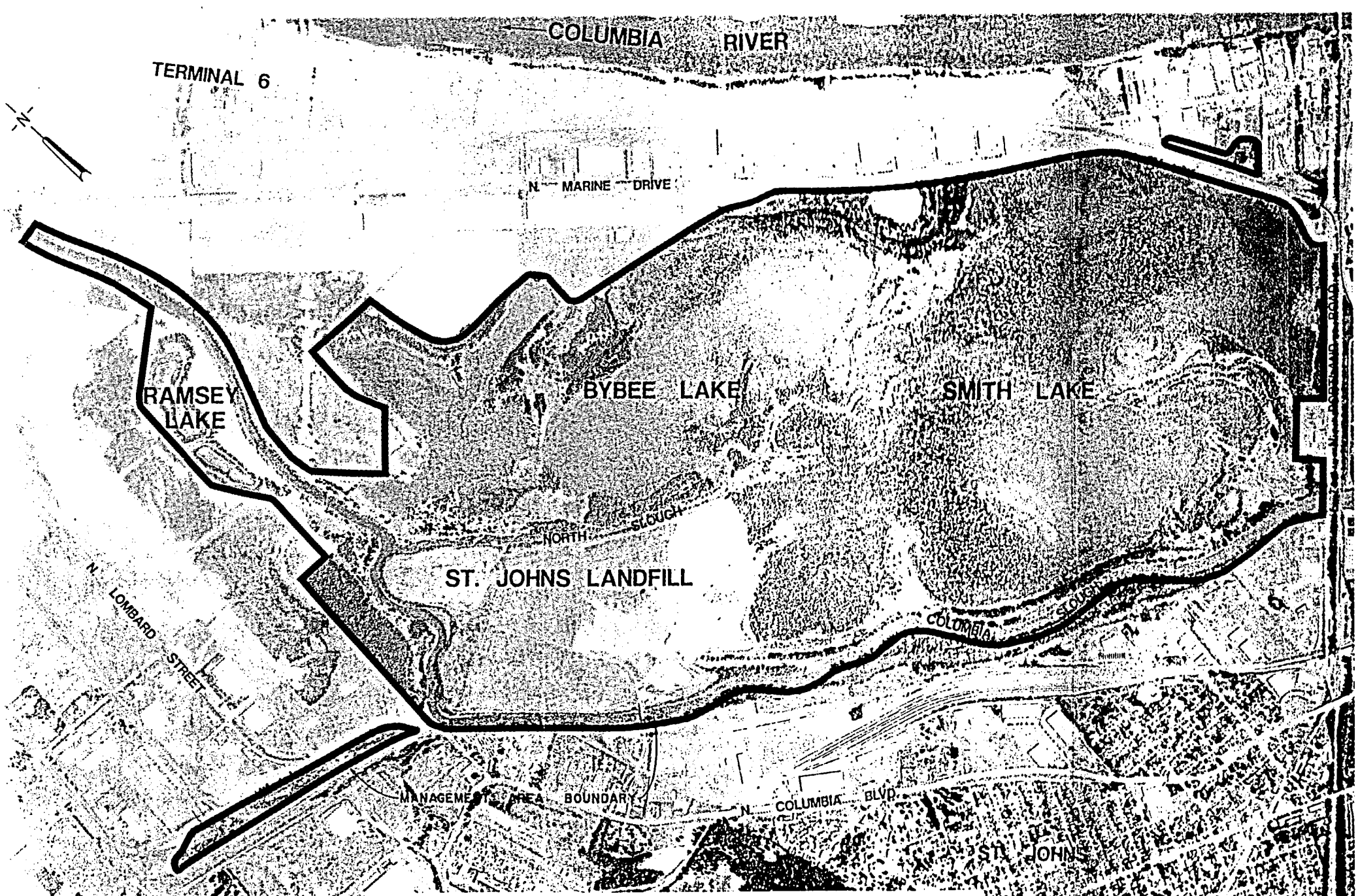


Figure 2. Aerial photograph of Smith and Bybee Lakes Natural Area.

