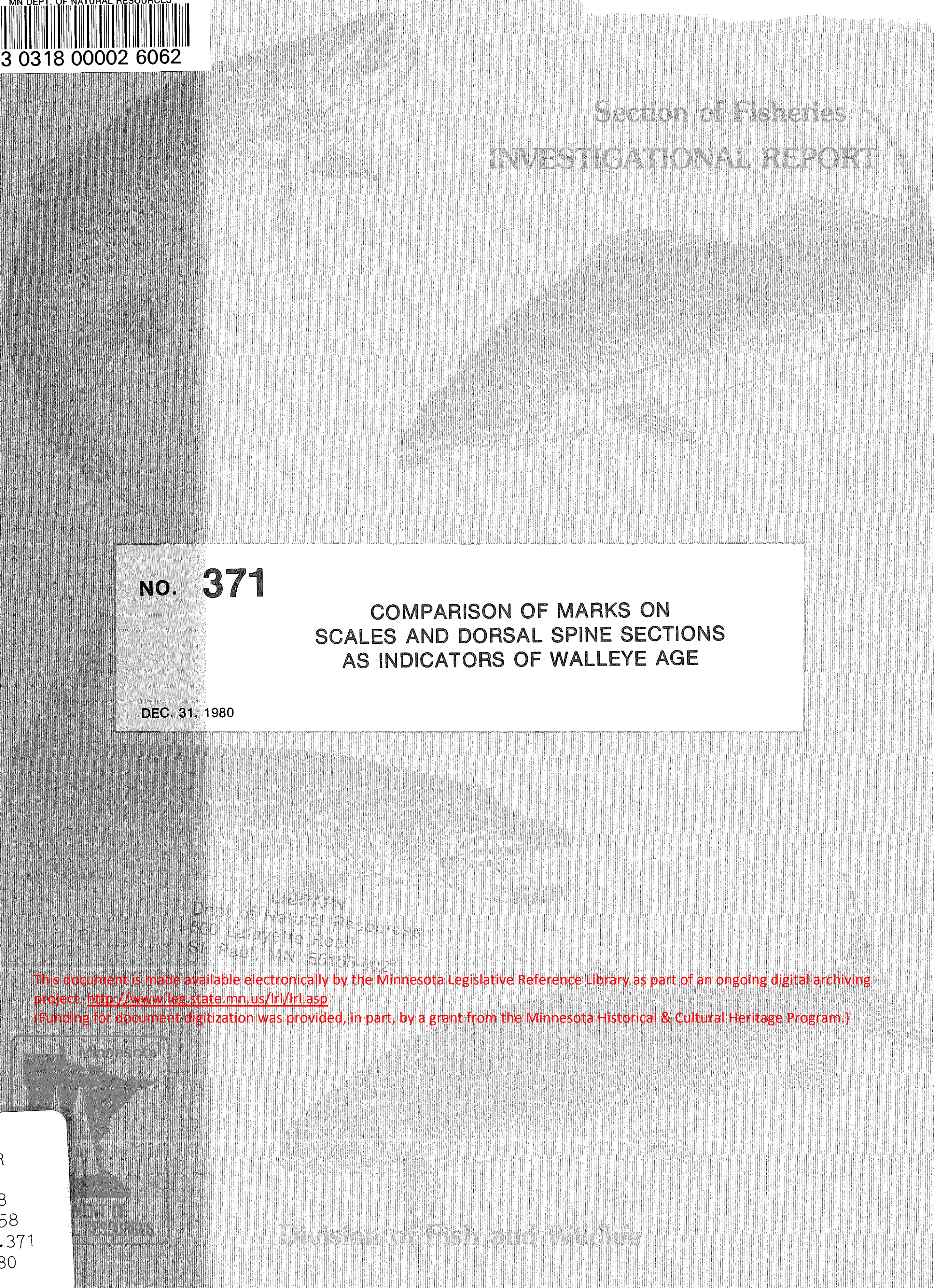

Section of Fisheries
INVESTIGATIONAL REPORT

NO. 371

COMPARISON OF MARKS ON SCALES AND DORSAL SPINE SECTIONS AS INDICATORS OF WALLEYE AGE

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Minnesota
DEPARTMENT OF NATURAL RESOURCES

