The American Coot (*Fulica americana*) **on the Hanford Site** **Part 1: Nesting Biology**

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R. G. Schreckhise

May 1979

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SUMMARY

The nesting biology of the American coot (Fulica americana) was studied on low-level radioactive waste ponds located on the Hanford DOE Site and on control ponds located in the Columbia National Wildlife Refuge in southeastern Washington from 1974 through 1976. The objective was to discover any differences in the nesting biology of the birds which could be attributed to the low-level radioactive wastes present in the Hanford DOE Site ponds.

Coots nesting on the Hanford ponds and those nesting on the wildlife refuge were found to have similar nesting habits. Nesting habitats were similar for coots from both the control ponds and those exposed to radionuclides; all coots selected habitats in which the water level was moderate to shallow, and stable. Emergent aquatic plants such as cattail (Typha latifolia) and bulrush (Scirpus acutus) were characteristic of both habitats.

There were no apparent differences in nesting chronology between birds from the different study sites; nests containing eggs were found from April through mid-June on most ponds. Clutch size showed no significant differences. The average number of eggs per nest for all ponds was 6.7. Egg and chick weights and percent hatching success were similar among coots from both study sites. Feeding habits of the coots from the two sites did show some differences. However, this is probably related to the availability of food items in each pond.

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THE AMERICAN COOT (Fulica americana)
ON THE HANFORD SITE, PT. 1: NESTING BIOLOGY

INTRODUCTION

From 1974 through 1976 the breeding biology of the American coot (Fulica americana) was studied. Five ponds of similar vegetational succession stages and water depth were selected for the investigation. These were Gable Mountain Pond, U Pond and B Pond on the U.S. DOE Hanford Site, and Royal Slough and Morgan Lake within the Columbia National Wildlife Refuge located near Othello, Washington. Gable Mountain, U and B Ponds differed from the other two study ponds, having received small amounts of radionuclides and other contaminants introduced along with process water from nuclear fuel reprocessing facilities. The radionuclides were found to be primarily associated with bottom sediments (U.S. ERDA, 1975).

The objective of this study was to discover any observable differences in the nesting biology of coots residing on the contaminated ponds on the Hanford Site and those nesting on the ponds on the Columbia National Wildlife Refuge. The biological parameters examined were diet, nesting habitat and nest site selection, duration of egg laying and incubation, clutch size, egg and chick weight, and overall nesting success (productivity). This study was conducted simultaneously with an investigation which examined the levels of radionuclides in coots on the Hanford Site and their potential for transporting radiocontaminants through food chains to man.

STUDY AREAS

Gable Mountain Pond (Fig. 1) occupies about 28 ha of the Hanford Site and has been a permanent part of the landscape since its creation in 1957. Its average depth is 1.6 m. Water loss occurs through percolation and evaporation. The surrounding undeveloped land supports sagebrush (Artemisia tridentata) and a herbaceous understory comprised mostly of cheatgrass (Bromus tectorum) and Sandberg bluegrass (Poa sandbergii) (Cline et al., 1977). Shallow portions of the pond support dense stands of cattail (Typha latifolia) and bulrush (Scirpus acutus). Pondweeds (Potamogeton spp.) are the abundant aquatic plants. Insects and other invertebrate animals are also abundant.

B Pond, located outside the 200E Area of the Hanford Site, covers approximately 19 ha. Its average depth is 3 m. The shoreline, which was reduced in 1971, was sprayed with herbicides in 1971 and again in 1972. Most of the terrestrial vegetation consists of Russian thistle (Salsola kali) and cheatgrass. Only a small portion of the shoreline is vegetated. A few willows (Salix amygdaloides) less than 2 m high occupy one end. The small patches of emergent vegetation consist of bulrush and cattail.

FIGURE 1. Gable Mountain Pond on the Hanford Site. Cattails and bulrush provide a good nesting habitat for the American coot.