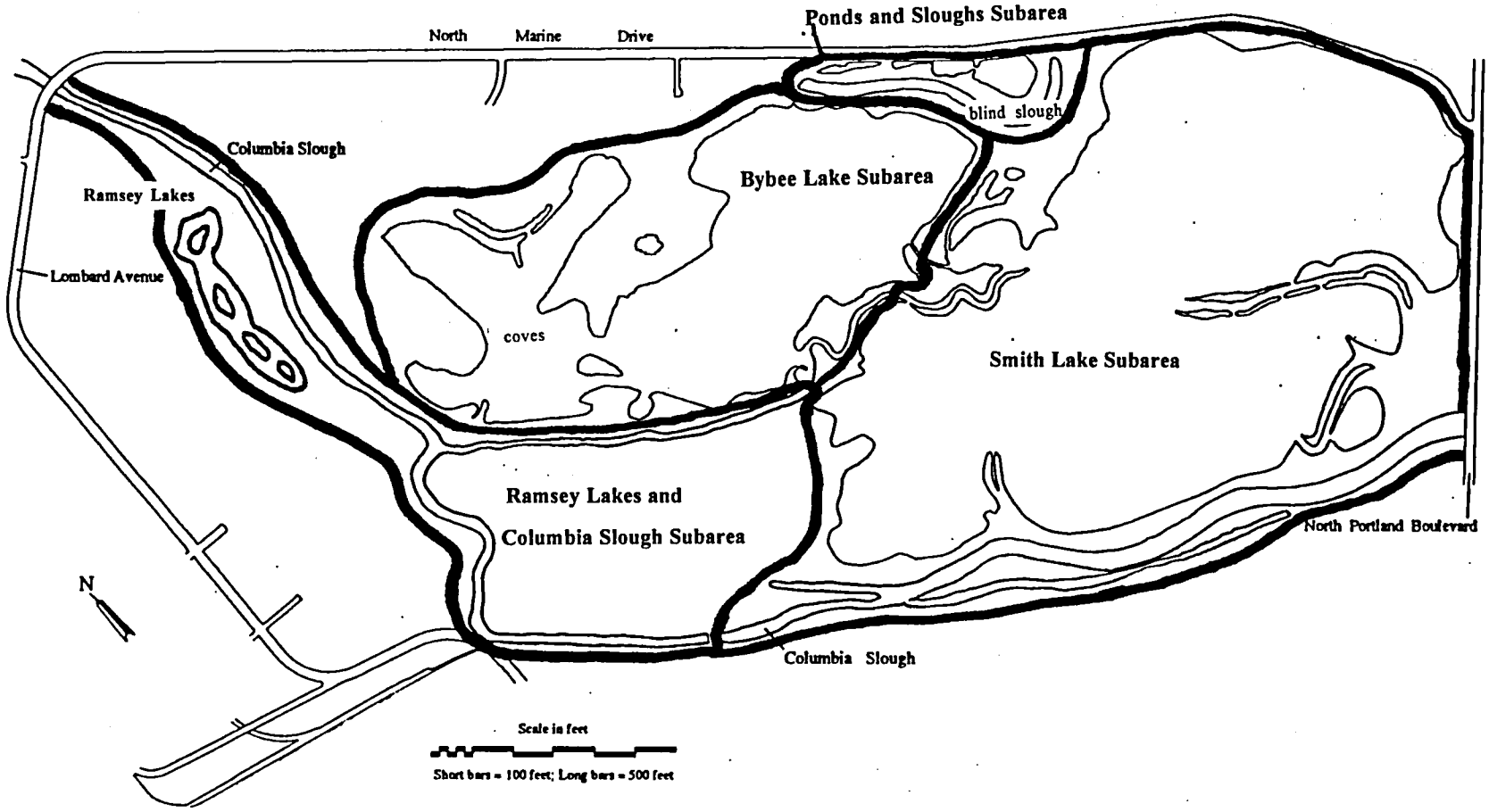


Figure 3. Four subareas of the study site at Smith and Bybee Lakes Natural Area.

Figure 4. Bybee Lake subarea typical view.

Figure 5. Ponds and Sloughs subarea typical view.

Figure 6. Smith Lake subarea typical view.

Figure 7. Ramsey Lakes and Columbia Slough subarea, typical view of lakes.

Protocol

The five-year turtle survey and monitoring plan is designed to address a total of six goals, with ongoing review and revision based on field testing. The budget for the first year permitted study of two of the six goals (goals 1 and 5, below). As a database is built with each successive year of the study, information can be developed to enhance the conservation and management of the western painted turtle at SBLWA. Annual funds available for each year will determine which goals can be pursued. The six research goals are (Appendix):

Goal 1. Demographics.
The first and most important task in developing a management plan for western painted turtles at SBLWA is to conduct a comprehensive survey of the entire site to measure the demographics of the population and assess its overall health. Establishing a clear picture of the status of the turtle population requires ongoing systematic surveys.

Goal 2. Nesting
Identifying and describing nesting behavior is critical to managing and protecting nesting habitat.

Goal 3. Impacts
Measuring the effects of human and non-human negative impacts on the turtle population at SBLWA is important so that management plans can incorporate effective protection for the turtle population. No studies exist to guide the evaluation of various impacts on turtles. One approach for measuring human impacts is a comparative study between SBLWA and a similar site with limited human activity.

Goal 4. Overwintering
Management of the species must include protection of overwintering sites because turtles are particularly vulnerable during this period. Overwintering sites may be different from summer locations used by the turtles, and may also vary depending on gender and age.

Goal 5. Basking
Successfully managing the turtle population at SBLWA includes providing for and protecting basking habitat. Basking is essential for proper turtle thermoregulation, digestion, female hormonal regulation and other life processes. Turtle populations without safe, undisturbed, or adequate basking structures are subject to illness, increased mortality, and reduced reproductive success.

Goal 6. Habitat Use
An overall understanding of turtles' use of SBLWA is important to planning for the successful maintenance of the population and integrating those needs into other requirements for the site. Use of aquatic and non-aquatic habitat needs to be documented by season, age and gender.

Data Collection

Prior to the beginning of the 1999 field season, a literature search was conducted in order to compile a bibliography of relevant sources for review. Additions to the bibliography were made throughout the field season. The bibliography and consultations with experts in the field of freshwater turtle research were a vital part of the data collection effort. Two research techniques were employed: live-capture (capture-mark-release) and visual surveys. Data collection occurred from 7 April to 14 October 1999. Field work was conducted during daylight hours. Length of field days averaged eight to ten hours and ranged from 0800 to 2100 hours. For safety reasons, no field work was conducted before dawn or after dusk.

Implementation of the demographic goal required conducting five-day live-capture and visual survey sessions twice per month in each subarea. Basking surveys were to occur two days per month. In addition, an effort was made to conduct research so as to vary the day of the week and time of day subareas were studied. At the request of Metro, live-capture work at the Ponds and Sloughs subarea was restricted to weekdays. A total of 88 field days were scheduled, however poor weather conditions forced cancellations, reducing that number to 66.

The protocol separates turtles into three different age classes using carapace (upper shell) length as the indicator of age: adults (over 100 mm), juveniles (50 mm-99 mm), and hatchlings (0-49 mm) (Lindeman, 1996). These age classes were used in order to facilitate classification of turtles.

Live-Capture

Turtles were live-captured using five different methods: double-throated funnel traps, hoop nets, drift nets, dipnets and hand captures from boats. The live-traps were baited with salmon smolts, smelt, canned sardines, canned kippers, tuna, cat food and assorted vegetables. Data collection noted weather, water and habitat conditions along with demographic information for each turtle caught. Adults and older juveniles were shell-notched with a small file to create a unique, permanent number. Hatchlings and younger juveniles were not shell-notched due to their small size and the fragility of their shells. Physical measurements and photographs were taken for each turtle captured. Each turtle's health was evaluated and any problems addressed. Turtles were handled humanely and were immediately returned to their point of capture.

Visual Surveys

Visual surveys of turtles were conducted from land and boats (canoes, and duckboats equipped with electric trolling motors). Binoculars and spotting scopes were used to observe and identify turtles. Data collected for each turtle sighting included weather, water and habitat conditions, along with demographic information.

Analysis

It is widely accepted that it is difficult to estimate the size of wildlife populations, including those of freshwater turtles. The dynamics of unknown rates of immigration and emigration, comparative natality and mortality, differences in research results due to sampling bias, and variations in daily and seasonal habitat use based on gender and age, all create serious obstacles to accurately describing population characteristics (Campbell, 1975; Schemnitz, 1980; Ream and Ream, 1966).

While the results of live-capture and visual surveys cannot be combined for statistical analysis, the two methods together complement one another by indicating the locations and densities of turtles.

