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MAINE COOPERATIVE WILDLIFE RESEARCH UNIT

University of Maine

Orono, Maine

QUARTERLY REPORT

January-March, 1972

Cooperating Agencies

Maine Department of Inland Fisheries and Game
University of Maine
Bureau of Sport Fisheries and Wildlife
Wildlife Management Institute

NOT FOR PUBLICATION

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WILDLIFE STAFF

Howard L. Mendall, Unit Leader and Professor of Wildlife Resources
 Voit B. Richens, Assistant Unit Leader and Assistant Professor of Wildlife Resources
 Malcolm W. Coulter, Associate Director for Wildlife, School of Forest Resources
 and Professor of Wildlife Resources
 S. D. Schemnitz, Associate Professor of Wildlife Resources (on leave until 7/1/72)
 R. B. Owen, Jr., Assistant Professor of Wildlife Resources
 Frederick F. Gilbert, Assistant Professor of Wildlife Resources
 Donald A. Hammer, Assistant Professor of Wildlife Resources (1 year appointment)

Unit Collaborators - Personnel from many University departments as well as State, Federal and private organizations are actively collaborating with the Unit. Individuals assisting with projects that are currently reported upon are listed in connection with the appropriate project summary.

Graduate Assistants: David H. Abell
 Chester F. Banasiak (Ph.D. Program)
 James Barnes
 William Crenshaw
 Roy D. Hugie
 James Kienzler (Ph.D. Program)
 David M. Knupp
 Jeffrey R. Kropp
 John F. Moroney
 William F. Reid, Jr. (Ph.D. Program)
 William Sarbello
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Graduate Fellow: Katherine Little

N.S.F. Trainee: James Wakeley

Graduate Students: Myrtle C. Bateman
 David E. Capen
 J. George Gleich
 Barbara McKean (Trustee Scholarship)
 Mark Mowatt
 William R. Whitman (Ph.D. Program)

Unit Secretary: Maxine L. Horne

Unit Coordinating Committee

Maynard F. Marsh, Commissioner, Maine Department of Inland Fisheries and Game
 Edwin L. Giddings, Acting Director, School of Forest Resources
 Howard L. Mendall, Unit Leader

RESEARCH PROJECTSBIG GAMEImportance of Snow Support in the Welfare and Survival of Wintering Deer in Western Maine

- Objectives: (1) To investigate characteristics of the snow cover that determine trafficability for deer.
- (2) To explore hardness gauges and sinking depth simulators as aids in determining snow support for deer.
- (3) To study snow stratification as a component of snow support.
- (4) To relate snow strength and stratification to cover type, weather conditions and deer mobility.

Assignment: Voit B. Richens, Assistant Unit Leader

Consultants: John H. Hunt, Maine Dept. of Inland Fisheries and Game
William O. Pruitt, Jr., University of Manitoba
Edmund S. Telfer, Canadian Wildlife Service, Edmonton

This report covers the period from December 21, 1971 to April 21, 1972. This winter was moderate until March and April, when heavy snowfalls and relatively cold weather occurred.

Weather Conditions. Softwood cover, in relation to other cover types, was warmer this year than last but similar to two winters ago. Apparently long, unrelenting and extremely cold periods are needed before temperatures in softwood consistently drop below that in other cover types; this occurred in the winter of 1970-71. None-the-less, sub-zero thermometer readings were recorded every week in all cover types for January, February and March (Table 1). Average weekly maximum temperatures were in the +30's each week of these three months.

This winter appeared to be consistently more windy than a year ago in all cover types. There was an inverse relationship between increasing cover density and greater windiness. Openings averaged three times and hardwood more than twice as windy as softwood stands. There was a great difference, however, between sites within the hardwood and open types. One open and one hardwood site were about twice as windy as were their replicates. The reason for this disparity is not known but it does suggest that there is need of further field study of local weather in relation to deer yarding. See Table 1 for numerical wind and temperature data.

Snow Depth and Sinking Depth. Data on snow depth and simulated deer sinking depth (Table 2) were obtained as described in the Unit Quarterly Report for April-June, 1970. Twenty readings were taken per cover type at bi-weekly intervals; two sites per type were represented. Except for a slight decrease in February, snow depth increased as the winter progressed with the greatest depth in April. In mid-April snow depths of this and last winter were about the same.

Average simulator sinking depths (Table 2) suggest that deer sank from zero to 61% of the total snow depth. Sinking depth varied greatly between different times of the winter as snow density, hardness and temperature varied. Depth measurements of deer tracks corresponded closely to adjacent simulator sinking depths; on March 4, for example, the average difference was less than 2 cm.

Moose were again noted to sink more deeply than deer. On January 18, 2 deer sank an average of 27 cm in 52 cm (52%) of snow whereas a moose sank 54 cm average in 60 cm of snow (90%); the sets of tracks were only a few feet apart and were made about the same time under the same weather conditions. Three cases of moose attempting to use deer trails were noted. They did not gain adequate support on these trails and they left large foot holes in the trail bottoms. The deer had excellent support. Snow hazard ratings vary with snow depth and support and are given in Table 2.

Snow Crusts. On December 22, snow pit profiles showed five distinct layers with two crusts, one weak and one strong. The strong crust had a hardness of 6,500 g/cm² but it did not support deer due to a weak snow layer beneath. By January 6 this crust had hardened to 38,500 g/cm² (density = 40%) in softwood where it supported deer well. In the open it had a hardness of only 6,650 g/cm² but it offered fair support for deer. On January 21 this crust was 10-20 cm below the snow surface, was 4-5 cm thick, had a density of 45-48%, and a hardness of 30,000-76,000 g/cm² in the four cover types. Deer walked on this crust easily but they punched through it when jumping. On February 18 there were two trafficable crusts, one 28 cm down in the snow profile and one on the surface. The surface sun crust had a hardness of 2,000-7,000 g/cm² and a density of 40%. This time the crust was much the weakest in the softwood (where it gave only partial support to deer) and strongest in the open.

On March 3 a weak ice pellet crust formed on the snow surface but it gave virtually no support for deer. Deer punched through this surface crust to find support on the sun crust below which then had a hardness of 4,000-5,000 g/cm² nearly everywhere. Moose, however, punched through the second crust and were held by the bottom sun-rain crust which had a hardness of 20,000-80,000 g/cm². By March 22 the ice pellet crust had been strengthened by rain and subsequent freezing to hardnesses of 4,100 in softwood to 60,000 g/cm² in open areas. This crust then had 15-25 cm of new snow on top and deer moved freely over the crust. At this time there were three support crusts for deer and only one for moose.

The hardest surface crust of the winter period formed the night of April 21. The next morning deer could run or jump on the surface without going through and barely left tracks on it. This crust resulted from thawing and freezing; it was 7-9 cm thick, had a density over 50% and a hardness over 100,000 g/cm². However, this crust was of short duration, and by 2:00 p.m. of that same day it would not support a deer. A hard surface crust in early morning and no surface crust in the afternoon was observed several succeeding days. The deer seemed to adapt to this, moving extensively in the night and early morning and moving little in the afternoons. At this time sub-surface crusts had almost entirely disappeared and in the afternoons deer could get little support above ground level--a hazardous situation.

Food-Cover Relations. It appears that white-tails in western Maine readily gravitate to abundant food supplies if the food is found before the snow gets too deep. They use open softwood and mixedwood stands, and even hardwoods and openings when food is plentiful.

Deer abandoned the Basin Pond yard following a small logging operation 2-3 miles to the southwest in the late fall and early winter of 1969-70. Deer have still not returned to Basin Pond and the overused browse there is recovering.

In the fall and early winter of 1971 some of the Hayden Brook area was logged; all deer from the Black Brook yard moved to this area as did many from the Spencer Stream yard (from across the Dead River) and some from several small (3 to 5 deer) yards nearby. Until late winter this cutting at Hayden Brook furnished abundant high-quality browse, mainly white cedar but also some maple and birch. A complex system of deer trails was soon developed throughout all the cutover area and trails extended into surrounding habitats. Heavy trails, bedding sites and deer were observed in areas of sparse cover but good food, despite the tendency for such areas to be colder and more windy. Deer congregated on the access logging road. They sometimes bedded on the road and dug pits down to the ice layer left by the trucks, urinating and trampling in and around these pits. The roadway seemed to serve as their major trail for much of its 3.5-mile length. Deer ploughed through deep snow, scrambled up snow-covered piles of tree tops and forced their way in among branches of logging waste to obtain food. It was also surprising to find deer in this area going into other difficult places. For example, on January 7, 2 deer sank an average of 46 cm in 56 cm of snow to feed on felled hemlock, 2 deer sank 58 cm, on the average, to feed on branches of mountain and striped maple, and 1 deer followed an old trail with foot pockets 72-78 cm deep (body formed 24-28 cm from top) to feed on raspberry.

Later in the winter (January-March) areas on Hurricane Mountain, Pierce Pond Mountain and near Grass Pond were logged. The abundant browse which resulted remained unused by deer throughout the winter. No deer trails or tracks were noted in these cutover areas and it is probable that deer just simply did not know these food supplies existed. There is a former deer yard on East Brook that has an excellent food supply, yet the food goes unused. The Fish Pond yard area has been without any deer for about six years and the browse has partly recovered from heavy past overuse. These and similar instances suggest that white-tailed deer in western Maine do not appear to have any great fidelity to a fixed yard but seem to move from one yard to another in response to a large forage supply, usually produced by logging activities. These forage reserves may be eaten out and the deer population declines or moves to another fortuitous food reserve. If this is the case, deer populations in western Maine depend more on food than on cover as there is evidence that well-fed deer are not in great need of cover. However, when logging in a given area is not frequent, cover may become extremely vital to deer due to food scarcity and we may be erroneously led to conclude that deer "choose" yards primarily for their cover value rather than for food. Biotic succession for deer food is undoubtedly more rapid than for trees for profitable logging and hence most deer populations in western Maine may be highly dependent on cover due to lack of nutritious food.

