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Interspecific Correlations of Harvest and Price for Arkansas Furbearers: A Cautionary Note

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As a neophyte instructor in 1964, the author was informed that the mathematical ability of the student was the best indicator of success in chemistry. Studies of the (former) chairman indicated that high school chemistry had little impact on a student's ability to cope with general chemistry. This conclusion was compatible with that mentioned by Schelar, Cluff, and Roth (Schelar, Cluff, and Roth, J. Chem. Ed., 40,No.7:369-370, 1963). However, it is quite probable that our present day students cannot be so categorized.

Starting in 1964, all agriculture students were required to take general chemistry in the chemistry department at Arkansas State University. In the intervening years, the introduction of new majors within the university swelled the growth of the chemistry department disproportionately to the growth of the university. Approximately one third of the students enrolled in general chemistry have had no high school chemistry. Two thirds of this group consists of agriculture or nursing majors. Unfortunately, it has become apparent that the expansion of D, F, and W grades has outstripped the growth of the student population.

"I had to fail Chem I. I did not take chemistry in high school so I had to flunk. Now that I have done this, I will pass this time." That remark, overheard by chance, seems to sum up the attitude of an increasing number of students. This particular student was wrong on both counts, but she believed it — so did her companions.

McQuary, Williams, and Willard (McQuary, Williams, and Willard, J. Chem. Ed., 29,No.9:460-464, 1952) studied the factors that determine student achievement in first year college chemistry. One of their conclusions was that students who have had chemistry in high school are as a group superior to students who have not had high school chemistry. Rowe (Rowe, J. Chem. Ed., 60,No.11:954-956, 1983) points out that chemistry students must assimilate over 6,000 units of information, which is more than is required in the first year study of a foreign language. In addition, word meanings are new in chemistry. The work of Hadley, Scott, and Van Lente (Hadley, Scott, and Van Lente, J. Chem. Ed., 30,No.6:311-313, 1953) led to the observation that students who had high school chemistry, irrespective of other courses, made better records in chemistry than those who did not have high school chemistry.

First semester general chemistry sections were surveyed during the fall terms of 1981, 1982, and 1983. From a total of 789 students, 273 (34.6%) had not taken chemistry in high school. This group accounted for 51% of the D, F, and W grades and only 11.4% of the A and B grades. From another perspective, 196 of 273 students (71.8%) with no high school chemistry received a grade of less than C. From the 516 students who had taken high school chemistry, 188 (36.4%) received a grade of less than C.

A grade of D is passing at ASU. However, it is equivalent to failing for many majors. Prepharmacy students transfer after two years at ASU; a D is non-transferable. BSN nursing majors must have a C average in two chemistry courses and one zoology course. Medical technology majors must have a C average for admission into the final year of that program. Most health science majors will repeat chemistry if their grade is less than C. Therefore, D, F, and W grades were combined for the purpose of this paper.

The data for 1981 indicated that a significant number of students could be helped by some introduction to chemistry prior to their enrollment in the regular college chemistry course. Topics such as the metric system, exponential arithmetic, significant figures, etc., are routinely introduced in the first chapter of many college texts. The student acquainted with these topics from high school chemistry would have an advantage (real or imagined) over a student with no such acquaintance.

A survey of high school chemistry teachers in 1985 (Hammett, Incomplete M.S. Thesis, Arkansas State University) supports this idea. The metric system is taught by 172 respondents and 108 indicated that their students have difficulty with this subject. Likewise, 81 of 164 who teach exponents report deficiencies in this area. Since 83 percent of these teachers rank the bulk of their students in the top 25 percent of their classes, it is not unreasonable to assume that a greater percentage of students with no high school chemistry would have difficulty with these and other math topics covered in the first chapter of most college chemistry texts.

Chemistry 16003, Introduction to Inorganic Chemistry, was offered as a three hour lecture course during the fall term of 1982. The course was a true elective since it would not substitute for the physical science requirement. Advisors were requested to suggest that any student with no high school chemistry consider enrolling in this course, particularly if they were not proficient in algebra. Arrangements were made with the registrar to permit students having difficulty in the regular chemistry course to transfer into CHEM 16003 through the sixth week of school.