Live-capture

For purposes of data analysis one month sampling periods were used. Descriptive statistics were used to present data from all subareas. Tables 1 and 2 compare age and gender, respectively, by subarea and month for the 80 turtles live-captured during 1999. To develop an estimate of the number of turtles in the Ponds and Sloughs subarea, data for 1999 was analyzed using two statistical methods, the Lincoln Index and Schnabel Method. A chi-square test was used to analyze gender ratios from the Ponds and Sloughs subarea data. Any turtles marked at the site prior to 1999 and then caught in 1999 were considered to be first-time captures for purposes of this study. The length of time elapsed since previous surveys were conducted at the Ponds and Sloughs subarea precludes pooling previous data with 1999 results, because it is impossible to account for changes in the population structure during this intervening period.

Visual Surveys

For purposes of data analysis one month sampling periods were used. Visual surveys can provide an indication of turtle density, habitat use and activity levels. However, it is important to emphasize that the number of turtles sighted is not a reflection of the actual turtle population; visual surveys cannot reliably distinguish among individuals. For example, from a distance it is difficult to identify age and gender. Visual surveys can also be highly biased based on the experience and competence of observers. Turtle activity based on age and gender may vary depending on season and weather conditions, making turtles more or less visible. For example, hatchlings and small juveniles prefer shallow water habitat with heavy vegetation mats which makes them more difficult to observe (Congdon and Tinkle, 1992).

The results of the land and boat surveys were compared using a t-test to determine if the survey types could be pooled for analysis. It was assumed that all observers were equally competent. The mean minimum number of turtles sighted per person hour (MTPH) was calculated in order to compare land and boat surveys within and among subareas. Average air temperatures during surveys were also computed as an indicator of daily and seasonal turtle activity (Figures 8, 9, 10, 11).

RESULTS and DISCUSSION

Live-capture

The western painted turtle was the only species captured at the site in 1999. All turtles were captured in aquatic habitats. Eighty individuals were captured a total of 101 times. Of that 80, 16 individuals were re-captured a total of 21 times. Of the 80 captures, 13 were marked prior to 1999: 2 were marked by Holland and Hayes prior to 1994 (pers. comm.); 9 were marked by Barclay between 1994 and 1996; 1 was marked by DeLorenzo in 1992; and 1 by an unknown source. Two rehabilitated western painted turtles were introduced to the site in 1999, and for purposes of analysis they were considered new captures.

Turtles were caught in all four subareas. Of the 80 individuals captured, 13 percent (10) were in the Bybee Lake subarea, 61 percent (49) were captured in the Ponds and Sloughs subarea, six percent (five) in the Smith Lake subarea and 20 percent (16) in the Ramsey Lakes and Columbia Slough subarea.

Turtles were captured in a variety of aquatic habitats and a range of water depths. Turtles were captured in water depths ranging from 0.2 to 2.0 meters. Water depths were comparable at three subareas, Bybee Lake, Smith Lake, and Ramsey Lakes and Columbia Slough, ranging from 0.2 to 0.9 meters. Capture depths at the Ponds and Sloughs ranged from 0.35 to 2.1 meters. Juveniles and hatchlings were captured in either static aquatic habitat sheltered from the wind, or shallow water with significant aquatic vegetation. In a comparison of all four subareas, adults were captured in areas ranging from those having little or no woody structure to areas with high amounts of woody structure. Turtles were also captured in areas of open water as well as sheltered coves.

Over the entire site, turtles were captured when air temperatures ranged from 11.3 to 30.5 degrees Celsius. Turtles were captured in water temperatures ranging from 13.8 to 30.1 degrees Celsius. Seventy-one of the 101 total captures occurred when water temperatures were greater than or equal to 20 degrees Celsius. As expected, capture rates increased as both air and water temperatures increased over the field season. In August and September, when air and water temperatures were at their highest, 54 (53.5 percent) of the 101 turtle captures occurred.

Table 1 displays the age distribution of turtles by subarea by month. In the Bybee Lakes subarea, three adults were captured in the coves and the remaining seven adults were captured along the eastern edge. In the Ponds and Sloughs subarea, 42 adults and seven juveniles were captured. Adults were caught throughout the Ponds and Sloughs subarea, and all juveniles were caught in the blind slough. In Smith Lake, five adults were captured, all in the southwest region. In the Ramsey Lakes and Columbia Slough subarea, 16 turtles were captured including 13 adults and two juveniles in the chain of lakes, and a hatchling in the north fork of the Columbia Slough. Capture results for 1999 are adult-biased, but there is insufficient data to assume that the entire population is also adult-biased. Other studies of western painted turtles suggest a wide range of adult to juvenile ratios from 0.71 to 2.08:1. (Bury, 1979; Gibbons, 1968).

Table 1. Age comparison by month and subarea of 80 western painted turtles live-captured in 1999 at Smith and Bybee Lakes Natural Area, Multnomah County, Oregon.

	Bybee Lake			Ponds and Sloughs			Smith Lake			Ramsey Lakes and Columbia Slough			Total		
	A	J	H	A	J	H	A	J	H	A	J	H	A	J	H
April	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0
May	0	0	0	12	0	0	0	0	0	1	1	0	13	1	0
June	2	0	0	7	2	0	0	0	0	6	0	0	15	2	0
July	3	0	0	1	0	0	0	0	0	0	0	1	4	0	1
August	5	0	0	15	2	0	1	0	0	5	1	0	26	3	0
September	0	0	0	4	3	0	3	0	0	0	0	0	7	3	0
October	0	0	0	2	0	0	1	0	0	0	0	0	3	0	0
Total	10	0	0	42	7	0	5	0	0	13	2	1	70	9	1

A=adult, carapace length ≥100 mm
J=juvenile, carapace length 50-99 mm
H=hatchling, carapace length, ≤ 49 mm

Table 2 displays gender by subarea by month for the 80 individual turtles captured in 1999. Seven turtles were too young to identify gender. Of the remaining 73 individuals, 54 percent (39) were males and 46 percent (34) were females. In the Bybee Lakes subarea, six males and four females were caught; in the Ponds and Sloughs subarea, 24 males, 19 females and five of unknown gender were caught; in the Smith Lake subarea, three males and two females were caught; and, in the Ramsey Lakes and Columbia Slough subarea, seven males, seven females and two of unknown gender were caught. Research reports variability in male to female gender ratios ranging from 0.6 to 2.21:1 (Bury, 1979) although one researcher suggests 1:1 is the norm (Gibbons, 1968). The preliminary results from the 1999 field effort suggest a gender ratio within those reported in the literature. However, data from the 1999 field season is insufficient to provide definitive results.