Use of Trails. Again this winter deer used snowmobile trails readily for travel, food, or curiosity. Their affinity for trails and their movements in response to large food supplies has prompted plans for initiation of a

study next winter on the utility of snowmobile trails for leading deer from yards to food, and from one yard or yard segment to another.

Table 1. Cumulative miles of wind and weekly minimum and maximum temperatures, averaged by month, in four vegetation cover types, 1971-72.

Cover Type	Miles of Wind	Temp. Extremes (°F)		Month
		Av. Min.	Av. Max.	
Open	779	-6	40	December
Hardwood	684	1	39	
Mixedwood	369	0	39	
Softwood	277	2	36	
Open	1179	-21	38	January
Hardwood	1188	-14	37	
Mixedwood	653	-15	38	
Softwood	382	-19	35	
Open	1007	-17	34	February
Hardwood	876	-15	38	
Mixedwood	557	-12	36	
Softwood	325	-12	32	
Open	965	-15	37	March
Hardwood	789	-3	35	
Mixedwood	502	-5	34	
Softwood	245	-11	33	
Open	803	11	45	April
Hardwood	640	13	45	
Mixedwood	469	13	45	
Softwood	210	13	42	

Table 2. Simulator snow support measurements by month and cover type for the winter of 1971-72.

Plant Cover Type	Mean Snow Depth (ft.)*	Mean Sinking Depth (ft)	Snow Hazard Rating
Open	1.6	.2	1.8
	2.2	1.3	3.5
	2.1	.2	2.2
	3.7	.9	4.6
	3.9	.5	4.4
Hardwood	1.3	.2	1.5
	1.9	1.1	3.0
	1.7	.3	2.0
	3.3	1.0	4.3
	3.5	.6	4.1
Mixedwood	1.2	.4	1.6
	1.8	1.1	2.9
	1.6	.3	1.9
	3.0	1.1	4.1
	3.2	.7	3.9
Softwood	1.1	.0	1.1
	1.5	.7	2.2
	1.5	.2	1.7
	2.8	1.1	3.9
	3.4	.4	3.8

* Rows of figures within each cover type, from top to bottom, represent the months of December, January, February, March and April, respectively.

WATERFOWL

Renesting of the American Eider in Penobscot Bay Colonies

Objective: To determine the extent to which eiders reneest following the loss of initial clutches.

Assignment: William Sarbello, Graduate Assistant

Thesis Advisor: Howard L. Mendall, Unit Leader

The embryos of all clutches collected last summer were aged using the set of known-age embryos established last quarter. The dates of the start of laying and the start of incubation were then determined by backdating. During the 1971 nesting season, laying commenced in the first observed nest on April 19. Laying had begun in one-third of all nests (with complete histories) by May 10. By May 27, laying had started in two-thirds of the total number of nests observed. In the last known nest initiated, laying began on July 4.

Mouse Island had the longest nesting span (74 days), followed by Robinson Rock (72 days), Goose Island (58 days), and East Goose Rock (41 days). The variation was possibly related to observer disturbance, as the number of days worked on each island was 28, 21, 19, and 10 days, respectively. However, island size was an important factor in this regard, determining the number of days the investigator had to devote to trap the island, and the amount of space available for nesting. The vegetated areas of the islands are 1.26, 0.76, 0.42, and 0.14 acres, respectively.

Preliminary data analysis of the 16 records of reneesting (see July-Sept. 1971 Quarterly Report) indicate no correlation between stage of incubation and reneest interval or between date of nest loss and reneest interval.

Plans for next quarter: Analysis of data will be completed. A thesis outline will be submitted and writing of the thesis will be started.

Establishing Breeding Populations of Wood Ducks by Relocating Wild Broods

Objective: To establish new breeding populations of wood ducks by moving hens and their recently hatched broods to areas with no wood duck production.

Assignment: David E. Capen, Graduate Student

Thesis Advisor: Malcolm W. Coulter, Professor, Wildlife Resources

Consultant: J. William Peppard, Migratory Bird Research Leader, Maine Dept. of Inland Fisheries and Game

Graduate student Capen completed his thesis during the quarter and will receive his M.S. degree in June. The summary is as follows:

This study was designed to develop a procedure for moving nesting wood ducks and their clutches or broods from one area and establishing them in another location as a means of restocking vacant habitat.

The following were the results and conclusions of the study:

1. In the first two experiments, nest boxes containing females and their clutches were moved to new areas while the eggs were in the late stages of incubation. The females abandoned their clutches and quickly left the new areas. One of the hens returned 30 miles to her original marsh where she reneested.

2. In the next six cases, each hen and her recently hatched brood were moved while they were still in the original nest box. In two instances, females called the young from the nests and cared for the broods in a seemingly normal manner. Three other hens left the release areas, but did not abandon as quickly as the hens which had been moved with their clutches. The fate of the sixth female and brood which were moved in this way is unknown.

3. In the final method, females and their broods were moved in a special release box that permitted easy exit by the ducklings. An additional modification was that the hens were wing-clipped. In nine of 10 cases, hens and broods were successfully relocated using this technique.

4. Of 63 ducklings released on UMBERHIND'S Marsh in 1971, 25 were later trapped when 4 to 5 weeks of age. There were additional survivors which were not caught in traps. It is expected that some of the females from these broods will return to nest on this marsh in future years.

5. The methods developed for moving wood duck broods and releasing them on new areas may be suitable for use with other hole-nesting species. Three trials with hooded mergansers were successful.

OTHER PROJECTS

Effects of DDT on Red-backed Salamanders in Northern Maine

- Objectives: (1) To compare population parameters of red-backed salamanders in DDT sprayed and non-sprayed areas.
 (2) To contribute to the knowledge of the life history and ecology of the red-backed salamander in northern Maine.

Assignment: Chester F. Banasiak, Graduate Assistant

Thesis Advisors: John B. Dimond, Professor, Entomology
 Ray B. Owen, Jr., Assistant Professor, Wildlife Resources

Consultants: Carter Gibbs, Project Leader, N.E. Forest Experimental Station and Graduate Faculty Lecturer
 Frederick F. Gilbert, Assistant Professor, Wildlife Resources
 Richard W. Hatch, Associate Professor, Zoology

Mortality among immature salamanders, hatched in the laboratory in August, 1971, continued during the quarter. Of an original 50 young retained, 20 had died by the end of the year and an additional 8 died during the past quarter. All of the deaths during the quarter occurred among individuals of less than average weight. In contrast to the young, all of 24 adult females have survived the same period of captivity.

At the beginning of the quarter the captive population was separated randomly into two groups and subjected to contrasting temperature and photoperiod. Changes in photoperiod and temperature for one group simulated normal conditions for northern Maine. The other groups receive an accelerated change in light and temperatures simulating an annual cycle condensed into a six month period. Effects of the treatments will be measured by growth development of the young and egg development of the adult females.

Processing of specimens and related data continued through the quarter.

Plans for next quarter: Plans for the summer's field work will be completed. Laboratory rearing and experimentation will continue.

Environmental Studies on the Lower Penobscot River (I)

Objective: To establish a biological base by qualitative sampling of benthic macroinvertebrates in tidal and non-tidal areas.

Assignment: John F. Moroney, Graduate Assistant

Thesis Advisors: Malcolm W. Coulter, Professor, Wildlife Resources
Ray B. Owen, Jr., Assistant Professor, Wildlife Resources

Consultants: Richard H. Storch, Associate Professor, Entomology
Robert L. Vadas, Assistant Professor, Botany and Assistant Professor, Zoology
Franklin E. Woodard, Associate Professor, Civil Engineering

Analysis of benthic samples was completed and thesis writing was begun. The detailed analysis of the benthos substantiated the preliminary findings reported last quarter.

Plans for next quarter: Completion of the thesis.

CURRENT PROJECTS NOT REPORTED THIS QUARTER

Mobility of Deer in Three Western Maine Winter Yards - R. D. Hugie
Woodcock Nocturnal Habitat Utilization in Relation to Sex, Age, and Molt -
R. B. Owen, Jr.
Ecology of the Ruffed Grouse in Maine - S. D. Schemnitz
Waterfowl Distribution and Breeding Ecology - H. L. Mendall
Ecology and Behavior of the Fisher - M. W. Coulter
Factors Affecting Summer Flight Behavior of white-tailed Deer on Isle au Haut -
S. D. Schemnitz
Effects of Three Cover Conditions on Behavior and Physiological Responses
on Pinned White-tailed Deer - Myrtle C. Bateman
Annual Production and Factors Influencing Nesting Success of the American
Eider - H. L. Mendall
Breeding Season Studies of Male American Woodcock - S. D. Schemnitz
Incidence of Pneumostrongylus tenuis on Aquatic Snails in Maine - M. R. Mowatt
Effects of Fertilization on Nutrient Content of Deer Browse and Forest
Vegetation in a Recently-cut Area - D. H. Abell
The Effects of DDT on Robin Reproduction in Northern Maine Forests - D. M.
Knupp
The Ecology and Population Dynamics of the Crayfish (Cambarus bartoni)
in Northern Maine - W. F. Reid, Jr.
Incidence of Occurrence of Pneumostrongylus tenuis in Potential Intermediate
Hosts Collected from Various Ecological Regions in Maine - J. G. Gleich
Distribution of Eider Populations in Coastal Maine - H. L. Mendall and W. D.
Snow
Environmental Studies on the Lower Penobscot River (II) - G. C. White

COOPERATION, EDUCATIONAL WORK AND MISCELLANEOUS ACTIVITIES

Coulter attended the North American Wildlife and Natural Resources Conference and The Wildlife Society Council Meeting during March in Mexico City.