U Pond (200W Area) covers about 9 ha and averages 1.5 m in depth. It is successional more advanced than any of the other ponds studied. There is a stand of large (6 to 10 m tall) cottonwoods (Populus sp.) and a dense understory of willows in many places (Fig. 2). The prominent emergent vegetation consists of cattail, bulrush and sedges (Carex spp.). Floating duckweed (Lemna minor) and submerged pondweeds are prevalent. The advanced stage of plant succession at this pond provides cover and food for a variety of animal life. Aquatic snails, dragonflies, damselflies and midges are particularly abundant invertebrates. The vegetation at U Pond was sprayed with herbicides in July of 1972, which had a major impact on trees but had little effect on emergent and submergent aquatic vegetation. See Fitzner and Rickard (1975) for a cross-section diagram of each of the above mentioned ponds.

FIGURE 2. U Pond on the U.S. DOE Hanford Site. Willows dominate the shoreline and emergent aquatic vegetation is sparse. Few American coots nest here.

The Morgan Lake study site (Fig. 3) consists of two small lakes (Halfmoon and Morgan) which are connected by a channel. The two lakes are 13 and 6 ha in size, respectively, and both have average depths of 5 m. In several areas basalt rock outcroppings and cliffs eliminate any shoreline and associated

FIGURE 3. Halfmoon and Morgan Lakes, Columbia National Wildlife Refuge. This is an ideal habitat for American coot nesting.

emergent vegetation. On the gentler slopes of this terrain, the surrounding land supports sagebrush and an understory of cheatgrass and Sandberg bluegrass. Shallow water areas are dominated by stands of cattail and bulrush. Deeper water harbors aquatic vegetation consisting mostly of submergent pondweeds.

The Royal Slough area (Fig. 4) is about 24 ha in surface area and has an average depth of 1 m. Bulrush forms island-like patches throughout the marsh. Pondweeds are the principal aquatic plants. The surrounding dry lands are dominated by sagebrush, cheatgrass and Sandberg bluegrass.

FIGURE 4. Royal Slough, Columbia National Wildlife Refuge. This and many of the marsh units of the Columbia Refuge provide the ideal combination of open water and emergent aquatic vegetation for American coot nesting.

MATERIALS AND METHODS

The nesting biology of the American coot was studied primarily on Gable Mountain Pond, Morgan Lake and Royal Slough during the spring of 1976 by observation of individual nests. Nests were discovered by systematic searching while canoeing and wading. Data were recorded concerning the number of eggs and young present, weight of eggs and young, nest location, cover type, and nest fate (successful, deserted, destroyed). Eggs were counted in each nest during each visit and the date of initiation of laying was estimated through backdating by allowing one egg per day (Sooter, 1941; Gullion, 1954). Nests were marked with individually numbered pieces of orange plastic flagging tape tied to cattails or bulrushes near each nest.

Coots were collected monthly (by shooting) in 1975 and 1976. The proventriculus and gizzard contents were saved for food habit analysis. Few food items were present in the proventriculi, but most gizzard samples did contain food fragments. The gizzard contents were separated into food and grit. Food fragments were washed from the gut with distilled water. Two slides from each sample were then prepared with Hoyer's solution (Hansen and Flinders, 1969) and dried for approximately 72 hr at 60°C. Plant fragments were identified by microscopic examination of gizzard contents on the basis of structural modification in epidermal cells when compared to reference material prepared from plant specimens collected in the study areas. Twenty microscope fields were examined on each slide and all recognizable fragments recorded. Frequency of occurrence was determined by dividing the number of microscope views in which a given species occurred by the total number of views x 100 (Curtis and McIntosh, 1950). This frequency value for a given species was divided by the total of the frequency values for all species and expressed as percent frequency.

During the winters of 1975 and 1976, an attempt was made to capture and band coots residing on Gable Mountain Pond. Nightlighting, mist-netting and clover-leaf trapping were tried. Only nine birds were captured and banded.

THE BIOLOGY OF THE AMERICAN COOT

PLUMAGE AND VOICE OF THE AMERICAN COOT

The American coot is the only member of the genus Fulica commonly found in North America. The adult's body plumage is grey, and the head and neck black. The white bill has a red-brown fleck near the tip of each mandible. The frontal shield is brown. Toes are lobed (Fig. 5) and feet and legs greenish. On older birds, the tarsus is yellow-lime to scarlet-orange.

FIGURE 5. American Coot Showing Frontal Shield and Scalloped Toes.