The 1999 field results from the Ponds and Sloughs subarea were analyzed and an attempt was made to pool and compare this data with previous research results. Two methods of estimating population size were computed. The Lincoln Index is less conservative and provides a population range, while the Schnabel Method tends to be more conservative (Schemnitz, 1980). Unfortunately, data from 1999 was insufficient to calculate a reliable estimate of population using either statistical method. Data available from prior research could not be combined with 1999 due to lack of chronological continuity and differences in methodologies (e.g., Barclay's research ended in 1996 and its focus was nutrition not demographics).

Of 176 turtles known to be previously marked at the site, only 13 were re-captured in 1999. Given the stability of western painted turtle populations (Bury, 1979), field efforts can expect to re-capture a large percentage of previously marked animals (Holland, pers. comm.). The low recapture rate for previously marked turtles may suggest a recent dramatic decline in the population or may be an artifact of different field methodologies between previous studies and the 1999 work. Capture success in 1999 may have been limited by the total number of hours devoted to live-capture, the limited number of live capture methods employed, skill and experience of field workers, and the restriction to being on site during limited daylight-only hours. In addition certain turtles are known to become "trap-happy"—susceptible to multiple re-captures as well as "trap-shy"—unlikely to be captured or re-captured. Variable weather conditions can also influence trap success.

The low re-capture rate in the Ponds and Sloughs subarea may also reflect the effects of a dramatic event which caused a large reduction in turtle numbers. For example, floods such as the 100-year event in 1996, can disperse animals to new sites thereby removing them from the local population. Illegal collection of turtles has been observed to cause sudden declines in populations (Holland, pers. comm.), and illegal collection has been documented at the site in 1992 (DeLorenzo and Holland, pers. comm.) and 1997 (NERI, 1997.) Human-caused injury can be a significant cause of turtle mortality. Turtles moving from one area to another via roads or rails are often run over by cars and trains (Holland, 1994)). Mortality caused by automobiles has been documented at the site (Hayes, pers. comm.). Swallowing fish hooks can cause injury and mortality to native turtle species (DeLorenzo, pers. comm.; Holland, 1994). Barclay found one turtle which had swallowed two fish hooks and subsequently died, and three were captured in 1999. All three required professional veterinary care, and one had to be euthanized as a result of the severity of the fish hook injury. These fish hook injuries represent over six percent of the turtles live-

captured in 1999. Such continual removal from the population could cause a rapid, significant decline. Turtles with respiratory distress have also been observed at the Ponds and Sloughs (NERI, 1998). Upper respiratory disease (URD) occurring locally in western pond turtles has been documented to cause population declines in excess of 40 percent (Holland, 1994). Another possibility is that cumulative negative impacts to the habitat may have reached levels that may now compromise the sustainability of the turtle population. Such impacts may include introduced predators and competitors, and degraded habitat and disturbances due to increased human activity. As other studies have shown, long-term and ongoing research is needed to gain a full understanding of western painted turtle population dynamics at SBLWA (Lindeman, 1996).

Table 2. Gender comparison by month and subarea of 80 western painted turtles live-captured in 1999 at Smith and Bybee Lakes Natural Area, Multnomah County, Oregon.

	Bybee Lake			Ponds and Sloughs			Smith Lake			Ramsey Lakes and Columbia Slough			Total		
	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U
April	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0
May	0	0	0	6	6	0	0	0	0	0	1	1	6	7	1
June	2	0	0	4	4	1	0	0	0	4	2	0	10	6	1
July	1	2	0	0	1	0	0	0	0	0	0	1	1	3	1
August	3	2	0	8	8	1	0	1	0	2	4	0	13	15	1
September	0	0	0	3	1	3	3	0	0	0	0	0	6	1	3
October	0	0	0	2	0	0	0	1	0	0	0	0	2	1	0
Total	6	4	0	24	20	5	3	2	0	7	7	2	39	34	7

M= male
F=female
U=unknown

Visual Surveys

The purpose of visual surveys is to identify habitat use by turtles and their distribution at the site on a seasonal basis. Research on western pond turtles (Holland, 1994) suggests that turtles visible at a given time may reflect about 20 percent of the existing population. For example, 30 visual surveys averaged 15 sightings per day at the Ponds and Sloughs in 1999. However, on one day 89 turtles were observed. These results reinforce that visual surveys alone are not adequate indicators of population size. In addition, as previously stated, visual surveys cannot distinguish among individuals thereby precluding a reliable census of turtles.

There were significant differences in results between land and boat surveys. Figures 8, 9, 10 and 11 compare land and water survey results for each subarea by month, using mean minimum number of turtle sightings per person hour (MTPH). The figures also record average monthly air temperatures during surveys, which can be an indicator of turtle activity levels. All turtles were observed in aquatic habitat from the shoreline to 200 meters from shore.

Of sightings in which species could be identified, most were western painted, with a few sightings of the native western pond turtle and the introduced red-eared slider. In April 1999, there were two sightings of the native western pond turtle, at least one of which was a male.

In April and May, there were a total of four sightings of the introduced red-eared slider, at least one of which was a large female. Three sightings were in Smith Lake and the other was at Ramsey Lakes. Existence of red-eared sliders has been documented in other local wetlands (Beilke and DeLorenzo, pers. comm.). These sightings are the first to record the presence of this exotic species at SBLWA. Turtles native to Oregon are not equipped to compete with red-eared sliders which have the potential to introduce pathogens, compete for resources and disrupt reproductive activities (Holland, 1994).

A total of 551 person hours were devoted to visual surveys. Boat surveys as compared with land surveys yielded more MTPH, perhaps because of their shorter average duration and lower average number of surveyors. Most boat surveys were conducted in conjunction with live-capture efforts. In addition, beginning in July, availability of volunteers diminished significantly which limited the ability to conduct visual surveys.

Bybee Lake

Figure 8 summarizes turtle sightings by month. Total duration of visual surveys was 186.4 person hours. For 1999 MTPH was 1.9. Turtles were seen anywhere from 1 to 200 meters from shore. From April through June most turtles were seen in the protected pond coves in the western section of Bybee Lake. From July through October, most turtles were seen along the southeastern forested wetland edge of the lake. The observations of turtles in different locations at different times may reflect seasonal movements related to habitat use, such as movement to and from overwintering and feeding areas.

Many areas in which turtles were seen were not accessible by land. Approaching the shoreline for land surveys through noisy dense underbrush could have disturbed turtles and caused them to seek cover. Receding water levels through the field season may have encouraged turtles to move

farther from shore making them less visible to land surveys. Boat surveys were handicapped by selected inaccessibility due to seasonal low water levels.

Only visual surveys from boats were conducted in August. September yielded the highest number of MTPH in the Bybee Lake subarea which may have been due in part to higher air temperatures. Receding water levels and/or seasonal movements may have encouraged turtles to aggregate, thus yielding higher numbers of sightings per observation.