Graduation exercises on March 31 for 16 men (14 State game wardens and 2 Baxter State Park rangers) marked the conclusion of the 8th annual 8-week Warden School held at the University of Maine. This joint endeavor, sponsored by the Maine Department of Inland Fisheries and Game and the School of Forest Resources includes training in a variety of subjects. Examples are courtroom procedure, report writing, public speaking, game and fisheries biology, plant identification, public relations, self-defense, and Maine fish and game laws.

Mendall attended a two-day seabird conference at Lincoln, Massachusetts, January 11-12. This meeting was sponsored by the Massachusetts Audubon Society. He also attended the International Symposium on Breeding Behavior and Reproductive Physiology in Birds at Denver, Colorado, February 1-3. From March 17-22 he attended the annual Unit meeting and North American Wildlife and Natural Resources Conference in Mexico City. On March 28 he participated in the winter meeting of the Maine Waterfowl Council at Augusta.

Mendall devoted considerable time during the quarter as consultant on the coastal island preservation programs of the Bureau of Sport Fisheries and Wildlife, Maine Department of Inland Fisheries and Game, Maine Audubon Society, Nature Conservancy and Natural Resources Council. Several planning conferences were held in Orono, Augusta and Gardiner.

PUBLICATIONS AND THESES

Bateman, Myrtle C. 1972. What Do Deer Do in the Winter? Maine Fish and Game, XIV(1):10-11.

Capen, David E. 1972. Establishing Breeding Populations of Wood Ducks by Relocating Wild Broods. M.S. Thesis, Univ. of Maine, Orono. 57 pp. Unpubl.

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Graduate Students: Myrtle C. Bateman
 J. George Gleich
 Barbara W. McKean (Trustee Scholarship)
 Mark R. Mowatt (Teaching Assistant)
 William R. Whitman (Ph.D. Program)

Unit Secretary: Maxine L. Horne

Unit Coordinating Committee

Maynard F. Marsh, Commissioner, Maine Department of Inland Fisheries and Game
 Edwin L. Giddings, Acting Director, School of Forest Resources (Until 5/1/72)
 Fred B. Knight, Director, School of Forest Resources (Effective 5/1/72)
 Howard L. Mendall, Unit Leader

RESEARCH PROJECTSBIG GAMEEffects of Fertilization on Nutrient Content of Deer Browse and Forest Vegetation in a Recently-cut Area

- Objectives: (1) To measure seasonal nutrient content of selected browse species subjected to different fertilization treatments.
 (2) To measure effects of fertilization on forest composition and growth during the season in which fertilizer is applied.

Assignment: David H. Abell, Graduate Assistant

Thesis Committee: Sanford D. Schemnitz, Associate Professor, Wildlife Resources - Co-chairman
 Frederick F. Gilbert, Assistant Professor, Wildlife Resources - Co-chairman
 Charles E. Schomaker, Associate Professor, Forest Resources
 Roland A. Struchtemeyer, Professor, Plant and Soil Sciences

Abell has completed his thesis, an abstract of which follows:

A recently-cut forested area in Sebec, Maine was fertilized with single and combination applications of nitrogen, phosphorus and potassium during June, 1971. Selected vegetation was analyzed for nutrient content before fertilization in April and following fertilization in August and December. Detailed vegetative analysis of the fertilization plots was obtained in the summer and fall of 1971.

The vegetative composition of the study area was found to be extremely variable. The most important tree species on the area were red maple and balsam fir. Sugar maple, aspen, white ash, beech, and, to a lesser extent, hornbeam, mountain maple, striped maple, yellow birch and white birch contributed to the hardwood nature of the area. Important shrubs on the study area were beaked hazel, raspberry and blackberry, while important herbaceous species were wild sarsaparilla, rose twisted-stalk, bracken fern, ground pine, running pine and wild lily-of-the-valley.

Soil analysis and description disclosed low fertility levels in the Plaisted and Thorndike soil types found on the study area. Results suggest that low soil fertility levels may exist in a large portion of white-tailed deer habitat in Maine, since Plaisted-Thorndike soil types are a major soil association in forested areas in northern Maine.

Nutrient analysis revealed that levels of crude protein and phosphorus available in selected browse species from the study area were minimal or slightly below levels suggested as optimum for growth and development of deer. Vegetation responded to nitrogen fertilization by having consistently and significantly higher ($P \leq .05$) crude protein levels. Phosphorus treatment resulted in variable phosphorus uptake by plants, and potassium treatment had little effect on potassium levels in the vegetation sampled. Calcium, magnesium, aluminum, manganese, molybdenum, zinc, copper, iron and boron levels in vegetative parts analyzed from the study area varied within and

between species but were within the ranges suggested for domestic ruminants. Twigs had wider calcium-phosphorus ratios than did foliage, and fertilization with phosphorus did not consistently reduce these ratios.

In vitro digestion trials showed no consistent trends in digestibility due to fertilization. Significant differences in digestibility were found between species analyzed, however, with balsam fir having the highest percent digestible dry matter followed by red maple and beaked hazel.

Results from this study suggest the need for future research regarding nutrition of white-tailed deer in Maine.

Winter Shelter: Some Effects on the Behavior and Physiology of Penned White-tailed Deer

- Objectives: (1) To relate differences on behavior of deer penned under three different cover conditions to environmental conditions.
 (2) To determine if certain physiological parameters indicate a difference among deer penned under three different cover conditions.

Assignment: Myrtle C. Bateman, Graduate Assistant

Thesis Committee: Frederick F. Gilbert, Assistant Professor, Wildlife Resources
 Chairman
 David C. O'Meara, Associate Professor, Animal Biology
 Voit B. Richens, Assistant Unit Leader
 Ray B. Owen, Jr., Assistant Professor, Wildlife Resources

Miss Bateman completed all requirements for an M.S. degree during the quarter and an abstract of her thesis is as follows:

The behavior of 11 white-tailed deer (Odocoileus virginianus) fawns was observed in December, 1970, and in January, February, and March, 1971. Six of the deer were male and five were female; six were raised at the State game farm and five were reared by their does at Orono. One fawn was confined in each of four wooded pens (N), four absolute clear-cut pens (A), and three clear-cut pens with windbreaks (C). Commercial deer pellets were supplied ad libitum and environmental parameters measured. An attempt was made to determine the effects of weather conditions on food consumption and behavioral responses.

The deer were killed and autopsied at the end of March, 1971. Blood parameters and condition indices were measured to determine if the different cover conditions resulted in differences in the physiology of the deer. Measured blood parameters did not differ significantly between cover types, sexes, or origins of deer.

The deer in cover type C lost a greater percent of their body weight, had a lower kidney fat index, and ate less, relative to body weight, in late winter than the deer in the other cover types. Fewer opportunities for socialization were considered partly responsible for these differences in the C. deer.

The game farm-raised fawns ate significantly more feed relative to body weight, but not per deer, than the larger Crono-raised fawns.

Solar radiation accounted for approximately 28 percent of the variation in food consumption. Food intake was maximum at an average daily air temperature of -15°C , minimum at -4°C , increased above -4° and decreased below -15° .

Greater feeding and general activity was observed when skies were overcast than when clear, when the barometer was falling than when rising or steady, and with increasing vapor pressure humidity. Activity patterns were similar in all cover types, and increased with increasing temperature. The daily feeding activity peaks coincided to peaks in general activity.

The location of bed sites were affected primarily by the location of deer in adjacent pens. Bed site selection was influenced by temperature during the colder months, but in the C pen where bed sites surface temperatures were measured, the bed site with the warmest surface temperature was selected only a small percentage of the time.

Bed sites which were potentially solar exposed were selected more often on clear than on overcast days. C deer appeared to select for solar exposure more than N or A deer.

The deer in the open maintained trails around the periphery of the pens. Deer used the trails along the fences with deer on the opposite side more than those without deer on the opposite side. Deer seldom moved off trails when sinking depth exceeded 30 centimeters.

WATERFOWL

Distribution of Eider Populations in Coastal Maine

- Objectives: (1) To conduct aerial breeding ground inventories; to maintain a current classification of the important nesting islands, and to establish priorities for agency acquisition.
- (2) To determine the abundance and subspecific composition of fall and winter populations.

Assignment: Howard L. Mendall, Unit Leader
William D. Snow, Game Management Agent, Bureau of Sport Fisheries and Wildlife

The biennial aerial inventory of breeding eider ducks was conducted along the Maine coast and offshore islands. In addition to Agent-pilot Snow and Unit Leader Mendall, Agent Donald Blais participated in the regular census as he has each year. A special check flight was made a week later of some of the eastern Maine breeding islands with Curtis Bohlen of the Secretary of Interior office accompanying Snow and Mendall.

Tabulation of the data indicated about a 20 percent increase in total eiders observed. Adjustments are necessary to the gross figures for non-breeding or sub-adult birds. These are based on random sex and age counts, made both visually and by photography. Preliminary compilations show a somewhat higher proportion of sub-adult males than in 1970, the last year of the inventory. The assumption is made that a similar proportion of sub-adult females exists in the population.

Analysis of the photographic sample has not been completed yet. If results follow the visual tabulation, then the final estimated percentage increase of breeding eiders will be in the order of 12 percent. This is encouraging considering the severe outbreak of fowl cholera that occurred in central Maine after the 1970 census was made. However, the western part of Penobscot Bay and adjacent outer islands (within the cholera zone) did have a much lower rate of increase than was the case east of Rockland.