Division of Fish and Wildlife

Comparison of Marks on Scales and Dorsal Spine Sections as Indicators of Walleye Age [1/]

by

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ABSTRACT

Four fisheries biologists independently aged walleyes by examining: (1) scale impressions (2) dorsal spine sections, and by (3) examining both structures concurrently to assess the age of individual fish. There was high agreement among readers in aging younger walleyes from Lake Winnibigoshish, but readers frequently disagreed in scale and spine ages of older walleyes. Readers showed great variation in aging 172 walleyes from various Minnesota waters which were examined without knowledge of fish length or location of capture. A majority of readers agreed in the age of 7 percent of scale ages, 32 percent of spine ages, and 51 percent of age determinations when scales and spines were examined concurrently.

INTRODUCTION

Unavailability of known-age fish required that early fisheries workers devise indirect methods to validate year marks on fish scales and boney structures. Validations for aging sport and commercial fishes relied mostly on comparisons of growth histories as related to marks and on the persistence of strong or weak year classes in separate years of collections. These indirect methods frequently validated marks for younger age groups in a population and were then projected as evidence for valid annulus formation in older fish.

[1/] Completion report-Study 119- D.J. Project F-26-R Minnesota

Investigators have also approached validation of aging techniques by comparing year-mark counts on scales with counts on boney structures of individual fish of various species: Beamish and Harvey (1969), Johnson (1971), Aass (1972), Power (1978), Beamish and Chilton (1977), Erickson (1979), Campbell and Babaluk (1979), Mills and Beamish (1980). Such comparisons often indicate that readers are unable to distinguish annuli formations on scales of older fish. Fish and scale growth slows when approaching asymptotic size and insufficient circuli are formed in a growing season to form a recognizable mark on scales each year. Acceptance of this limitation in age assessment from scales might explain the frequent observations of Lee's phenomenon (Lee 1920) in age and growth studies. That is, if slower growing individuals form more recognizable annuli on scales before approaching asymptotic size than faster growing individuals, then, with projection of valid annulus formation to older age groups it would appear in back calculations of fish length at annulus formation that older fish were smaller at a given age than younger fish in the collection.

In this investigation, four readers independently determined ages of walleyes from scales and from dorsal spine sections. The separate scale and spine ages were compared with a third determination when each reader made a best judgment of fish age from concurrent examination of scales and spines. This approach does not give a definitive evaluation of aging techniques. Agreement among readers does not assure accuracy in age assessment. Poor agreement indicates ambiguity of marks for these readers but cannot be expected to be the same for another group of readers or another collection of walleyes. This approach may, however, suggest limitations in aging walleyes from marks on scales and spine sections and emphasize need for objective validation of a subjective art.

METHODS

Scale impressions were made by the heat-press method on acetate plastic slides. Spine sections were cut with a dental abrasive-disc mounted in a Dremel moto-tool [2] held in a jig resembling a miniature table saw. Spines were clamped to a guide and cut by moving them into the cutting disc. A section of about 0.4 mm was cut near the spine base, polished on fine-grit carborundum paper, and secured to a glass slide in a drop of clear mounting medium. Sections were from the third or fourth dorsal spine.

Walleye scales and spine sections from two separate groups of fish were examined. One group was a collection of 112 walleyes (12.2 to 25.0 inches TL) from a single body of water, Lake Winnibigoshish, and the second group was a composite collection of 172 mostly larger walleyes (10.5 to 27.6 inches TL) from 36 Minnesota lakes. Walleyes in the composite collection were identified by only a serial number. The location and date of capture, sex and total-length of each walleye was provided to the readers when aging Lake Winnibigoshish walleyes.