Ponds and Sloughs

Figure 9 summarizes turtle sightings by month. Total duration of visual surveys was 123 person hours. In 1999 MTPH was 3.7. Turtles were seen from the shoreline to 100 meters from shore. Turtles were observed throughout the subarea. Most sightings were concentrated in the eastern portion of the blind slough. It may be that more turtles were seen in the blind slough due to its higher water levels and greater disturbance in the adjacent ponds from human activities. The largest number of sightings occurred during one survey in June when 89 turtles were observed.

Smith Lake

Figure 10 summarizes turtle sightings by month. Total duration of visual surveys was 155 person hours. In 1999 MTPH was 0.55. Turtles were seen anywhere from 4 to 120 meters from shore. Smith Lake is the largest and most difficult area to survey primarily because of the abundance of woody structure that is present in much of the lake, thus limiting access by boat and obscuring the line of sight from both land and water. All sightings occurred in the southwest region of Smith Lake. Boat surveys conducted in June were of shorter duration than those in May which created the differences noted on Figure 6. A total of 28.4 hours were spent conducting visual surveys from July through October, with only one turtle being sighted. Turtles may have aggregated in other areas of the lake inaccessible to boat and land surveys.

Ramsey Lakes and Columbia Slough

Figure 11 summarizes turtle sightings by month. Total duration of visual surveys was 86.47 person hours. In 1999 MTPH was 1.38. Turtles were seen from the shoreline to 100 meters from shore. Boat surveys conducted in April, May and June did not result in any turtle sightings. Turtles may have been disturbed by boating activity or other unknown reasons which caused them to seek cover.

The 1999 field results from visual surveys provided a general indication of areas of turtle activity and density, which complemented the live-trapping effort. As a result, surveys conducted in future years can more effectively target times and locations of turtle activity. Much of 1999 field work was dedicated to learning where at the site turtles were likely to occur and how to best cope with the logistical challenges of surveying such a large site.

Figure 8. Comparison of mean minimum number of turtle sightings per person hour (MTPH) for land and boat surveys at Bybee Lake subarea, 1999, Smith and Bybee Lakes, Multnomah County, Oregon.

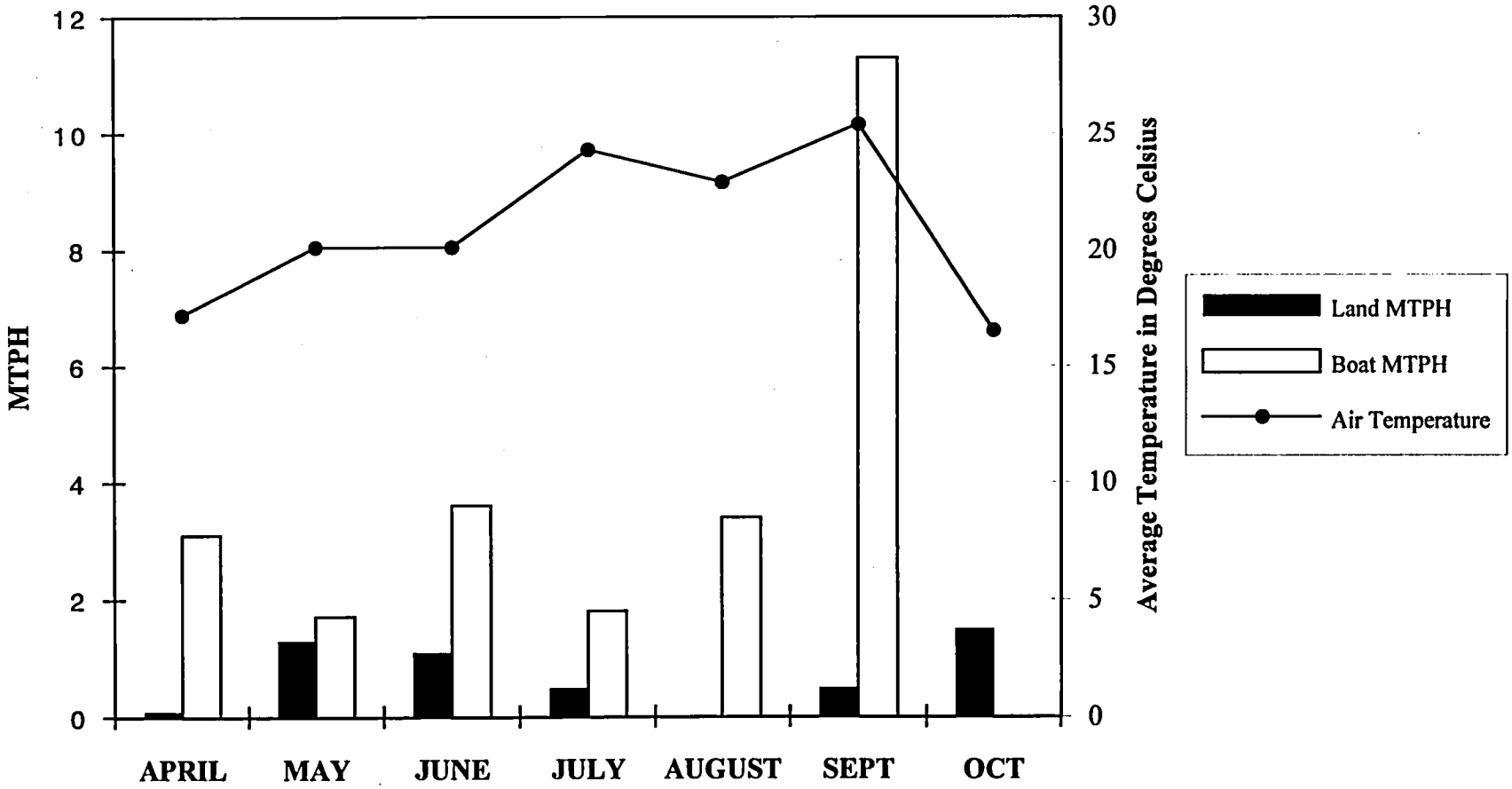


Figure 9. Comparison of mean minimun number of turtle sightings per person hour (MTPH) for land and boat surveys at the Ponds and Sloughs subarea, 1999, Smith and Bybee Lakes, Multnomah County, Oregon.