In view of the data thus far tabulated it is concluded that Maine's population of breeding eiders in 1972 is well in excess of 20,000 pairs.

Plans for next quarter: Inactive.

OTHER PROJECTS

Incidence of Nematodes in Aquatic Snails from Central Maine

- Objectives: (1) To investigate the possibility of P. tenuis larval stages occurring in aquatic gastropods.
 (2) To determine the distribution of aquatic gastropods in representative areas of different moose and deer densities.

Assignment: Mark R. Mowatt, Teaching Assistant

Thesis Committee: Frederick F. Gilbert, Assistant Professor, Wildlife Resources - Chairman
 Malcolm W. Coulter, Professor of Wildlife Resources
 Marvin C. Meyer, Professor of Zoology

Five collections from seven sites in central Maine yielded 4,023 aquatic snails representing 18 species and seven families. Amnicola limosa was widespread and common on all areas except in Baxter State Park. This species accounted for 1,887 snails. Over 2,000 of the following gastropods were taken: Physa gyrina, P. ancillaria, Campeloma decisum, Valvata tricarinata, and Helisoma anceps. These species have local distributions but when present exist in large numbers. The remaining 12 species were uncommon to rare and collectively yielded only 124 individuals.

Gastropod numbers were lowest in Baxter Park. Ten collection stations in two ponds yielded no snails while only two species, Physa and Helisoma were represented at 10 stream stations. The Piscataquis River near Milo supports the most diverse gastropod populations of all areas studied. Five stations there yielded over 2,000 individuals representing 10 species. Organic pollution may be one factor contributing to such high snail densities for the section of river sampled lies just eight miles below the town of Dover-Foxcroft.

All gastropods were digested in a mild acid solution and examined for nematode infection, particularly Parelaphostrongylus tenuis (Dougherty), the species which causes cerebrospinal nematodiasis in moose. The only identifiable nematodes recovered proved to be larval stages of Rhabditis spp. Some partially digested nematodes could not be identified. None of these should have been P. tenuis for parasitic nematodes are resistant to the digestive fluid.

Plans for next quarter: All field data are now compiled and summarized. Writing is in progress and will be completed during the next quarter.

CURRENT PROJECTS NOT REPORTED THIS QUARTER

Mobility of Deer in Three Western Maine Winter Yards - R. D. Hugie
 Woodcock Nocturnal Habitat Utilization in Relation to Sex, Age, and Molt -
 R. B. Owen, Jr.
 Ecology of the Ruffed Grouse in Maine - S. D. Schemnitz
 Waterfowl Distribution and Breeding Ecology - H. L. Mendall
 Ecology and Behavior of the Fisher - M. W. Coulter
 Factors Affecting Summer Flight Behavior of White-tailed Deer on Isle au Haut -
 S. D. Schemnitz
 Annual Production and Factors Influencing Nesting Success of the American
 Eider - H. L. Mendall
 Breeding Season Studies of Male American Woodcock - S. D. Schemnitz
 The Effects of DDT on Robin Reproduction in Northern Maine Forests - D. M.
 Knupp
 The Ecology and Population Dynamics of the Crayfish (Cambarus bartoni) in
 Northern Maine - W. F. Reid, Jr.
 Incidence of Occurrence of Pneumostrongylus tenuis in Potential Intermediate
 Hosts Collected from Various Ecological Regions in Maine - J. G. Gleich
 Environmental Studies on the Lower Penobscot River (I) - J. F. Moroney
 Environmental Studies on the Lower Penobscot River (II) - G. C. White
 Importance of Snow Support in the Welfare and Survival of Wintering Deer
 in Maine - V. B. Richens
 Renesting of the American Eider in Penobscot Bay Colonies - W. Sarbello
 Effects of DDT on Red-backed Salamanders in Northern Maine - C. F. Banasiak

COOPERATION, EDUCATIONAL WORK AND MISCELLANEOUS ACTIVITIES

Coulter was asked to serve on a Forestry-Wildlife Advisory Committee to the Faculty of Forestry at the University of New Brunswick, Canada and he attended the initial meeting of the committee on May 2. Membership includes a representative each from the Canadian Wildlife Service, Acadia University, University of Maine and provincial agencies in Quebec and the Atlantic Provinces.

Mendall attended Laval University's annual waterfowl seminar in Quebec City April 19-20. He gave an illustrated talk on the current and recent eider studies by Unit personnel in Maine.

Gilbert attended the Canadian Society of Zoologists Meeting at York University, Toronto, Ontario, May 28-31.

Graduate Assistant Hugie participated in a conservation meeting concerning the program for the Boy Scouts of America, National High Adventure Area at the Matagamon Wilderness Base, July 19, 1972. The next meeting of the conservation committee will be held at the University of Maine during December 1972.

PERSONNEL CHANGES

Graduate Assistant David E. Capen received an M.S. degree in June and is now working toward a Ph.D. degree at Utah State University at Logan.

PUBLICATIONS AND THESES

Bateman, Myrtle C. 1972. Winter Shelter: Some Effects on the Behavior and Physiology of Penned White-tailed Deer. Unpublished M.S. Thesis, Univ. of Maine, Orono. 108 pp.

September 18, 1972

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copy

MAINE COOPERATIVE WILDLIFE RESEARCH UNIT

University of Maine

Orono, Maine

QUARTERLY REPORT

July-September, 1972

Cooperating Agencies

Maine Department of Inland Fisheries and Game
University of Maine
Bureau of Sport Fisheries and Wildlife
Wildlife Management Institute

NOT FOR PUBLICATION

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WILDLIFE STAFF

Howard L. Mendall, Unit Leader and Professor of Wildlife Resources
 Voit B. Richens, Assistant Unit Leader and Assistant Professor of Wildlife Resources
 Malcolm W. Coulter, Associate Director of Wildlife, School of Forest Resources,
 and Professor of Wildlife Resources
 Sanford D. Schemnitz, Associate Professor of Wildlife Resources
 Ray B. Owen, Jr., Assistant Professor of Wildlife Resources
 Frederick F. Gilbert, Assistant Professor of Wildlife Resources
 Michael D. Zagata, Assistant Professor of Wildlife Resources

Unit Collaborators - Personnel from many University departments as well as State,
 Federal and private organizations are actively collaborating with the Unit.
 Individuals assisting with projects that are currently reported upon are
 listed in connection with the appropriate project summary.

Graduate Assistants: Chester F. Banasiak (Ph.D. Program)
 William J. Crenshaw
 Howard O. Delo
 Roy D. Hugie
 James M. Kienzler (Ph.D. Program)
 Carl E. Korschgen (Ph.D. Program)
 Jeffrey R. Kropp
 Gerald R. Lavigne
 William F. Reid, Jr. (Ph.D. Program)

Graduate Fellow: Kenneth J. Reinecke

N.S.F. Trainee: James S. Wakeley (Graduate Assistant as of September 1)

Graduate Students: David H. Abell
 James B. Barnes
 Timothy G. Dilworth (Ph.D. Program)
 J. George Gleich
 David M. Knupp
 Katherine J. Little
 Barbara W. McKean
 John F. Moroney
 Mark R. Mowatt
 William Sarbello
 Gary C. White
 William R. Whitman (Ph.D. Program)

Unit Secretary: Maxine L. Horne

Unit Coordinating Committee

Maynard F. Marsh, Commissioner, Maine Department of Inland Fisheries and Game
 Fred B. Knight, Director, School of Forest Resources
 Howard L. Mendall, Unit Leader

RESEARCH PROJECTSBIG GAMEInfluences of Deer Upon Forest Vegetation

- Objectives: (1) To measure the influence of a known population of deer upon forest vegetation.
- (2) To develop and test more adequate deer census methods than those currently available.

Assignment: S. D. Schemnitz

Two fenced deer exclosures at Isle au Haut were visited on August 2. With the aid of Park Ranger William Stevens, permanent photo stations were relocated and photographs of the vegetation were taken. The exclosure and an adjacent control in a conifer swamp showed no visible differences in vegetation after 4 years. Apparently the lack of white cedar reproduction was due to lack of light or other silvical factors rather than to deer browsing.

By contrast, the deer exclosure in upland hardwood showed conspicuous differences within and outside the fence. White birch seedlings on two transects inside the fence averaged 21.4 and 19 inches (20 samples 3 ft. apart) high. The latter series of measurements were taken within the hare proof portion of the exclosure. No birch seedlings could be found outside the exclosure.

UPLAND GAMEWoodcock Nocturnal Habitat Utilization in Relation to Sex, Age, and Molt

- Objectives: (1) To explore the feasibility of banding woodcock in their "diurnal cover" at night.
- (2) To study the molt chronology of woodcock throughout the summer and fall.
- (3) To compare the age, sex, and molt of woodcock remaining in the "diurnal cover" at night with those utilizing summer fields.
- (4) To investigate the use of telemetry as a tool for locating woodcock nocturnal habitat.

Assignment: R. B. Owen, Jr.

Consultants: M. W. Coulter

J. W. Peppard, Dept. Inland Fisheries and Game

W. B. Krohn, U.S. Bureau of Sport Fisheries and Wildlife

A paper entitled "Molt Patterns and Weight Changes of the American Woodcock" by Owen and W. B. Krohn was submitted for publication. A summary follows:

A study of molt and changes in body weight of American woodcock was conducted to better understand the summer and fall behavior of these birds and to indicate periods of physiological stress. The postnuptial molt of adults was a complete molt beginning in late June and ending by the middle of October. In contrast, the postjuvenile molt was a less intensive partial molt beginning in mid-July but also extending to the middle of October. Both male and female adult birds experienced weight loss in August during peak molt. Young birds gradually gained weight throughout the summer. Fat deposition was negatively correlated with molt while fall body weights were positively correlated with fat deposition. The data indicated that the majority of Maine woodcock are not physiologically prepared for migration until mid-October. Weights of adult males during the spring suggested that this is an important period of stress for these birds.