CHEM 16003 was initially offered at 10:00 a.m., MWF. The enrollment was small, and only four students managed to drop back into the course. Several others could not do so because of conflicts with other courses. In the fall of 1983 the course was offered at 2:00 p.m., MW. The non-prime time scheduling attracted an initial 22 students. By the end of the fifth week, enrollment had swelled to 42 due to the drop-back option.

Isolated from students with some acquaintance with chemistry, a CHEM 16003 class makes a stark contrast with a regular chemistry class. In general the students are poorly motivated, have bad study habits, are very hesitant in asking questions, and are slow to participate in any type of classroom exercise. With encouragement, some have made excellent efforts to overcome their deficiencies. The metamorphosis of these latter made the program rewarding to the instructors.

The author is under no illusions about the late transfer of (probably) failing students into the introductory course. Only a small fraction give evidence of making a significant effort to succeed.

To date, 47 students have passed CHEM 16003 and enrolled in the regular chemistry course at ASU. Twenty-seven of these subsequently passed. Thirteen of those who failed or withdrew earned only a D in CHEM 16003.

The student response to the introductory course has been positive. Those who have continued into the regular chemistry course have been emphatic in their affirmation of the worth of the course.

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INTERSPECIFIC CORRELATIONS OF HARVEST AND PRICE FOR ARKANSAS FURBEARERS: A CAUTIONARY NOTE

As part of a continuing analysis of Arkansas fur harvest records (Heidt et al., 1984; Heidt et al., 1985; Peck et al., 1985; Clark et al., 1985; and Peck and Heidt, 1985), this study investigated interspecific correlations of season length, harvest, and price as variables for fur harvest analysis of 12 Arkansas fur bearers (coyote - *Canis latrans,* muskrat - *Ondatra zibethicus,* river otter - *Lutra canadensis,* nutria - *Myocastor coypus,* mink - *Mustela vison,* eastern spotted skunk - *Spilogale putorius,* striped skunk - *Mephitis mephitis,* beaver - *Castor canadensis,* opossum - *Didelphis virginiana,* gray fox - *Urocyon cinereoargenteus,* raccoon - *Procyon lotor,* bobcat - *Felis rufus*).

The Arkansas Game and Fish Commission has maintained fur harvest records since 1939; because of the relative completeness and accuracy, records for the past 20 seasons (1965-1984) were used for this study (Peck and Heidt, 1985). Season length and total numbers of each species harvested were available for all years. For 1979-80 only, annual mean pelt values for all species were extrapolated from Missouri values. No correction factors were applied to the data to adjust for out-of-state sales of Arkansas fur or for inflation. The data were analysed using a statistical program (Statpak by Northwest Analytic, Inc.) on an Epson QX-10 microcomputer. Correlation coefficients were tested at the 0.01 and 0.05 levels for significance (Table 25, Rohlf and Sokal, 1981).

The data matrix of correlation coefficients for season, harvest and price correlation coefficients for Arkansas furbearers is presented in Table 1. Table 2 illustrates significance levels for the same matrix. With respect to season length, a significant negative correlation was noted for coyote, otter, gray fox, and bobcat. More animals were harvested even though season length has been shortened (116 days in 1968 to 62 days since 1982). These species demonstrated the highest prices through the 1970's and into the 1980's (Clark et al., 1985). There were no positive significant correlations between season length and harvest of furbearers (in fact, most remaining correlations were negative), indicating that shortened seasons did not constrain the take. In Arkansas, as a single variable in fur harvest dynamics, season length did not appear to be particularly important. In contrast, Erickson (1981) found that there was a significant positive correlation between season length and beaver and muskrat harvest in Missouri. Erickson also stated that season length was the only variable accounting for significant annual variation in Missouri beaver harvests.