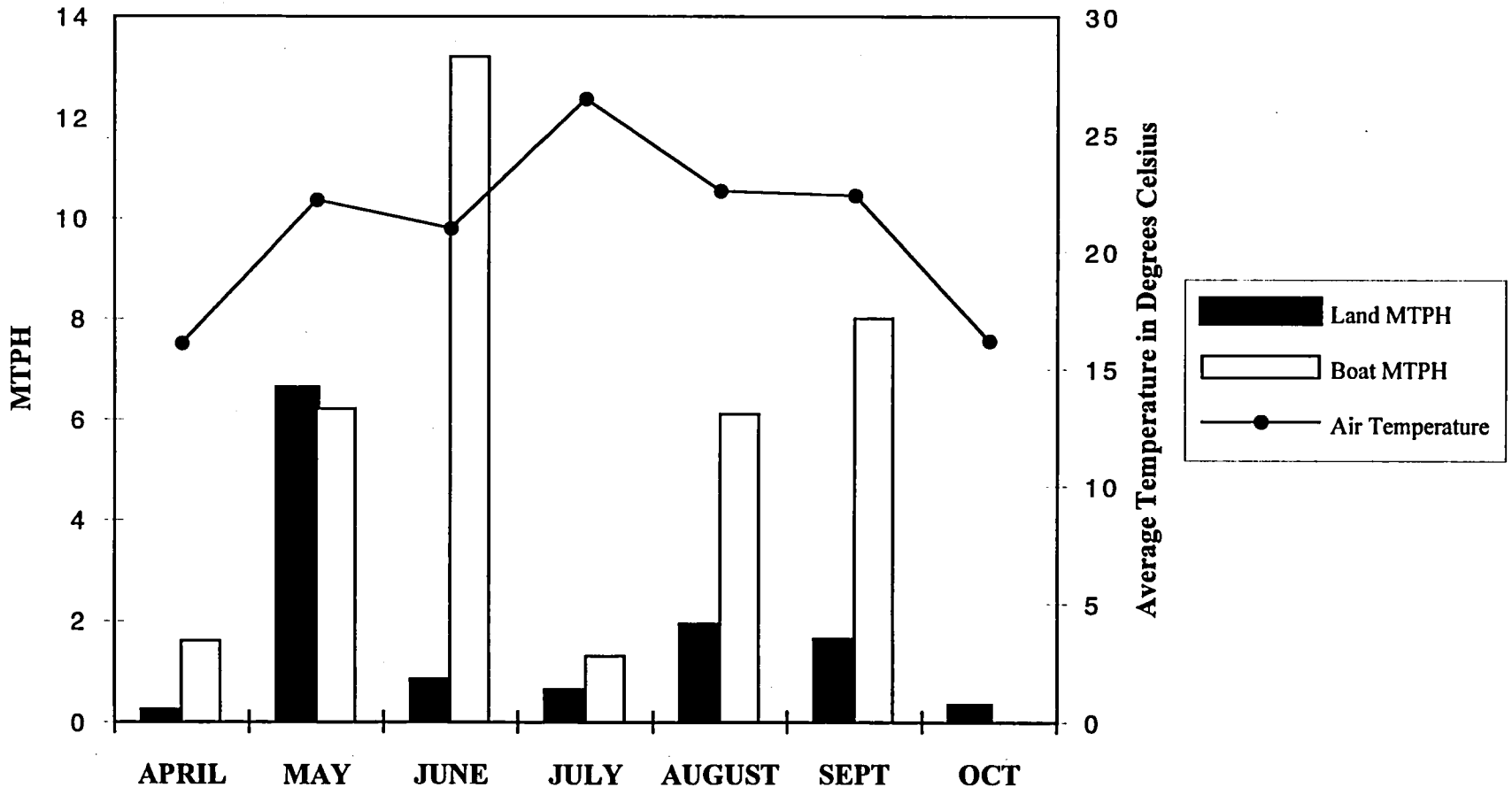


Figure 10. Comparison of mean minimum number of turtle sightings per person hour (MTPH) for land and boat surveys at Smith Lake, 1999, Smith and Bybee Lakes, Multnomah County, Oregon.