Bent (1926, pp. 361-362) describes the newly hatched young as follows:

The downy young coot is a grotesque but showy little chick; a black ball of down with fiery red head. The almost bald crown is but thinly covered with hairlike black down; the upper parts are thickly covered with glossy black, long, coarse down, mixed with long, hairlike filaments, which vary in color from "orange chrome" on the neck and wings to "light orange-yellow" on the back; the lores, chin, and throat are covered with short, stiff, curly hairs, varying

in color from "flame scarlet" to "orange chrome"; the bill is "flame scarlet," with a black tip; the underparts are thickly covered with dense furlike down, very dark grey to almost black, with whitish tips (Figs. 6 and 7).

FIGURE 6. Newly Hatched American Coot, Less than 2 Hr Out of the Shell.

After 3 or 4 weeks young coots show the first light grey feathers on their breasts. The dark sooty grey down and orange hairs still persist, and the feathery plumage is not complete until the birds are about 2 months or older. The wing feathers begin to grow when the birds are 5 to 7 weeks old (Sooter, 1941).

Bent (1926, p. 362) describes the full juvenile plumage as follows:

In the full juvenile plumage the upper parts vary from "hair brown" to "chaetura drab" more brownish on the back; the chin, throat and neck are "deep natural grey" mottled with greyish white; and the under parts are mottled with neutral greys and whitish.

FIGURE 7. Young American Coot, Approximately 8-10 Days Old.

The sexes of both young and adult are indistinguishable. However, during the breeding season, adult females often have a conspicuous yellow margin around the leading edge of the frontal shield. The young gradually change to the darker adult plumage during late summer, fall and winter. Traces of juvenile markings persist after the first post-nuptial molt. Until the first molt the young birds can be discerned by their darker bill, lack of distinct frontal shield, lighter colored underparts, chin, throat and belly (Sooter, 1941).

Coots produce a variety of guttural sounding calls described as "puhlk," "poonk," "kuh-kuh-kuk," "cack-ka," "puhk-uh," "cou-ah," and "punk-cow-ah." The female voice is more nasal than the male's and is also lower pitched (Gullion, 1950).

MIGRATION

Fredrickson et al. (1977, p. 125) state, "Coots migrate in a broad front across North America, but concentrations occur in staging areas." Coots are nocturnal migrants and are seldom seen flying during daylight hours. For some unexplained reason, the females migrate farther south than males. Brisbin et al. (1973) found more males than females wintering in South Carolina, but once spring arrived, the ratio changed in favor of females.

In Washington, southerly migrations probably begin in September and reach a climax in November. This undoubtedly varies from year to year depending on the severity of weather and the availability of open water. Fitzner and Rickard (1975) generally found fewer coots inhabiting Hanford waste ponds during late winter (January and February) and during summer months (late May through early August) than at any other times (Fig. 8). Their data also indicated that northerly migrations began in March and their frequency plateaued in April. By late April coots settled into wetland habitats in eastern Washington and generally had begun to nest. The large seasonal variations in numbers indicated that the coot population on the Hanford Site ponds was not static. Some birds, no doubt, passed through the area while on migration, and others overwintered and/or nested on the ponds.

FIGURE 8. Seasonal Abundance of American Coots on the Hanford DOE Site (From Fitzner and Rickard, 1975).

The limited amount of banding conducted on the waste ponds did not yield a detailed description of the dynamics of the coot population. We do not yet know if birds nesting on the ponds also overwinter on them. No data exist revealing whether or not juveniles raised on the ponds return to them to nest in subsequent years. Further study is needed to answer these questions.

NESTING

Nesting Habitat and Nest Site Selection

All of the ponds examined in this phase of the study had a stable water level of moderate to shallow depth, and emergent plant communities of cattail

and/or bulrush. All of these features appear to be important for coot nesting. Cattails and bulrushes serve as the nesting and rearing cover. Bent (1926, p. 360) says of nesting:

The nests are usually partially or well concealed in the bulrushes or flags about the borders of sloughs or marshy ponds; sometimes the nests are in plain sight near the edge; or in an isolated clump; occasionally one is seen in an entirely open situation with no concealment whatever. The nest is usually a floating structure; under which one could pass the hand without obstruction; but it is generally firmly attached to growing reeds or flags to prevent drifting. Whatever material is most readily available, bulrushes, flags, reeds or grass, is used and firmly woven into a substantial basket; the inner cavity, which is hollowed just enough to hold the eggs, is neatly lined with pieces of dry flags and other smooth material. An average nest, well concealed in a thick clump containing 10 eggs, measured 14 in. in outside and 7 in. in inside diameter, the rim being 8 in. above the water. A layer nest in more open situation containing 15 eggs, measured 18 in. outside and 7 in. inside but the rim was only about 4 in. above the water. The largest nest ever measured contained only 9 eggs but it was 20 by 15 in. outside diameter and built up 7 in. above the water. These are normal types.