In regard to harvest, significant correlations were found among upland long-hair species, wetland short-haired species, as well as, between species of these respective groups (Table 2). One might biologically expect to see hunting/trapping efforts toward target upland or wetland species to influence the take of other ecologically similar species. The strong correlation (Table 1) between all species (upland with wetland) would seem to indicate that the annual variations in Arkansas furbearer harvests are not based on some interspecific biological principle (e.g., beaver/otter commensal relationships [Tumlison et al., 1982]), but instead are probably based on some harvesting/marketing mechanism. Additional support for this view is illustrated by examining 16 and 20 year correlations between spotted and striped skunk and other furbearer species. When the 1981-84 seasons are removed from the calculations, skunk correlations increase with all furbearers (Table 1 and 2). The number of skunk sold in Arkansas has been greatly reduced each year since 1980, probably due to high incidences of rabies and the concommitant caution of trappers (Peck et al., 1985). This demonstrates the importance of non-interspecific biological factors influencing Arkansas fur harvest dynamics.

The most important non-biological factor shown to influence fur harvest is price (Erickson and Sampson, 1978; Erickson, 1981, 1982; Heidt et al., 1984; Clark et al., 1985,; and Peck and Heidt, 1985). Tables 1 and 2 further demonstrate the importance of price in explaining variation in annual fur harvests. Once again, these data demonstrate significant and highly significant positive correlations among upland long-haired species, wetland short-haired species, and most upland and wetland species. It would also appear that as the price of bobcat, raccoon, gray fox, muskrat, and mink have increased, the season length was decreased, resulting in significant negative correlations. It should also be noted that these five species represent, over the past 10 years, Arkansas' most valuable furbearers (Heidt et al., 1985).

Data presented in this study demonstrate that extreme caution must be used when attempting to explain fur harvest dynamics by using interspecific correlations. Further, use of partial data sets (e.g., only using upland long-hair species or wetland short-hair species) may result in faulty conclusions resulting in poor management practices. While price seems to be the factor contributing the greatest impact to fur harvest dynamics, we agree with Erickson (1981) that multivariate analysis may help to identify and weigh multiple variables which may simultaneously be influencing fur harvests.

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Table 1. Season, harvest, and price correlation coefficients for 12 most important Arkansas furbearers. Data reflect 20 harvest seasons (1965-1984) except for SpS and StS where only 16 seasons (1965-1980) were used. Values for harvest are to the top and right in the table; values for price are to the left and lower portion of the table.

	CY	MR	OT	NU	MK	SpS	SpS 16	StS	StS 16	BV	OP	GF	RC	BC	Season
CY	----	.653	.758	.840	.723	.748	.881	.648	.822	.822	.907	.924	.723	.950	-.453
MR	.806	----	.649	.675	.759	.197	.237	.175	.213	.425	.543	.690	.795	.282	.196
OT	.744	.737	----	.761	.751	.304	.694	.168	.653	.666	.620	.697	.829	.793	-.474
NU	.709	.081	.596	----	.811	.437	.636	.371	.605	.830	.728	.802	.475	.792	-.375
MK	.783	.906	.617	.760	----	.427	.702	.372	.742	.834	.762	.812	.506	.747	-.396
SpS	.701	.819	.879	.625	.657	----	----	.911	----	.534	.791	.716	.560	.743	-.222
SpS16	.778	.838	.762	.637	.755	----	----	----	.914	.693	.890	.832	.866	.879	-.394
StS	.770	.845	.462	.610	.390	.857	----	----	----	.432	.736	.670	.475	.646	.021
StS16	.860	.872	.901	.624	.854	----	.863	----	----	.643	.866	.856	.879	.858	-.201
BV	.357	.331	.462	.463	.390	.226	.226	.425	.424	----	.876	.810	.845	.775	-.392
OP	.764	.833	.899	.609	.737	.854	.858	.984	.985	.455	----	.900	.892	.883	.389
GF	.823	.946	.731	.726	.928	.796	.861	.294	.930	.294	.857	----	.892	.956	-.495
RC	.868	.879	.620	.664	.918	.771	.916	.760	.937	.196	.763	.948	----	.064	-.439
BC	.831	.897	.682	.719	.393	.732	.789	.749	.830	.210	.758	.944	.936	----	-.486
S	-.380	-.529	-.201	-.439	-.568	-.310	-.356	-.367	-.437	.157	-.347	-.527	-.311	-.526	----