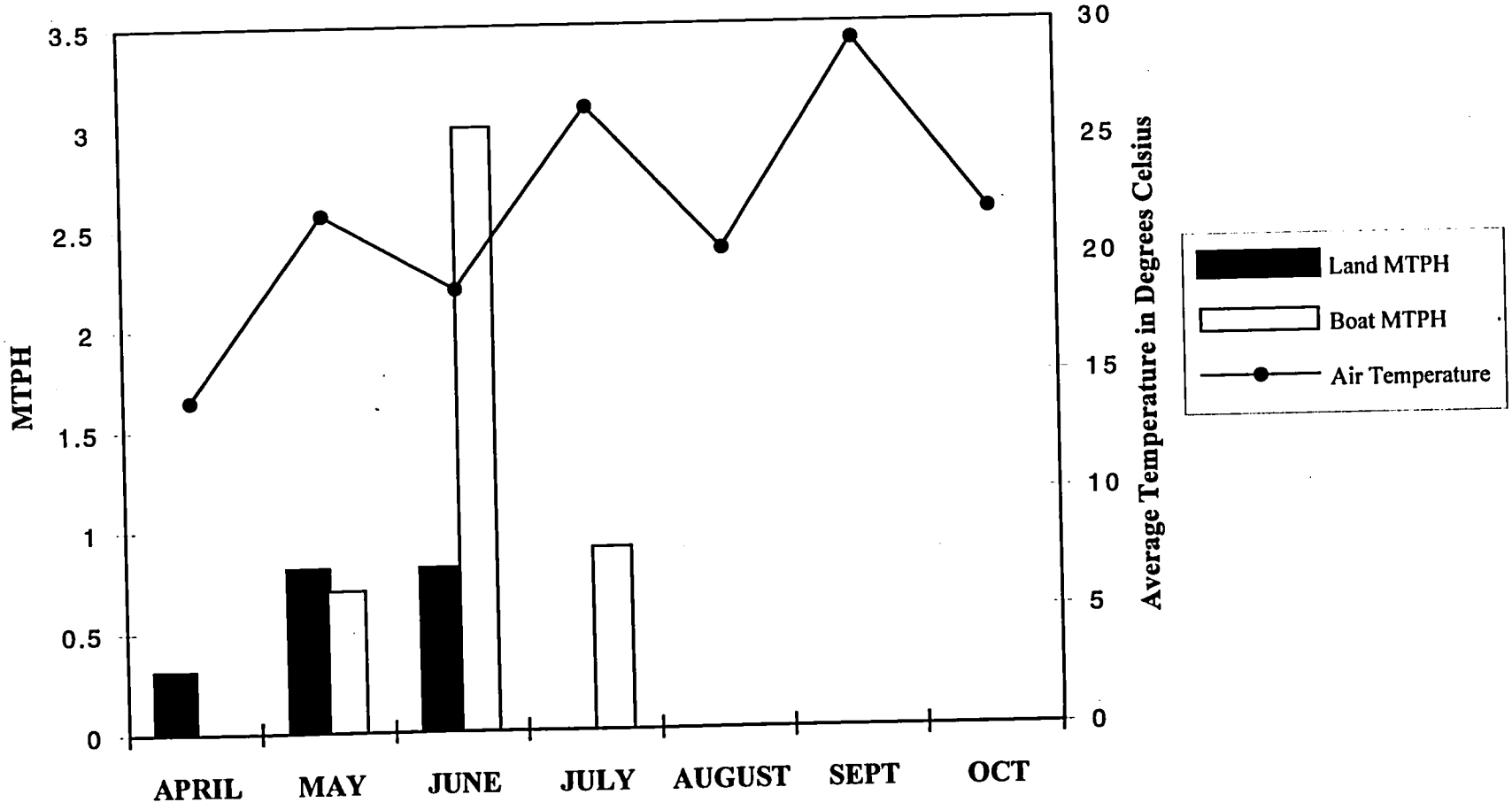
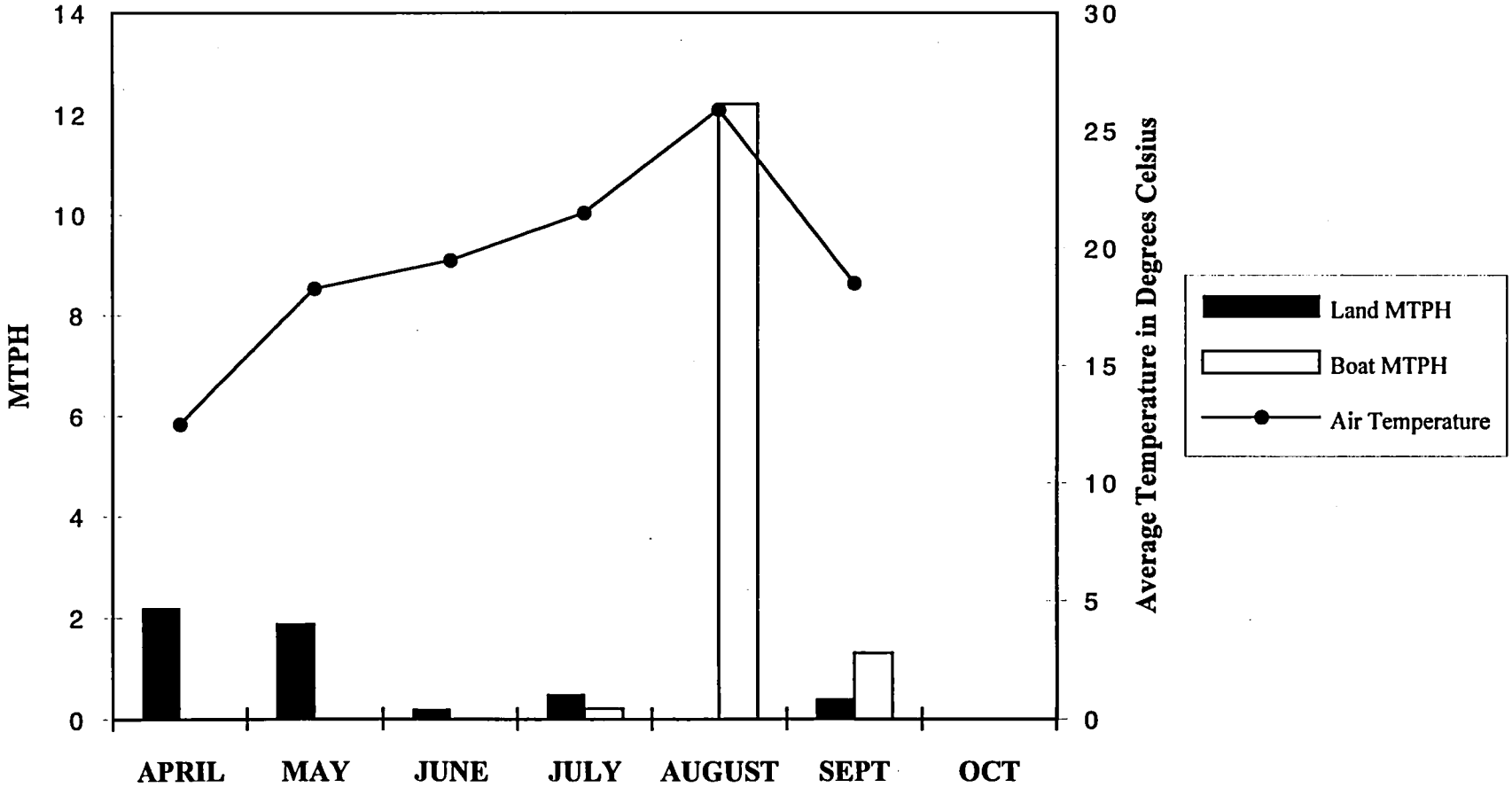


Figure 11. Comparison of mean minimum number of turtle sightings per person hour (MTPH) for land and boat surveys at Ramsey Lakes and Columbia Slough, 1999, Smith and Bybee Lake, Multnomah County, Oregon.



Other Observations

Four gravid (egg-bearing) turtles were captured during the field season, two at Ramsey Lakes and Columbia Slough subarea, both on 6 June 1999; and two at the Ponds and Sloughs subarea, one on 17 June and one 21 June 1999.

One turtle nest, probably excavated by a predator, was found 14 October 1999 in the Ramsey Lakes area. Nest site characteristics were documented, and egg shells and soil samples were collected.

Only one instance of turtle movement from one subarea to another was recorded. An adult female first caught on 14 August 1999 in the southern part of Bybee Lake was re-captured on 5 October 1999 in the blind slough of the Ponds and Sloughs subarea.