Figures 9, 10, 11, 12 and 13 show typical nests observed in this study. The nests in Figures 9, 10 and 11 were constructed in bulrush habitat. Those in Figures 12 and 13 were located in cattail stands. Fifty (76%) of the study nests were situated in bulrush stands and 16 (24%) in cattail habitat. Table 1 provides a breakdown by pond of vegetation composition and use of vegetation types for nesting.

Egg Laying and Incubation

Nests containing eggs were observed from mid April through mid-June 1976. The first nest of the season was found on Gable Mountain Pond. It contained one egg on April 12 and seven eggs when next examined on May 1. These eggs hatched on May 12 and 13. Most coots on all ponds finished laying eggs on or around May 10. However, nests with new eggs were observed as late as June 20. These late nests may represent renestings.

Gullion (1954) reported that the American coot lays one egg each day until the clutch is complete. In nests observed in this study, this appeared to be the case. He found that incubation of early season clutches may start with the second egg or not until the clutch is complete. By carefully observing several pairs of nesting coots, Gullion determined that the incubation period ranged from 23 to 25 days. Data gathered during this study support his findings.

FIGURE 9. A Well-Concealed Nest in Bulrush Habitat.
Note entrance leading to nest.

Clutch Size

During the course of this study, 66 coot nests were examined. Data from 41 nests were used to calculate the mean clutch sizes. Eleven of these were from Gable Mountain Pond, 13 from Morgan Lake, and 17 from Royal Slough. The mean clutch size for all 41 nests was 6.71 ± 0.49 .¹ On Gable Mountain Pond the clutch size was 6.45 ± 0.55 . Morgan Lake clutches and Royal Slough clutches had mean sizes of 6.08 ± 0.97 and 7.35 ± 0.84 , respectively. We compared clutch sizes from Gable Mountain Pond, Morgan Lake, and Royal Slough using an ANOVA test and found no significant differences ($\alpha=0.05$).

¹ Numbers following $\pm$ represent standard error.

FIGURE 10. American Coot Nest in Bulrush Habitat, Gable Mountain Pond, Hanford Site.

FIGURE 11. American Coot Nest in a Stand of Bulrush, Gable Mountain Pond, Hanford Site.

FIGURE 12. Newly Hatched American Coot in a Nest Constructed of Cattail; Gable Mountain Pond, Hanford Site.

Clutch size data collected on the American coot from several different geographical areas in North America are presented in Table 2. Clutch sizes of the American coot in southeastern Washington (this study) appear to be smaller than those reported in other studies conducted in the United States. The reasons for this are presently unclear. It is probable, however, that our sample size of 41 clutches is not large enough for comparison purposes. Differences may also be due simply to population variation in different geographical areas. Also, clutch sizes reported in this study may not represent the actual (maximum) clutch size. Daily observations of nests were not possible and eggs which were destroyed or lost between surveys could not be used in computing clutch size. The mean clutch sizes reported in this study therefore represent the "minimum" clutch size as influenced by natural egg losses during laying.

The frequency distribution of clutch size in nests studied on Gable Mountain Pond, Morgan Lake and Royal Slough are presented in Table 3. These data revealed that clutches of six to ten eggs are most common. Sixty-six percent of all clutches fell within this range. Clutches of six eggs occurred most often (22%), but clutches of eight were nearly as common (20%). In examining ponds separately, 73% of the clutches at Gable Mountain Pond fell within the range of six to eight, while 31% and 47% of the clutches at Morgan Lake and Royal Slough respectively fell into this range. The variation in clutch size from Royal Slough and Morgan Lake was, in general, greater than those from Gable Mountain Pond.

FIGURE 13. American Coot Nest Hidden in Cattails Showing Vegetation Canopy Over Nest; Morgan Lake, Columbia National Wildlife Refuge.