[1] Species identifications: CY - coyote, MR - muskrat, OT - river otter, NU - nutria, MK - mink, SpS - spotted skunk, StS - eastern striped skunk, BV - beaver, OP - opossum, GF - gray fox, RC - raccoon, BC - bobcat, S - season length.

Table 2. Significance of season length, harvest, and price correlation coefficients for 12 most important Arkansas furbearers. Values for harvest are to the top and right in the table; values for price are to the left and lower portion of the table. Species identification codes are indicated in Table 1.

	CY	MR	OT	NU	MK	SpS	SpS 16	StS	StS 16	BV	OP	GF	RC	BC	Season
CY	—	**	**	**	**	**	**	**	**	**	**	**	**	**	*
MR	**	—	**	**	**	ns	ns	ns	ns	ns	*	**	**	ns	ns
OT	**	**	—	**	**	ns	**	ns	**	**	**	**	**	**	*
NU	**	**	**	—	**	ns	**	ns	*	**	**	**	*	**	ns
MK	**	**	**	**	—	ns	**	ns	**	**	**	**	*	**	ns
SpS	**	**	**	**	**	—	—	**	—	*	**	**	*	**	ns
SpS16	**	**	**	**	**	—	—	—	**	**	**	**	**	**	ns
StS	**	**	*	**	ns	**	—	—	—	ns	**	**	*	**	ns
StS16	**	**	**	**	**	—	**	—	—	**	**	**	**	**	ns
BV	ns	ns	**	**	ns	ns	ns	ns	ns	—	**	**	**	**	ns
OP	**	**	**	**	**	**	**	**	**	*	—	**	**	**	ns
GF	**	**	**	**	**	**	**	ns	**	ns	**	—	**	**	*
RC	**	**	**	**	**	**	**	**	**	ns	**	**	—	ns	ns
BC	**	**	**	**	**	**	**	**	**	ns	**	**	**	—	*
S	ns	*	ns	ns	**	ns	ns	ns	ns	ns	ns	*	*	*	—

* = significant value, k>0.444 (n=20, p=0.05) or k>0.561 (n=16, p=0.01)
** = highly significant value, k>0.561 (n=20,p=0.01) or k>0.623 (n=16, p=0.05)
ns = nonsignificant values

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DRYOPTERIS CARTHUSIANA AT MT. MAGAZINE, LOGAN, CO., ARKANSAS

Until the present, the only verifiable Arkansas population of the spinulose wood fern, *Dryopteris carthusiana* (Villars) H. P. Fuchs (*D. spinulosa* [O. F. Muell.] Watt), was one discovered by D. M. Moore on 7 August, 1960, at the entrance to Rowland Cave in Stone Co. This population represents the most extreme southwestern population of this species in eastern North America (Carlson & Wagner, Contr. Unif. Michigan. Herb. 15:141-162, 1982). In spite of the phytogeographic importance of this species in Arkansas, its presence and location has not been known with much certainty.