RECOMMENDATIONS

Suggested Changes to the Field Protocol

One of the goals of the first field season was to field test and evaluate the protocol. Following are changes to the protocol:

Changes to Goal 1 Demographics

- Turtles were not field marked with temporary large numbers on their shells, which would have made them more visible to predators—including humans. Unless a safer method is devised (such as marks visible only with special sensing devices), it is not recommended that this technique be employed.
- Several changes to live-capture techniques may improve field success:
  —Using a more flexible field schedule, by employing shorter or longer live-capture bouts, and taking advantage of weather conditions favorable to high levels of turtle activity.
  —Developing methods to permit safe deployment of live-traps for longer periods of time, including overnight.
  —Experimenting with different types and designs of live traps, such as basking traps. Continuing to experiment with different types of bait.
  —Increasing the use of other techniques, such as dipnetting.
- Changes to visual survey methods:
  —Clarifying protocol methodology for collecting visual survey data while conducting live-capture activities, i.e. visual surveys to be conducted during live-trapping.
- Add recording of human activities observed during visual surveys, to begin to develop a database of intensity and types of activities at SBLWA that may affect turtle behavior.

Changes to Goal 5 Basking

After conducting initial basking surveys, budget, logistical and time constraints precluded continuing this research. It is recommended that the purpose of this goal be re-examined for the year 2000 field season, and incorporated with the impacts goal 3 for the next field season.

Basking surveys conducted without a comparison study site may not provide useful management and conservation information. No systematic basking surveys of the type suggested in the protocol have been documented. The primary value of such surveys in the case of SBLWA is to compare turtle basking activity in different types of habitat and, more importantly, to compare turtle basking activity at SBLWA with areas of very limited human access. Since turtles bask for a variety of reasons, including thermoregulation, parasite control, nutrition (vitamin D_3 absorption), digestion and incubation of eggs prior to nesting, appropriate places and sufficient time to bask are critical to turtle health. Comparing SBLWA with areas of limited human access may provide useful information for both habitat preservation and human management at SBLWA.

Security, Safety and Logistics

- The logistics of the large site made arranging comfort breaks for field teams difficult, thereby limiting field time. Strategically placed additional port-a-potties would allow more time to be devoted to the study.

- For most work, canoes proved more effective than duckboats. The availability of more canoes would increase accessibility to the site and thereby benefit the research effort.

Other Recommendations

- Only long-term, ongoing research will reveal the complex life history of the long-lived western painted turtle at SBLWA. Over the remaining four years of the study, it is imperative that demographics remain the primary focus of the research.

- It is important for successful management of the turtle population at SBLWA to begin collecting nesting and overwintering data in year 2000. NERI is committed to partnering with Metro Regional Parks and Greenspaces to seek the funding needed to expand the research effort.

- Of concern were the three turtles caught with fish hooks imbedded in their digestive tracts. Without veterinary intervention none of these animals would have survived. This information combined with observations that turtles have been illegally removed from the site, may make it timely and prudent for Metro to investigate ways of decreasing turtle mortality. For example, turtles at SBLWA may benefit from limitations and/or bans on fishing activities. Another possibility would be restricting human activity in some or all parts of the site.

- Conservation of turtles at the site may also benefit from Metro continuing and increasing public education in various forms.

ACKNOWLEDGMENTS

Thank you to Metro Regional Parks and Greenspaces for staff support, especially assistance from Emily Roth, Lupine Jones and Dave Drescher. Thank you to the staff of the Metro St. Johns Landfill for their support and assistance at the field site. Thank you to the Oregon Zoo volunteer and research departments for assistance with the field effort, including Paula McCall, Blair Csuti, David Shepherdson and Nori Dimeo-Ediger. Thank you to Oregon Department of Fish and Wildlife, especially Kathy Shinn, for helping recruit volunteers. A generous thank you to veterinarian Dan O'Loughlin and the staff at Parkway Veterinary Hospital, Lake Oswego, Oregon for providing *pro bono* care for injured turtles from the site. NERI would also like to thank the Port of Portland for providing staff and equipment for the field effort, including Scott Carter, Mike Platt, Susan Oman and Carrie Stevenson. Thank you to Columbia Sportswear for use of their restroom facilities. NERI offers particular thanks for invaluable *pro bono* assistance and support of advisors Arthur D. Monson, management consultant, and Dan C. Holland, herpetologist.

REFERENCES CITED

Bury, R. Bruce. 1979. Population Ecology of Freshwater Turtles, in Harless, M. and Morlock, H., Turtles Perspective and Research John Wiley and Sons, New York.

Campbell, R.C. 1975. Statistics for Biologists, second edition. Cambridge University Press. London.

Christens, E, and Bider J. Roger, 1987. Nesting Activity and Hatching Success of the Painted Turtle (*Chrysemys picta marginata*) in Southwestern Quebec, Herpetologica. 43(1):55-65.

Congdon, J.D. and Gatten, R.E. Jr. 1989. Movements and Energetics of Nesting *Chrysemys picta.* Herpetologica 45(1):94-100.

Congdon, J. D. and Tinkle, D.W. 1982. Reproductive Energetics of the Painted Turtle (*Chrysemys picta*). Herpetologica. 38(1): 228-237.

Ernst, C.H., 1972. Temperature-activity Relationships in the Painted Turtle, *Chrysemys picta,* Copeia. (2):217-222.

Fishman Environmental Services (FES). 1987. Smith and Bybee Lakes Environmental Studies. Port of Portland and City of Portland.

Gibbons, J. Whitfield. 1968. Population Structure and Survivorship in the Painted Turtle, *Chrysemys picta.* Copeia Number 2:260-267.

Holland, Dan C. 1994. The Western Pond Turtle, Habitat and History. U.S. Department of Energy, Bonneville Power Administration.

Legler, J.M., 1954. Nesting Habits of the Western Painted Turtle, *Chrysemys picta belli.* Herpetologica 10: 137-144.

Lev, Esther et al. 1994. The Biota Of Smith and Bybee Lakes Management Area. Metro Regional Parks and Greenspaces.

Lindeman, Peter V. 1996. Comparative Life History of Painted Turtles (*Chrysemys picta*) in two habitats in the inland Pacific Northwest. Copeia. (1): 114-190.

Ream, Catherine and Robert Ream. 1966. The influence of sampling methods on the estimation of population structure in painted turtles. American Midland Naturalist. 75(2):325-338.

Schemnitz, S.D., editor. 1980. Wildlife Management Techniques Manual, Fourth Edition. The Wildlife Society, Washington, D.C.

Turtle Project, Northwest Ecological Research Institute. 1997. Final Report, Results of Preliminary Visual Field Surveys and Interviews to Determine Terrestrial Habitat Use by Western Painted Turtles (*Chrysemys picta belli*) at Smith and Bybee Lakes North Marine Drive Road Project Study Area. CH2MHill.

Turtle Project, Northwest Ecological Research Institute. 1998. Five year plan for studying and managing western painted turtles at Smith and Bybee Lakes. Metro Regional Parks and Greenspaces.