TABLE 1. Vegetation Composition of Ponds Indicating Frequency of Use for American Coot Nesting.

Pond Name and Location	Vegetation Composition (approximate frequency of occurrence)	Number of Nests Associated with Each Type Vegetation
Gable Mountain Pond	60% <u>Typha</u>	9 (64%)
	40% <u>Scirpus</u>	5 (36%)
Royal Slough	100% <u>Scirpus</u>	24 (100%)
Morgan Lake	40% <u>Typha</u>	7 (25%)
	60% <u>Scirpus</u>	21 (75%)

TABLE 2. Clutch Sizes of the American Coot.

Number	Range	Clutches		Reference
		Mean	Location	
169	5-13	9.9	Manitoba	Kiel, 1955
104	1-11	6.08	Iowa	Sooter, 1941
347	4-18	7.92	Iowa	Sooter, 1941
281	4-17	9.03	Iowa	Fredrickson, 1967
8	7-10	9.0	California	Gullion, 1954
5	4-8	6.4	California	Gullion, 1954
11	3-10	6.45	Washington (GM Pond)	Present Study
13	1-11	6.08	Washington (Morgan Lake)	Present Study
17	1-12	7.35	Washington (Royal Slough)	Present Study
41	1-12	6.71	Washington (All Ponds This Study)	Present Study

TABLE 3. Distribution of Clutch Size in the American Coot.

Clutch Size	Gable Mt. Pond	Morgan Lake	Royal Slough	Total
1	0	2	3	5
2		1		1
3	1			1
4		2		2
5	1			1
6	5	2	2	9
7	1	1	1	3
8	2	1	5	8
9		2	1	3
10	1		3	4
11		2		2
12			2	2

Egg and Chick Weight

Thirty eggs from four nests on Gable Mountain Pond were weighed on May 12. They averaged (g wet wt) 31.62 ± 0.51 , and ranged from 27.2 g to 37.0 g. Eggs from three nests at Morgan Lake, weighed on May 22, had mean weights of $30.8 \text{ g} \pm 0.43$, $N=9$ (range 29.0-32.0 g); $31.0 \text{ g} \pm 0.27$, $N=11$ (range 30.0-32.0 g); and $30.0 \text{ g} \pm 0.27$, $N=11$ (range 28.0-31.0 g). The eggs from these same three nests were weighed again on May 29 and had mean weights of $29.6 \text{ g} \pm 0.41$ (range 28-31 g), $29.6 \text{ g} \pm 0.24$ (range 28-31 g) and $28.0 \text{ g} \pm 0.32$ (range 26.0-29.5 g), respectively. These data are similar to those reported by Gullion (1954) in California. Apparently there are no significant differences in egg weights between coots on Gable Mountain Pond and Morgan Lake and the California birds. We have not attempted to compare statistically egg weights between study areas, since variations are expected and can be accounted for as a function of weight loss through incubation time. Ranges in egg weights do, however, show that there are no gross differences in egg weights between two of the study areas.

Five pipping eggs from Gable Mountain Pond had a mean weight of $26.6 \text{ g} \pm 0.70$. Two pipped eggs from Morgan Lake had a mean weight of $27.0 \text{ g} \pm 0.00$ while three from Royal Slough weighed $24.2 \text{ g} \pm 0.88$. Gullion (1954) provided similar data. Five young coots from Morgan Lake were weighed immediately after hatching and the mean of their weights was $19.7 \text{ g} \pm 0.44$. One newly hatched coot from Gable Mountain Pond weighed 21.3 g. Gullion (1954) weighed a newly hatched chick and reported its weight as 22.4 g.

Hatching

The first hatching we observed in the study areas occurred on Gable Mountain Pond on May 12 and 13. The peak period for hatching on all ponds was approximately June 8. A small number of eggs hatched after June 20.

During this study, 66 nests were examined for hatching success (Table 4). Nests which hatched at least one young were recorded as successful. Unsuccessful nests were those destroyed by predators or weather. Only four infertile eggs and no dead embryos were found. Three infertile eggs were found in a clutch of six eggs and one was found in a clutch of eight eggs, both from Royal Slough. Successful nests, therefore, usually hatched all eggs. Unsuccessful nests were largely the result of predator destruction of an entire clutch.