A second paper entitled "The Summer Behavior of Immature Radio-equipped Woodcock in Central Maine" by R. D. Dunford and Owen was also submitted for publication. An abstract follows:

The behavior of 15 immature American woodcock (Philohela minor) was studied in central Maine during the summers of 1969 and 1970 using radio telemetry. The monitored birds used a variety of nocturnal sites including fields, bogs, powerlines, highway medians, woods roads and forest clearings. Fields were occupied more often than any of the other type of opening. Second growth-hardwoods, alders, hardwood-conifers and conifers were utilized as diurnal cover. Diurnal locations of radio-equipped woodcock averaged 15 m from major breaks in the forest canopy. Four birds were monitored continuously during the day and night to determine periods of activity. Although the birds were active throughout the day, very little activity was recorded after they moved to nocturnal sites. No apparent difference was found in the daily patterns of movement between immature male and female woodcock. Crepuscular movements between diurnal covers and nocturnal areas averaged 332 m. A composite summer range for the 15 woodcock during 183 woodcock days was 1060 ha. The data suggest that immature woodcock are quite mobile during the summer and utilize most of the forest openings occurring within three to four km of good nesting habitat. Many of these openings are also used for singing grounds by males in the spring.

The field work for the project was completed this quarter. Twenty-one adult woodcock were successfully radio-tagged during the 1971-1972 field seasons. Data on movements and habitat utilization by these birds are being analyzed.

Plans for next quarter: To continue data analysis.

WATERFOWL

Annual Production and Factors Influencing Nesting Success of the American Eider

Objective: To determine production and factors related to eider nesting success in breeding colonies of Penobscot Bay.

Assignment: H. L. Mendall

Seasonal breeding ecology studies on the Rockland study area were concluded during the quarter. Assistance with nest checks was given by

Richens, graduate students Sarbello and Wakeley and Mendall's wife.

Population estimates on the 5 study islands suggest about a 10 percent decrease from 1971. This is in fairly close agreement with the spring aerial breeding inventory (see April-June Quarterly Report) which showed little or no gain in Muscongus and West Penobscot bays, yet a substantial increase statewide. This would suggest that, although the Maine eider population as a whole is at a satisfactory level, there are still some colonies that have not yet recovered from the effects of the 1970 fowl cholera outbreak.

Nesting chronology was very late in 1972 as was the general spring phenology. Breeding peaks, however, were more nearly at average dates than were nest initiation peaks. For example, first hatchings did not occur until June 3, the latest thus far recorded, yet the peak of hatching on the study area was only about 10 days later than average.

Nest success ranged from a low of 31 percent on Tommy Island to a high of 65 percent on Fisherman's Island. At the former, deterioration of cover conditions and increasing human disturbance by sightseers and campers is rapidly changing this island from an area of high to low production. It is representative of the disturbance factor that is gradually becoming a threat to the welfare of many of the eider and seabird colonies throughout the Maine coast. It emphasizes the increasing need for agency ownership or control of important Maine bird islands.

A secondary objective of this project has been an attempt to obtain data on breeding population turnover and migrational homing through banding of nesting females. A total of 73 adult eiders were live-trapped or netted on their nests at Tommy and Fisherman's islands and an additional 60 females were captured that had been banded in previous years. Several hens have been handled during 3 or more years, some dating back to 1965 and 1966. Both site tenacity and longevity of adults appear strong characteristics of the eider. At Tommy Island, for example, a minimum of 40 percent of the nesting females banded in 1966 were known to be still alive in 1971.

Similar data were obtained by graduate students Sarbello and Wakeley on the Islesboro study area with even greater longevity data, since banding was initiated there earlier than at Rockland (see summary of Sarbello's study in this quarterly report).

Monitoring for disease was very encouraging. No evidence of even a minor outbreak of fowl cholera was obtained this year. Very few dead eiders were found on any of the nesting islands and most of these were clearly attributable to predation. Only one fresh carcass, obtained by Sarbello at Islesboro, showed positive cultures for cholera.

Plans for next quarter: Inactive.

Renesting of the American Eider in Penobscot Bay Colonies

Objective: To determine the extent to which eiders renest following the loss of initial clutches.

Assignment: W. Sarbello, Graduate Student

Thesis Committee: H. L. Mendall, Chairman
M. W. Coulter
S. D. Schemnitz
A. A. Barden, Jr., Professor of Zoology

Graduate Assistant Wakeley and Sarbello cooperated in field studies on the eider this season since the same study area was used. Considerable assistance throughout the season was given by Richens. Work was hampered considerably because of poor weather. A limited number of clutches were collected to simulate natural predation on Robinson and East Goose Rocks; however, none of these hens were known to renest. Three hens that were used in Wakeley's study of marking methods renested following abandonment of and/or natural predation upon their clutches. The maximum possible renest interval for one female was 8 days, the shortest interval yet recorded in this study. During the season 69 nesting females were live-trapped or netted; of these, 27 were returns of birds banded in previous years.

One case of fowl cholera was discovered on Goose Island. A moribund hen was captured on her hatching clutch. She exhibited classic symptoms of acute fowl cholera, and died within an hour. Water samples were collected from nearby stagnant pools of feces-fouled rainwater for culturing, and all such pools were treated with disinfectant immediately. The hen and one water sample were positive for the disease organism, but no additional cases of the disease were found.

Plans for next quarter: Analysis of data will continue. At present a computer program is being written to analyze factor interactions that may give the probability of a bird renesting. Work will continue on writing the thesis.

OTHER PROJECTS

Establishing a Quantitative Ecological Base in the Penobscot Estuary Using Benthic Macroinvertebrates

Objective: To establish a biological base by quantitative sampling of benthic macroinvertebrates in four coves in the Penobscot Estuary.

Assignment: G. C. White, Graduate Assistant

Thesis Committee: M. W. Coulter, Co-chairman
R. B. Owen, Jr., Co-chairman
R. H. Storch, Associate Professor, Entomology
R. L. Vadas, Assistant Professor, Botany
F. E. Woodward, Associate Professor, Civil Engineering

White completed the requirements for an M.S. degree during the quarter. The summary of his thesis follows:

The objective of this study was to establish a partial biological base in the Penobscot Estuary for measuring changes in environmental conditions using diversity and structure of benthic macroinvertebrate communities. This base can be compared with the future biological conditions that will be encountered with changes in quantity and quality of pollution.

The selection of four coves as benthic macroinvertebrate sampling areas in the estuary was based mainly on the pollution, salinity, and temperature gradient in the estuary, and bottom sediments in the coves. Two 200 m transects were set up in each cove with five .05 m² Ponar grab samples being taken at eight sampling stations along the length of each transect. Eighty samples were taken in each cove and 320 in the estuary. The mean number of each species and a 95 percent confidence interval were calculated for each series of five grabs at a sampling station and for each cove. Two measures of diversity, the Sequential Comparison Index and Brillouin's H, a measure of evenness, and a 95 percent confidence interval for each were calculated for each sampling station and each cove.

The two most widely occurring species in the estuary were the polychaetes Scolecoides viridis and Nereis diversicolor. A total of 35 species were found in the samples. Diversity was highest in the most saline cove.

Three methods are discussed for measuring changes in the biotic community: (1) a change in the species list, (2) a change in density of one or more species, and (3) a change in community diversity. These methods are discussed in relation to the sampling scheme. The number of samples, the size of the sampling unit, and the homogeneity of the sampling area all influence the three methods above. Changes in the species list or the density of one or more species appear to be the most sensitive indicators of subtle changes in environmental conditions, whereas diversity appears less likely to reflect subtle environmental changes.

Terrestrial Gastropods from Central Maine: Distribution, Relative Abundance and Relationship to Parasitic Nematodes, Especially Pneumostroylus tenuis

Assignment: J. G. Gleich, Graduate Student

Thesis Committee: F. F. Gilbert, Chairman
M. D. Ashley, Assistant Professor, Forest Resources
K. W. Allen, Professor and Chairman, Zoology

Gleich completed all requirements for an M.S. degree during the quarter. A summary of his thesis follows:

Terrestrial gastropods were collected from seven study areas in central Maine during four collection periods (June 23-29; July 17-28; August 16-September 6; and October 29-November 8, 1971). Gastropods were collected

from 12 cover types (lowland mixed wood, upland mixed wood, hardwood, abandoned field, red pine plantation, mixed wood, cutover mixed wood, spruce bog, spruce-fir, cedar swamp, log road and fir), but all cover types were not found on each study area.

Objectives of the study were to investigate the distribution, relative abundance, habitat preferences and possible nematode loads of terrestrial gastropods in central Maine with special emphasis on the meningeal worm (Pneumostrongylus tenuis).

Terrestrial gastropods were widespread, but not very abundant in central Maine. The Baxter State Park region apparently had very low gastropod populations.

Seventeen hundred gastropods were collected representing 29 snail and 8 slug species. Snails comprised 62 percent and slugs 38 percent of the gastropods. Observed snail-to-slug ratios ranged from 0.67 to 5.90 and averaged 1.82.

Total gastropod numbers were highest during the second collection period (July 17-28). Factors which may have explained this phenomenon (moisture, temperature, population dynamics) were discussed. Mean numbers of gastropods taken (per collection) varied from 93.3 to 25.3 with the average being 60.2.