Each of the four readers worked independently and made three separate assessments of walleye ages in the two groups. Scale impressions were read first followed by slides of mounted spine sections. Scales and spines were examined together for each readers third age determination. This approach provides a comparison of variations by each reader in scale and spine ages and also compares variations among readers.

RESULTS

There was good agreement among readers in scale and spine ages for younger walleyes from Lake Winnibigoshish (Table 1), but frequent disagreement in aging

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[2] Mention of brand names does not constitute endorsement of product.

walleyes considered to be over 5 years old. A majority of readers (3 or 4) agreed in 51 percent of scale ages, 60 percent of spine ages and 80 percent of ages of older walleyes when scales and spines were examined together. Each reader's third determination (scale-spine) was compared with his first reading (scale) and second reading (spine) to aid in analyzing variations. Reader 1 tended to interpret more marks on scales and spines as year-marks when viewing structures separately than when viewing them together (Figure 1). Scale-spine ages agreed more often with spine ages than with scale ages. Reader 2 tended to record fewer marks on older walleyes when examining scales (Figure 2). Reader 3 tended to interpret more marks as year-marks when aging spines (Figure 3). Reader 4 tended to record fewer marks on scales but showed high agreement in spine ages with scale-spine ages (Figure 4).

Table 1. Percentage of Lake Winnibigoshish walleyes for which a majority of readers agreed in independent age determinations.

		Structures Observed		
	Number of fish	Scales Only	Spines Only	Both Scales and Spines
5 years [a/] or younger	77	94	84	91
6 years or older	35	51	60	80
Total sample	112	80	77	88

[a/] A majority of the readers recorded 5 or less marks when viewing both structures.

Readers frequently disagreed in interpreting marks on scales or spines of walleyes collected from various Minnesota lakes which were identified by only a serial number (Table 2). Three or four readers agreed in aging 66 percent of walleyes in younger age groups when scales and spine sections were viewed concurrently for age assessment. Majority agreement occurred in 47 percent of spine ages and 11 percent of scale ages of walleyes considered to be less than 6 years old.

Table 2. Percentage of walleyes from various Minnesota lakes for which a majority of readers agreed in independent age determinations.

		Structures Observed		
	Number of fish	Scales Only	Spines Only	Both Scales and Spines
5 years[a/] or younger	64	11	47	66
6 years or older	108	5	23	43
Total sample	172	7	32	51

a/ A majority of the readers recorded 5 or less marks when viewing both structures.

Readers had greater difficulty in interpreting ages of walleyes older than 5 years. A majority of readers agreed in aging 43 percent of older walleyes when scales and spines were viewed concurrently, but only 23 percent of spine ages and 5 percent of scale ages when structures were read separately.