It was first reported for Arkansas by Lesquereux (A catalog of the plants of Arkansas, Pp. 346-399 *in* Owen, *Second report of a geological reconnaissance of the middle and southern counties of Arkansas made during the years 1859 and 1860,* 1860) from "woods". Based on this report, it was included in state lists by Harvey (Bot. Gaz., Crawfordsville 6:188-190, 1881) and Branner & Coville (A list of the plants of Arkansas, Pp. 155-242, *in* Branner, *Annual report of the Geological Survey of Arkansas for 1888,* Vol. IV, 1891). Buchholz (Am. Fern J. 14:33-38, 1924) expressed doubt about the presence of this species in Arkansas, in that he could not locate voucher material. Based on a discovery by Dwight M. Moore in 1924 (Moore, Am. Fern J. 31:63-71, 1941), Buchholz and Palmer (Trans. Acad. Sci. St. Louis 25:91-155, 1926) reported this species from the north side of Mt. Magazine, Logan Co., Arkansas. Recent efforts to locate a voucher or plants at that locality were also unsuccessful (Taylor & Demaree, Rhodora 81:503-548, 1979; Taylor, *Arkansas ferns and fern allies,* 1984, p. 106).

On 5 October, 1985, while surveying the status of *Woodsia scopulina* D. C. Eat. on Mt. Magazine, I located 4 plants of *D. carthusiana* on the northside of the mountain, near its summit, in the vicinity of Brown's Spring. This population, associated with three other fern species also occurring as peripheral populations (*Dennstaedtia punctilobula* [Michx.] Moore, *Dryopteris marginalis* [L.] Gray, and *Woodsia scopulina* D. C. Eat.), is most probably the population initially discovered by Moore in 1924. Verification of the occurrence of a Mt. Magazine population extends the known range of *D. carthusiana* 300 km to the southwest of the Stone Co. population. The occurrence of this northern species in Arkansas appears to be related to "northern" environmental factors provided in Logan Co. by elevation (860 m) at the top of the tallest mountain in Arkansas and in Stone Co. by moderated, cool, moist air blowing from a cave entrance. Based on the known locations of *D. carthusiana* in Arkansas, it is most improbable that Lesquereau ever saw this species in Arkansas during his travels; the earlier attributions of this species in the Arkansas flora must be considered spurius.

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A SURVEY OF THE INTERIOR LEAST TERN ON THE ARKANSAS AND WHITE RIVERS IN ARKANSAS

Potential tern sites were first identified by aerial surveillance and then explored by boat. The initial step involved a two-day helicopter search for evidence of nesting terns on the Arkansas River from Little Rock to the Oklahoma state line (26 June), and from Newport to St. Charles on the White River and again on the Arkansas River from Lock and Dam #3 to Little Rock (27 June). Due to a need to refuel frequently, and the limited availability of refueling stations, the lower 30 miles of the White River and the Arkansas River from its mouth to Lock and Dam #3 were not surveyed from the air.

All potential tern colonies identified by air on the Arkansas River, upstream from Little Rock, were visited by boat (1, 2, and 8 July), and the lower White River from Lock and Dam #1 to the Mississippi River and back up the Arkansas River to Dam #2 also was surveyed by boat (17 July).

The helicopter, provided by the Corps of Engineers and piloted by Army Reserve pilots, flew at heights of 100 to 200 feet above the ground at speeds of 30 to 75 m.p.h. Care was taken not to disturb tern colonies with prop wash. Visits to sandbars upstream from Little Rock were made in early morning (before 9:00 a.m.) and evening (after 6:30 p.m.) hours to avoid exposing young birds and eggs to the heat of the mid-day sun. However, sandbars on the lower White and Arkansas rivers were searched from the water in mid-day due to the late start of that survey.

Four rookeries were observed, one of them previously known, on the Arkansas River above Little Rock, and one rookery was found at the mouth of the Arkansas River. Approximately 80 adult least terns, 86 juveniles, and 40 eggs were counted at the five rookeries. No terns were found elsewhere on the Arkansas River or on the White.

The rookery at river mile 147, located on a side channel bar (spoilbank), was surveyed three times. On 1 July, 14 adults and one downy chick were found. No eggs or egg fragments were seen. A second trip to the ternery on 19 July proved more fruitful. Eight juvenile birds, seven of which were highly mobile, and 16 adults were counted. On a third visit, made 27 July, two flying young of the year were seen, but only six adults and no nests or flightless young. Though adults dive-bombing in one area of the spoilbank indicated that at least one nest was still active,