There appeared to be an inverse relationship between snail and slug abundance. Snails were most abundant near Moosehead Lake. Slugs were most abundant in the southeastern part of central Maine and decreased in a northwesterly direction. The possibility that slug introductions were responsible for this distributional pattern was discussed. Highest numbers of snails (per trap) were found in the fir cover type while highest slug numbers came from the upland mixed wood type. Softwoods, generally considered poor gastropod habitat, yielded relatively high numbers of gastropods.

Discus cronkhitei, Zonitoides arboreus, Z. nitidus, Striatura ferrea, S. exigua and Helicodiscus parallelus were found on all study areas. Discus cronkhitei and Zonitoides arboreus comprised 62 percent of all snails collected.

Deroceras reticulatus and Pallifera dorsalis were the most commonly collected slugs and the only slugs found on all study areas. Four of the eight species of slugs were introduced from Europe. They comprised 44 percent of all slugs. Pallifera ohioensis and Arion hortensis were reported from Maine for the first time.

The 655 nematodes recovered included 260 Cosmocercoides dukae, 215 Rhabditis spp., 4 Pneumostrongylus tenuis, one Criconema spp. and 175 unidentified larvae. More slugs (62) than snails (57) contained nematodes even though many more snails were examined. Frequency of nematode occurrence was relatively low in all gastropods except Pallifera spp., 19 percent of which were carrying nematodes. Nematodes occurred most commonly in the slugs, Pallifera dorsalis, P. ohioensis and Deroceras reticulatum and the snails, Discus cronkhitei, Zonitoides arboreus and Striatura ferrea. Cosmocercoides dukae was most commonly found in Discus cronkhitei while Rhabditis spp. were most common in Pallifera spp.

The four P. tenuis were found in Pallifera dorsalis, a new host record for this nematode. Two third stage larvae were found in each of two P. dorsalis collected in the upland mixed wood cover type. Both slugs also contained living Rhabditis spp. Questions involving possible means of P. tenuis dispersal in Maine were discussed. It appears that existing knowledge is insufficient to explain the movement of first and third stage P. tenuis larvae under field conditions.

Effects of DDT on Red-backed Salamanders in Northern Maine

- Objectives: (1) To compare population parameters of red-backed salamanders in DDT sprayed and non-sprayed areas.
 (2) To contribute to the knowledge of the life history and ecology of the red-backed salamander in northern Maine.

Assignment: C. F. Banasiak, Graduate Assistant

Thesis Committee: R. B. Owen, Jr., Co-chairman
 J. B. Dimond, Professor, Entomology, Co-chairman
 F. F. Gilbert
 C. B. Gibbs, N.E. Forest Experiment Station,
 Graduate Faculty Lecturer
 R. W. Hatch, Associate Professor, Zoology

Field investigations were carried out from June 6 through September 15 on four areas described in the July-September, 1971 Quarterly Report. Primary efforts entailed collections for population composition estimates in August and September. Approximately 1200 salamanders, exclusive of current-year hatch, were either measured in the field or collected for various purposes. These included two collections for DDT analysis which were conducted on each of the areas in June and August.

Clutches judged complete at 134 of 141 nesting sites examined yielded an average of 6.7 eggs/clutch. In contrast to 1971 findings, mean clutch size for the Greenlaw Mountain area (7.8 eggs/clutch) was significantly greater than found for the other areas (Table 1); this was the only area showing a significant difference in clutch size between years.

Hatching success for 718 eggs (623 with attending females) incubated under controlled humidity and temperature was similar to 1971 results. About 11% of the eggs attended by females were eaten in 1972 compared to 21% in 1971; this decreased egg eating was probably due to individual housing of females with their clutches. In 1971, two clutches with attending females generally were housed in the same container. Of the eggs remaining, 97% of those attended by females hatched in contrast to 54% for eggs without females.

Hatching of salamander eggs in the laboratory occurred between August 13 and September 5 with half of the hatch completed on August 24. Incubating temperature in 1972 was maintained at 60°F (15.6°C) to more closely approximate average natural conditions. In the field, egg clutches were found between June 6 and September 6 while the first hatchlings were noted on August 21. Survival of hatchlings in the laboratory at a minimum of 3

weeks post-hatch, amounted to 96% in 1972 with no significant differences evident among areas.

Population estimates on 8 plots (24 x 25 m) using mark and recapture methods produced highly variable results. By turning objects on the forest floor an average of 23 animals per plot were found and marked. However, returns were less than 1 per plot on subsequent searches. Complete searches (all movable objects turned, all decayed logs and stumps torn apart, and 4% of the litter sifted) on 5 plots where 125 animals had been marked produced 13 returns among 340 salamanders found. Animals per plot varied from 46 to 99 while for the total area searched (3,125m²) there was an average minimum density of 1088/ha (440/acre). The low returns of marked animals can be attributed to mortality, horizontal movement off of the plots or movement into the soil.

Table 1. Red-backed salamander mean clutch size by areas, 1971 and 1972.

Area	DDT* Residues	Sample Size			Mean± 1971	Std. Error	
		1971	1972	Total		1972	Total
Greenlaw Mountain	0.020	22	33	55	5.7±0.3	7.8±0.3	6.9±0.3
Weeks Brook	0.080	23	48	71	6.4±0.5	6.4±0.3	6.4±0.3
Sterling Brook	0.150	23	25	48	6.3±0.3	6.5±0.5	6.4±0.3
Beaver Brook	0.440	21	28	49	6.3±0.3	6.0±0.3	6.1±0.2
All Areas		89	134	223	6.2±0.2	6.7±0.2	6.5±0.2

*DDT determinations from 1970 samples.

A Comparison of Field and Classroom Methods in the Teaching of Ecology to Prospective Elementary School Teachers

- Objectives: (1) To measure knowledge of basic ecological principles gained by groups of prospective elementary teachers which have been taught by field and classroom methods.
- (2) To test for any difference in the knowledge gained by groups that have been exposed to each method.
- (3) To record any changes in attitude towards conservation and the environment that occurred after the learning experience.

Assignment: Barbara McKean, Graduate Student

Thesis Committee: S. D. Schemnitz, Chairman
 M. W. Coulter
 G. T. Davis, Professor of Education
 C. W. Chen, Assistant Professor of Mathematics

Teachers at the elementary school level are now expected to include some form of environmental education in the curriculum. Many teachers have had little university training in science, especially ecology. As a

result, different types of programs have been suggested to give teachers the background knowledge needed to teach environmental education.

Field study has been praised as the best method of environmental education, but it has not been shown more effective than classroom study. Thus, it was decided to compare field and classroom methods of teaching basic principles of ecology to prospective elementary teachers.

During the summer, lessons in basic ecology were prepared on the ecosystem, biogeochemical cycles, and biotic succession. A field area in the vicinity of the Orono campus was selected as the site of each lesson. To measure knowledge of definitions and principles of ecology, a 45 item multiple choice test was prepared for use as a pre-test and a post-test. A conservation attitude questionnaire used by researchers was modified for use in the present study and pre-test and post-test forms were arranged.

A class of prospective elementary teachers from the College of Education of the University of Maine formed the experimental groups. Pre-testing took place in late September and the first field and classroom lessons were subsequently begun.

Plans for next quarter: Field lessons, classroom lessons, and post-testing will be completed. Data will be analyzed and the writing of the thesis will begin.

CURRENT PROJECTS NOT REPORTED THIS QUARTER

Mobility of Deer in Three Western Maine Winter Yards - R. D. Hugie
 Ecology of the Ruffed Grouse in Maine - S. D. Schemnitz
 Waterfowl Distribution and Breeding Ecology - H. L. Mendall
 Distribution of Eider Populations in Coastal Maine - H. L. Mendall and
 W. D. Snow
 Banding Analysis of the Eider - J. S. Wakeley
 Ecology and Behavior of the Fisher - M. W. Coulter
 Factors Affecting Summer Flight Behavior of White-tailed Deer on Isle au Haut -
 S. D. Schemnitz
 Breeding Season Studies of Male American Woodcock - S. D. Schemnitz
 The Effects of DDT on Robin Reproduction in Northern Maine Forests - D. M.
 Knupp
 The Ecology and Population Dynamics of the Crayfish (Cambarus bartoni)
 in Northern Maine - W. F. Reid, Jr.
 Environmental Studies on the Lower Penobscot River (I) - J. F. Moroney
 Importance of Snow Support in the Welfare and Survival of Wintering Deer
 in Maine - V. B. Richens
 Incidence of Nematodes in Aquatic Snails from Central Maine - M. R. Mowatt

COOPERATION, EDUCATIONAL WORK AND MISCELLANEOUS ACTIVITIES

Owen visited the Northern Prairie Wildlife Research Center, Jamestown, North Dakota on August 21-25. On August 26-31, he attended the AIBS meetings at Minneapolis, Minnesota.

Zagata and Schemnitz, in cooperation with the University of Maine Student Chapter of The Wildlife Society, developed a poster advertising National Hunting and Fishing Day. One hundred copies were printed and posted in conspicuous places in Bangor and vicinity.

Schemnitz and Zagata attended the Wildlife Teacher's Subcommittee Meeting at West Virginia University August 27. Schemnitz chaired the business meeting.

Mendall participated in the Augusta meetings of the Maine Waterfowl Council on August 16 and 18.

During September a serious outbreak of paralytic shellfish poisoning (commonly called "Red Tide") occurred on the New England coast. Two days of spot checks and inquiries of fishermen by Mendall in Penobscot Bay yielded only negative results of any adverse effects on waterfowl. Similar findings are indicated from reports of monitoring by personnel of various agencies along other portions of the Maine coast.

A meeting of the Unit Coordinating Committee was held in Augusta September 1. Director Knight and Mendall represented the University and Unit. Commissioner Marsh and Deputy Commissioner Peppard represented the State Department of Inland Fisheries and Game.