Mortality of Young

By combining observed nests and birds performing annoyance displays (Sooter, 1941), we estimated that 20 broods were produced on Gable Mountain Pond and that, on the average, each brood contained 6.45 eggs. Therefore at least 128 could have hatched on this pond.

TABLE 4. Percentage of Successful American Coot Nests.
Data derived from present study and from other
nesting studies in North America.

Number	Nests		Location	Reference
		% Success		
104		91	Iowa	Sooter, 1941
347		77	Iowa	Sooter, 1941
380		97	Manitoba	Kiel, 1955
161		86	Iowa	Fredrickson, 1967
66		92	Washington	Present Study
14		100	G. M. Pond	Present Study
28 (3) ¹		89	Morgan Lake	Present Study
24 (2)		92	Royal Slough	Present Study

¹ Numbers in parentheses represent number of unsuccessful nests.

Mortality, however, may substantially reduce this figure. Sooter (1945) found that while a successful clutch averaged 8.2 eggs, only an average of 2.5 of these would grow to adulthood. Since 77% of the entire season's nests were successful in Sooter's study, 1.9 (approximately two) birds per nesting pair could be expected to reach adulthood.

FOOD HABITS OF THE AMERICAN COOT

The stomach contents (gizzards) of 143 coots (95 adults and 48 juveniles) were analyzed. Eighty-nine coots were collected from Gable Mountain Pond, 15 from Morgan Lake and Royal Slough collectively, 25 from B Pond, and 14 from U Pond.

Vegetable material was the most frequent item found in the coot stomachs examined (Table 5). It made up 79% of the food eaten by the juveniles and 89% of the food eaten by the adults (Table 6). The most common plants eaten were pondweeds, water milfoil (*Myriophyllum* sp.) and filamentous algae (*Thallophyta* sp.).

Animal materials made up 21% of the food eaten by juveniles. The major portion of this food consisted of insects (Odonata, Diptera, Coleoptera and Hemiptera). All age classes of juvenile coots, from 1 to 120 days of age,

TABLE 5. Food Habits of the American Coot, All Study Areas Combined. Dietary analysis was from gizzard contents only.

Plants	% Frequency $\pm$ S.E. N=43
Thallophyta	
Algae	
Filamentous algae	21.2 $\pm$ 0.02
<u>Chara</u> sp. (muskgrass)	3.7 $\pm$ 0.01
Spermatophyta	
Najadaceae	
<u>Potamogeton</u> sp. (pondweed)	21.2 $\pm$ 0.02
<u>Potamogeton pectinatus</u> (sago pondweed)	17.2 $\pm$ 0.03
Cyperaceae	
<u>Scirpus</u> sp. (bulrush)	0.3 $\pm$ 0.01
Lemnaceae	
<u>Lemna</u> sp. (duckweed)	0.5 $\pm$ 0.02
Typhaceae	
<u>Typha latifolia</u> (cattail)	0.5 $\pm$ 0.02
Ranunculaceae	
<u>Ranunculus aquatilis</u> (white water crowfoot)	2.1 $\pm$ 0.05
Haloragidaceae	
<u>Myriophyllum</u> sp. (water milfoil)	17.2 $\pm$ 0.02
Animals	
Invertebrates	13.6 $\pm$ 0.02
Undetermined	
Vegetation	2.5 $\pm$ 0.02

TABLE 6. Food Habits of Adult and Juvenile Coots,
All Study Areas Combined. Dietary analysis
was from gizzard contents only.

Plants	% Frequency + S.E. Juvenile Diet *N=48	% Frequency + S.E. Adult Diet N=95
Thallophyta		
Algae		
Filamentous algae	18.2 + 0.03	22.5 + 0.02
<u>Chara</u> sp. (muskgrass)	1.6 + 0.01	4.5 + 0.02
Spermatophyta		
Najadaceae		
<u>Potamogeton</u> sp. (pondweed)	22.5 + 0.03	21.2 + 0.02
<u>Potamogeton pectinatus</u> (sago pondweed)	19.5 + 0.04	16.7 + 0.03
Cyperaceae		
<u>Scirpus</u> sp. (bulrush)	0.2 + 0.01	0.4 + 0.01
Lemnaceae		
<u>Lemna</u> sp. (duckweed)	0.5 + 0.04	0.5 + 0.02
Typhaceae		
<u>Typha latifolia</u> (cattail)	0.6 + 0.03	0.5 + 0.02
Ranunculaceae		
<u>Ranunculus aquatilis</u> (white water crowfoot)	0.2 + 0.02	2.9 + 0.02
Haloragidaceae		
<u>Myriophyllum</u> sp. (water milfoil)	14.0 + 0.04	17.0 + 0.02
Animals		
Invertebrates	20.5 + 0.05	11.1 + 0.16
Undetermined		
Vegetation	2.2 + 0.01	2.7 + 0.02