PERSONNEL CHANGES

Schemnitz completed a 1-year sabbatical leave in Florida in June and has now resumed his duties with the Wildlife Resources staff.

J. William Peppard was appointed Deputy Commissioner of the Maine Department of Inland Fisheries and Game in September. Since 1968, he has been in charge of the Department's migratory bird activities. Bill has a B.S. degree in zoology and an M.S. in wildlife management, both from the University of Maine where he held a Unit Assistantship.

Donald A. Hammer, completed his 1-year appointment as Assistant Professor of Wildlife Resources at the University of Maine in June. He was a temporary replacement for Schemnitz who was on leave. Hammer is now serving as biologist with TVA at Norris, Tennessee.

Fred Gilbert resigned as Assistant Professor of Wildlife Resources and joined the Zoology staff at the University of Guelph, Ontario.

Michael Zagata completed his Ph.D. program at Iowa State University and joined the University of Maine staff as Assistant Professor of Wildlife Resources on September 1. He is a native of northern New York and received his M.S. and B.S. degrees at the State College of New York at Oneonta. Mike's dissertation was on the range and movement of white-tailed deer in Iowa; big game is his major interest.

Graduate Assistant Abell is now a biologist with the Rhode Island Audubon Society at Providence.

The following students began their graduate studies during the quarter:

- Howard O. Delo - University of Alaska, B.S., Wildlife Management-Fishery Biology and B.S. Biological Sciences, 1972
- Carl E. Korschgen - University of Missouri, M.A., Wildlife Ecology, 1972, University of Missouri, A.B., Zoology, 1970
- Gerald R. Lavigne - Syracuse University, B.S., Zoology, 1972
- Kenneth J. Reinecke - Rippon College, A. B., Math and Philosophy, 1970
- Timothy G. Dilworth - Ohio State University, B.S., Agriculture, 1961
University of New Brunswick, M.S., Biology, 1966

PUBLICATIONS AND THESES

- Abell, D. H. 1972. Effects of fertilization on nutrient content of deer browse and forest vegetation in a recently-cut area. Unpublished M.S. Thesis, Univ. of Maine, Orono. 132 pp.
- Cross, P. A., V. B. Richens, and R. D. Hugie. 1972. The coyote, Maine's Newest Wildlife Resident. Maine Fish and Game, Vol. XIV, No. 3, 12-13.
- Gleich, J. G. 1972. Terrestrial gastropods from central Maine: distribution, relative abundance and relationship to parasitic nematodes, especially Pneumostromgylus tenuis. Unpublished M.S. Thesis, Univ. of Maine, Orono. 176 pp.
- Mendall, H. L. 1972. Maine's Duck of Many Names---the Ring-neck. Maine Fish and Game, Vol. XIV, No. 3, 4-7.
- White, G. C. 1972. Establishing a quantitative ecological base in the Penobscot Estuary using Benthic Macroinvertebrates. Unpublished M.S. Thesis, Univ. of Maine, Orono. 102 pp.
- White, G. C. and J. F. Moroney. 1972. The Ecological Base. Chapter 5, pp. 115-145. In PENOBSCOT RIVER STUDY, Vol. I, Tech. Rept. No. 1, Environmental Studies Center, Univ. of Maine, Orono. 288 pp.

November 30, 1972

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MAINE COOPERATIVE WILDLIFE RESEARCH UNIT

University of Maine

Orono, Maine

QUARTERLY REPORT

October-December, 1972

Cooperating Agencies

Maine Department of Inland Fisheries and Game
University of Maine
Bureau of Sport Fisheries and Wildlife
Wildlife Management Institute

NOT FOR PUBLICATION

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WILDLIFE STAFF

Howard L. Mendall, Unit Leader and Professor of Wildlife Resources
 Voit B. Richens, Assistant Unit Leader and Assistant Professor of Wildlife Resources
 Malcolm W. Coulter, Associate Director of Wildlife, School of Forest Resources,
 and Professor of Wildlife Resources
 Sanford D. Schemnitz, Associate Professor of Wildlife Resources
 Ray B. Owen, Jr. Assistant Professor of Wildlife Resources
 Michael D. Zagata, Assistant Professor of Wildlife Resources

Unit Collaborators - Personnel from many University departments as well as State,
 Federal and private organizations are actively collaborating with the Unit.
 Individuals assisting with projects that are currently reported upon are
 listed in connection with the appropriate project summary.

Graduate Assistants: Chester F. Banasiak (Ph.D. Program)
 William J. Crenshaw
 Howard O. Delo
 James M. Kienzler (Ph.D. Program)
 Carl E. Korschgen (Ph.D. Program)
 Jeffrey R. Kropp
 Gerald R. Lavigne
 Mark R. Mowatt
 William F. Reid, Jr. (Ph.D. Program)
 James S. Wakeley

Graduate Fellow: Kenneth J. Reinecke

Graduate Students: Timothy G. Dilworth (Ph.D. Program)
 David M. Knupp
 Barbara W. McKean Capen
 John F. Moroney
 William Sarbello
 William R. Whitman (Ph.D. Program)
 Roy D. Hugie

Unit Secretary: Maxine L. Horne

Unit Coordinating Committee

Maynard F. Marsh, Commissioner, Maine Department of Inland Fisheries and Game
 Fred B. Knight, Director, School of Forest Resources
 Howard L. Mendall, Unit Leader

RESEARCH PROJECTSUPLAND GAMEEcology of the Ruffed Grouse in Maine

- Objectives: (1) To study population dynamics of a harvested and unharvested grouse population, and to compare mortality rates of resident non-migratory species (grouse) and migratory species (woodcock) on the same area.
- (2) To determine cover preferences and use of forest clearings by adults and broods in spring and summer.
- (3) To study the causes of juvenile mortality and measure the incidence of blood parasites.

Assignment: S. D. Schemnitz

Consultants: R. Wade, Moosehorn National Wildlife Refuge
J. Ware, Moosehorn National Wildlife Refuge

Grouse trapping results at Moosehorn, during the summer of 1972, followed the 1971 pattern of an upswing in capture success. The numbers of ruffed grouse captured for the first time (per trap day) for both Refuge Units was: 1968 = .0104; 1969 = .0045; 1970 = .0042; 1971 = .0112 and 1972 = .0099. An increase in captures of spruce grouse occurred in 1972 with 3 taken at Edmunds and 5 at Baring.

From 1963 to 1971 only one recovery of a hunter-harvested grouse was reported. In the fall of 1972, at least 3 ruffed grouse were harvested (Table 1).

Table 1. Hunting Recoveries of Grouse Banded on the Moosehorn Refuge

Band No.	Date	Age at Banding (Weeks)	Unit	Date Shot	Distance Moved (Miles)
RG 141	7/11/72	3	Edmunds	11/1/72	4.25
R 115	7/19/71	5	Edmunds	10/17/72	4.0
RG 287	7/20/72	4	Baring	10/18/72	3.0

A fourth banded bird was reported taken but has not been substantiated.

Plans for next quarter: Inactive.

WATERFOWLTechniques for Banding and Color-marking the American Eider and an Analysis of Banding Data

- Objectives: (1) To survey the various techniques employed in capturing, banding, and color-marking eiders in the New England states and eastern provinces of Canada.
- (2) To determine information on the population dynamics, migration, and distribution of the American Eider (Somateria mollissima dresseri) through the analysis of banding data.

Assignment: J. S. Wakeley, Graduate Assistant

Thesis Committee: H. L. Mendall, Chairman
M. W. Coulter
R. W. Hatch, Associate Professor of Zoology

Consultant: W. B. Krohn, Biologist, U.S. Bureau of Sport Fisheries and Wildlife

This is the initial report on a project which was begun last June with a study of eider marking methods carried out on the Penobscot Bay study area (see previous Unit Quarterly Reports). Graduate students Sarbello and Wakeley cooperated on the field work, with frequent assistance from Richens. Sixteen female eiders were paint-marked and another 4 were equipped with nasal saddles. Nine of the painted birds were observed a total of 16 times; three birds with nasal saddles were observed six times. In July, Wakeley and Sarbello participated in eider night-lighting operations in outer Penobscot Bay.

An analysis of American eider banding data was begun in October. All records of eider bandings in the Atlantic Flyway through August 1971 and recoveries through April 1972 have been received from the Bird Banding Laboratory. The analysis has been planned and organized with the assistance of Krohn.

The majority of the data originates from five major banding areas: Maine (Penobscot Bay), Quebec (St. Lawrence River), New Brunswick (Kent Island), Nova Scotia, and Massachusetts. All are summer bandings except the latter which are winter bandings. The sex and age composition of the bandings is shown in Table 1. The sample is heavily biased toward adult females due to the selectivity of the capture methods used on the breeding areas. The relatively large number of hatching-year birds banded in Maine is the result of night-lighting operations begun in 1970 by U.S. Game Management Agent William Snow.

Table 1. Age and Sex of Banded Eiders from the Five Major Banding Areas, through August 1971.

Banding Area	After Hatching Year			Hatching Year			Total
	Females	Males	Unknown	Females	Males	Unknown	
Maine	635	3	0	280	223	4	1145
Quebec	1046	6	1	7	5	19	1084
Nova Scotia	96	19	0	2	6	0	123
New Brunswick	37	0	0	0	0	8	45
Massachusetts	177	50	0	31	21	0	279
Total	1991	78	1	320	255	31	2676

The sample of recoveries and returns from eider bandings is quite small, which may reduce the amount of information that can be determined from the data. Only 428 records are contained in the file. Of these, 117 (27.3%) are hunting season recoveries and 201 (46.9%) are returns of live birds to the place of banding. The remaining 110 records include deaths due to disease, predation, oil spills, and other miscellaneous causes, as well as live returns to areas other than the place of banding.