* All juvenile coots collected on Hanford DOE Site waste ponds.

were pooled in our dietary analyses and hence our values probably underestimate the true importance of invertebrates to young birds (1 to 30 days old). Sooter (1941, p. 91) states that "animal food material was evidently of more importance with the youngest coots for older juveniles and adults had eaten only a small percent of this type of food." The diet of the 95 adult coots we examined contained only 11% animal matter.

No vertebrate remains were found in any of the coot stomachs we examined; however, adult coots have been observed feeding on goldfish at Gable Mountain Pond. Still, in view of our food habit analyses of the 143 coots and the general feeding habits of the species, it appears unlikely that coots consume many fish.

Hanson and Browning (1957) did not find pondweeds in their dietary analysis of coots inhabiting waste ponds on the Hanford Site (Table 7). This was undoubtedly due to the scarcity of these plants in the ponds at that time. In the late 1950's, Gable Mountain, U, B and Redox II ponds were relatively new and pondweeds had not yet become established. At that time, other plant species such as smartweed (*Polygonum* spp.), bulrush, and wild millet (*Echinochloa* sp.) were present and served the same function as pondweeds in the diet of the coot. Today, U, B and Gable Mountain Ponds are more successional advanced than they were in the 1950's and the vegetation is therefore different. Table 8 lists the foods consumed by coots on the three waste ponds on the Hanford Site and the two on the Columbia Wildlife Refuge. All of these ponds, with the exception of B, are over 18 years old. The principal difference to note in comparing these ponds is the small amount of algae present in the diet of coots from the Columbia Wildlife Refuge. This may be related to a nutrient difference between ponds. All of the ponds on the Hanford Site are closed systems with no outflow, while the ponds of the Columbia Wildlife Refuge have in- and outflows. There is probably more algae available in the nutrient-rich closed systems for the coots to consume. Since coots are fairly opportunistic in their selection of foods (Sooter, 1941) one can assume that they would eat food in proportion to its availability. Hence coots feeding at ponds with the highest algae supply would show the highest amount of algae in their diets.

Our food habit analyses confirm the findings of Sooter (1941), Jones (1940), Hanson and Browning (1957), and Eley and Harris (1976), which reported coots to be primarily vegetarian feeders. Both Sooter (1941) and Jones (1940) also noted that animal foods were more important to juvenile coots than adults. This is probably related to the protein requirements of the rapidly growing birds.

THE AMERICAN COOT AS A GAME SPECIES

Coots were the sixth most commonly harvested waterfowl in the Pacific Flyway during the combined 1972-73 hunting seasons, comprising 1.3% of the

TABLE 7. Major Food Items in Stomachs of Wildfowl Frequenting Waste Ponds (From Hanson and Browning, 1957).

Food Items	Percentage of Total Volume Eaten by Specimen Types		
	Diving Ducks	River Ducks	Coots
Immature insects	12	--	1
Adult insects	31	6	1
Algae	--	10	15
Pondweed	10	--	--
Smartweed	7	27	7
Bulrush	11	26	21
Wild millet	1	4	11
Sandbur	--	2	6
Miscellaneous vegetation	31	26	37

TABLE 8. Food Items from Gizzards of Coots at All Study Sites.