A preliminary examination of the distribution of recoveries of eiders from the two major banding areas suggests that the majority of Quebec birds (adult females) make a 1400 mile migration down the St. Lawrence River and around the Atlantic Provinces to wintering areas in coastal Maine and Massachusetts. Adult females from the Maine banding area winter along the Maine and Massachusetts coasts; while hatching year birds exhibit a more scattered and irregular migrational pattern, some wintering in Maine and Massachusetts (7 recoveries) and some off the southern tip of Nova Scotia (5 recoveries).

Plans for next quarter: Analysis of banding data will continue. A literature search for eider capture and marking information will begin.

OTHER PROJECTS

Incidence of Nematodes in Aquatic Snails from Central Maine

Assignment: M. R. Mowatt, Graduate Assistant

Thesis Committee: M.W. Coulter, Chairman
M. C. Meyer, Professor of Zoology
R. B. Owen, Jr.

Mowatt completed all requirements for an M.S. degree during the quarter. A summary of his thesis follows:

In the summer and early fall of 1971 a group of aquatic gastropods from central Maine was examined for larvae of the meningeal worm (Parelaphostrongylus tenuis). Aquatic snails were considered possible intermediate hosts for this neurotropic nematode, an important pathogen of moose. A secondary objective was to document the distribution and abundance of aquatic snails in central Maine.

Between July 11 and September 16, 1971, aquatic snails were sampled in seven areas. Five bi-weekly collections from 80 sites yielded 4023 specimens representing 18 species and seven families. The number taken per collection period rose uniformly from 496 on the first collection to 1233 on the fifth collection. This increase may have been the result of natural reproduction by one or two species.

Gastropod numbers were lowest in Baxter Park. Ten collection stations in two ponds yielded no snails while only Helisoma anceps and Physa sp., were represented at ten stream stations. The Piscataquis River, near Milo, supported the largest and most diverse gastropod population. Five stations there yielded over 2000 individuals representing 10 species.

Amnicola limosa was widespread and common on all areas except those in Baxter Park. Physa gyrina, P. ancillaria, Campeloma decisum, Valvata tricarinata, and Helisoma anceps accounted for 2012 snails. These species had local distributions but when present, existed in large numbers. The remaining 12 species were uncommon to rare and collectively yielded only 124 individuals.

All gastropods were digested in a mild acid-pepsin solution and 121 nematodes (five living, 116 dead) were recovered. None of the living nematodes were P. tenuis while a few of the dead were larval Rhabditis spp. None of the dead nematodes should have been P. tenuis for parasitic nematodes are resistant to the digestive fluid. Other parasites isolated by the digestive process included several unidentified trematode cercaria and three leeches (Helobdella sp.).

If P. tenuis does occur in aquatic snails in central Maine it appears to be a rare phenomenon. It should be noted, however, that no snails were collected before July 10. Therefore, the period of highest infection may have been missed. Further investigations in this region should be considered with particular emphasis on examination of snails collected in spring and early summer.

The Ecology and Population Dynamics of the Crayfish Cambarus b. bartonii in Northern Maine

- Objectives: (1) To determine the habitats occupied by and the life history of C. b. bartonii in northern Maine.
 (2) To investigate the role of C. b. bartonii as consumer, prey, host, and competitor.
 (3) To determine and compare the population dynamics and productivity of this species in four streams.
 (4) To investigate the possible effects DDT spraying has had upon these populations.

Assignment: W. F. Reid, Jr., Graduate Assistant

Thesis Committee: J. B. Dimond, Professor, Entomology, Chairman
 R. B. Owen, Jr.
 W. L. Soule, Jr., Assistant Professor, Mathematics
 R. B. Davis, Associate Professor, Botany & Geological Sciences
 R. W. Gregory, Assistant Professor, Zoology
 M. D. Ashley, Assistant Professor, Forest Resources

Field work was completed with sampling under winter conditions. Activity and growth of crayfish held in environmental chambers will be observed this spring.

Plans for next quarter: Surber samples, collected last summer, and crayfish stomachs will be examined.

CURRENT PROJECTS NOT REPORTED THIS QUARTER

Mobility of Deer in Three Western Maine Winter Yards - R. D. Hugie
 Waterfowl Distribution and Breeding Ecology - H. L. Mendall
 Distribution of Eider Populations in Coastal Maine - H. L. Mendall and
 W. D. Snow
 Ecology and Behavior of the Fisher - M. W. Coulter
 Breeding Season Studies of Male American Woodcock - S. D. Schemnitz
 The Effects of DDT on Robin Reproduction in Northern Maine Forests - D. M.
 Knupp
 Environmental Studies on the Lower Penobscot River - J. F. Moroney
 Importance of Snow Support in the Welfare and Survival of Wintering Deer
 in Maine - V. B. Richens
 A Comparison of Field and Classroom Methods in the Teaching of Ecology to
 Prospective Elementary School Teachers - B. W. McKean Capen
 Effects of DDT on Red-backed Salamanders in Northern Maine - C. F. Banasiak
 Annual Production and Factors Influencing Nesting Success of the American
 Eider - H. L. Mendall
 Renesting of the American Eider in Penobscot Bay Colonies - W. Sarbello
 Influences of Deer Upon Forest Vegetation - S. D. Schemnitz
 Woodcock Nocturnal Habitat Utilization in Relation to Sex, Age, and Molt -
 R. B. Owen

COOPERATION, EDUCATIONAL WORK AND MISCELLANEOUS ACTIVITIES

Dr. Carlton Herman, Memorial University, St. Johns, Newfoundland, visited with the Wildlife Staff on December 1. Dr. Herman is former Chief of the Disease Laboratory at Patuxent Wildlife Research Center.

Coulter, Schemnitz and Graduate Assistant Kienzler attended the annual Board of Directors Meeting, Walters Ecological Experiment Station, at Palermo, Maine to discuss research progress and future plans.

Mendall attended the Northeast Regional Remote Sensing Symposium at Orono on October 6 and gave a talk on the use of color infra-red photography in aerial censusing of eider ducks. On December 20 he participated in the winter meeting of the Maine Waterfowl Advisory Council in Augusta.

Coulter participated in a meeting of the External Advisory Committee to the undergraduate forest-wildlife program at the University of New Brunswick in Fredericton, N. B. on October 17-18.

Dr. Kayll of the University of New Brunswick presented an illustrated lecture on Heathland Fire Ecology in Scotland on December 8 to staff and graduate students of the School of Forest Resources.

Graduate Assistant Mowatt attended the annual meeting of the Atlantic Chapter of the Canadian Society of Wildlife and Fisheries Biologists at Brudnell Resort, Prince Edward Island October 23-25. He presented a paper entitled, "Incidence of Nematodes in Gastropods from Central Maine."

Owen was requested to serve on the President's Council of Priorities to establish a Mission and Goals statement for the University of Maine at Orono. He is also serving as Chairman of the Woodcock Planning Committee to provide information for a National Plan for Shore and Upland Migratory Game Birds.

Richens appeared on WDEA ETV, Maine Views and Comments, on November 17, and on the Bud Leavitt Sportscast WEMT TV on December 21 and 31, for questions and comments on Maine coyotes. On December 11 he gave an illustrated lecture on coyotes to the Student Chapter of The Wildlife Society at the University of Maine at Orono.

PERSONNEL CHANGES

Graduate student J. B. Barnes transferred to the program of Natural Resources Management, College of Life Sciences and Agriculture in October.

Graduate Assistant Reid is now Environmental Specialist for the Maine Department of Transportation. He is continuing work on his thesis project as a part-time student.

Graduate student McKean married former graduate assistant David Capen. They are now living in Logan, Utah where Dave is attending Utah State University working toward a Ph.D. degree in Wildlife Ecology and Barbara is completing her thesis in absentia.

Graduate student Knupp is now teaching biology at Unity College while completing work for his M.S. degree here.

Graduate Assistant Hugie was appointed Assistant Big Game Project Leader for the Maine Department of Inland Fisheries and Game effective December 18. He is continuing work toward the M.S. degree.

Former graduate student Gleich is now Assistant Research Associate with the C. W. Rice Division of Nuclear Utilities Services Corporation in Pittsburg, Pennsylvania.

PUBLICATIONS AND THESES

- Dilworth, T. G., J. A. Keith, P. A. Pearce, and L. M. Reynolds. 1972. DDE and eggshell thickness in New Brunswick woodcock. *J. Wildl. Manag.*, 36(4):1186-1193.
- Herman, C. M., J. Hynson, and S. D. Schemnitz. 1972. Malaria in woodcock and ruffed grouse in Maine. *J. Wildl. Diseases*, 8:318.
- Mowatt, M. R. 1972. Incidence of Nematodes in Aquatic Snails from Central Maine. M.S. Thesis, Univ. of Maine, Orono. Unpubl. 39 pp.
- Reid, W. F. 1972. Utilization of the Crayfish Orconectes limosus as Forage by White Perch (Morone americana) in a Maine Lake. *Trans. Amer. Fish. Soc.*, 101:608-612.
- _____. 1972. The distribution of benthic macrofauna in unpolluted river systems, pp. 11-25. In: R. W. Gregory (ed.), Some natural and man-induced changes in the character of a hypothetical river system from source to estuary. A mini-symposium, Dept. of Zoology, Univ. of Maine, Orono. 73 pp. (mimeo.).
- Zagata, M. D., and A. O. Haugen. 1972. Winter movement and home range of white-tailed deer at Pilot Knob State Park, Iowa. *Proc. Iowa Acad. Sci.*, 79(2):74-78.

March 2, 1973