Plants	Study Areas			
	Gable Mountain Pond % Frequency + S.E. N=89	U Pond % Frequency + S.E. N=14	B Pond % Frequency + S.E. N=25	Morgan Lake and Royal Slough % Frequency + S.E. N=15
Thallophyta				
Algae				
Filamentous algae	22.2 $\pm$ 0.02	22.4 $\pm$ 0.06	25.0 $\pm$ 0.04	7.2 $\pm$ 0.02
Chara sp. (muskgrass)	5.2 $\pm$ 0.02	---	1.8 $\pm$ 0.01	1.5 $\pm$ 0.01
Spermatophyta				
Najadaceae				
Potamogeton sp. (pondweed)	20.1 $\pm$ 0.02	23.3 $\pm$ 0.05	22.4 $\pm$ 0.03	21.1 $\pm$ 0.04
Potamogeton pectinatus (sago pondweed)	13.2 $\pm$ 0.02	26.1 $\pm$ 0.05	14.3 $\pm$ 0.03	27.8 $\pm$ 0.18
Cyperaceae				
Scirpus sp. (bulrush)	2.1 $\pm$ 0.01	0.1 $\pm$ 0.01	0.01 $\pm$ 0.01	0.01 $\pm$ 0.01
Lemnaceae				
Lemna sp. (duckweed)	0.3 $\pm$ 0.01	2.2 $\pm$ 0.01	---	3.01 $\pm$ 0.01
Typhaceae				
Typha latifolia (cattail)	0.5 $\pm$ 0.01	---	---	---
Ranunculaceae				
Ranunculus aquatilis (white water crowfoot)	3.1 $\pm$ 0.01	2.0 $\pm$ 0.01	---	---
Haloragidaceae				
Myriophyllum sp. (water milfoil)	18.6 $\pm$ 0.02	7.2 $\pm$ 0.03	17.7 $\pm$ 0.03	19.8 $\pm$ 0.04
Animals				
Invertebrates	12.5 $\pm$ 0.02	7.5 $\pm$ 0.02	17.2 $\pm$ 0.03	17.5 $\pm$ 0.05
Undetermined				
Vegetation	2.4 $\pm$ 0.03	1.3 $\pm$ 0.02	1.6 $\pm$ 0.02	2.0 $\pm$ 0.02

total retrieved kill (Table 9). During the 1975 and 1976 hunting seasons, the coot kill in the Pacific Flyway was 189,116 and 142,419 birds, respectively (Sorenson et al., 1977). The estimated harvest in Washington (1971-72) was 20,000 birds (Fredrickson et. al., 1977). Coots were the most abundant waterfowl species observed on the waste ponds by Fitzner and Rickard (1975), comprising 36% of the total waterfowl observed.

TABLE 9. Percentage of Waterfowl Species Harvested in Washington by Hunters During the Combined 1972-1973 Waterfowl Season (taken from Schroeder, Sorensen and Carney, 1974).

<u>Waterfowl</u>	<u>% Composition</u>	<u>Rank</u>
Mallard	54.7	1
American Wigeon	12.5	2
Pintail	9.6	3
Green-winged Teal	9.8	4
Geese ^(a)	6.2	5
Coots	1.3	6
Bufflehead	1.1	7
Shoveler	1.0	8
Goldeneye	1.0	9
Scaup	0.9	10
Ringneck Duck	0.7	11
Gadwall	0.5	12
Hooded Merganser	0.3	13
Other Mergansers	0.3	14
Redhead	0.2	15
Blue-winged Teal	0.2	16

(a) Includes the Canada goose.

Assuming that two young per nest reached adulthood, a minimum of 40 birds could have been produced on Gable Mountain Pond. Nesting success on Gable Mountain Pond was 100%. If these birds leave the Hanford Site, particularly during the fall hunting season, they could be harvested. Should radionuclides be incorporated into the flesh of coots utilizing waste ponds, hunter harvest of these birds provides a potential route to man for radionuclide ingestion. The radioecology of coots on the Hanford Site is discussed in a separate document.

CONCLUSIONS

We could find no observable differences in comparing the food habits, nesting habitats and nest site selection, egg laying and incubation, clutch size, egg and chick weights and hatching success of American coots on the Hanford DOE Site ponds with coots inhabiting ponds of the Columbia National Wildlife Refuge. Apparently the low-level radioactive wastes in the Hanford ponds have had no discernible effect on the nesting biology of coots residing there. Continued observations in conjunction with radiochemical analyses of coot tissues and eggs may help determine if long-lived radionuclides can become more available to coots over time through various types of ecological, biological, and chemical transformations.

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