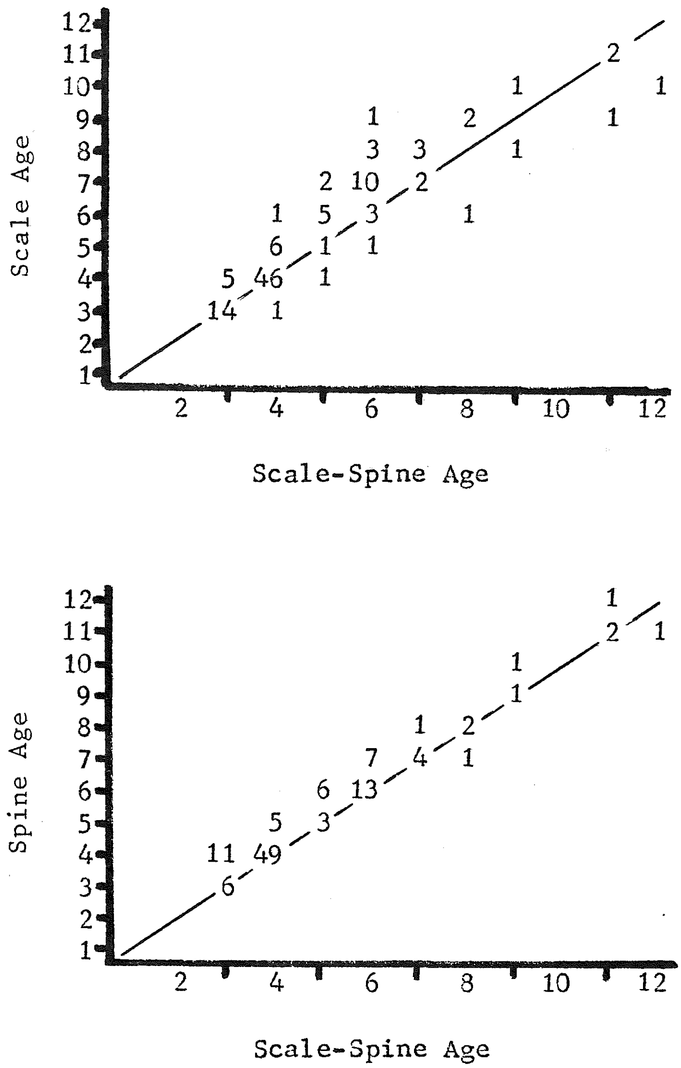


Fig. 1. Reader 1 comparisons of Lake Winnibigoshish walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader.

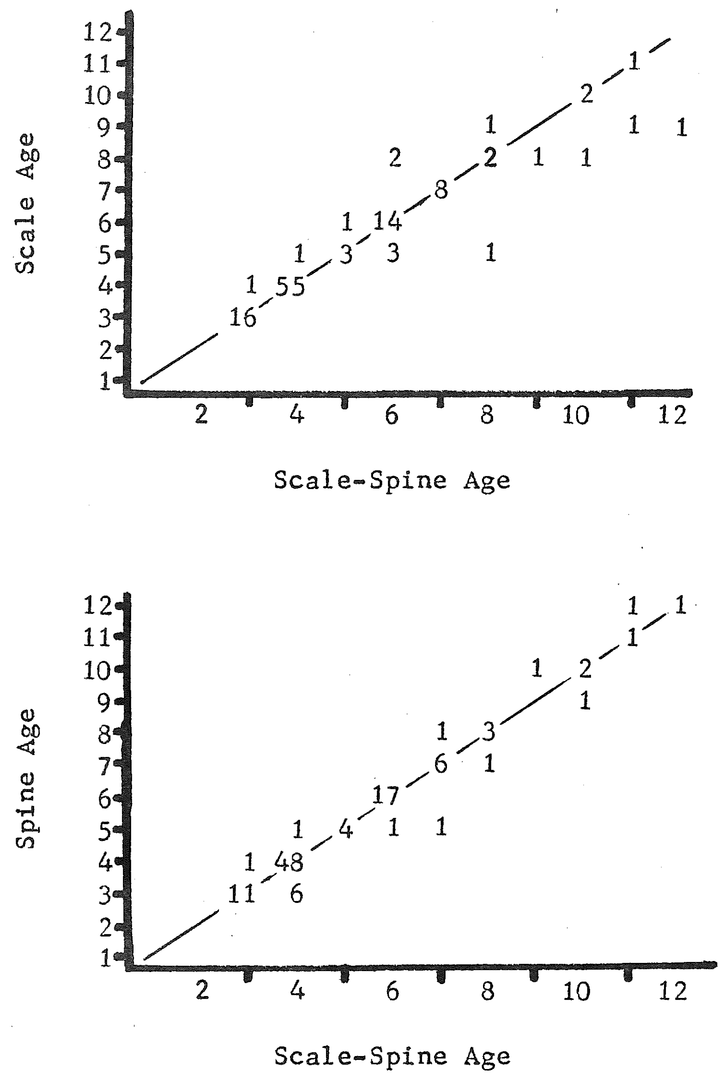
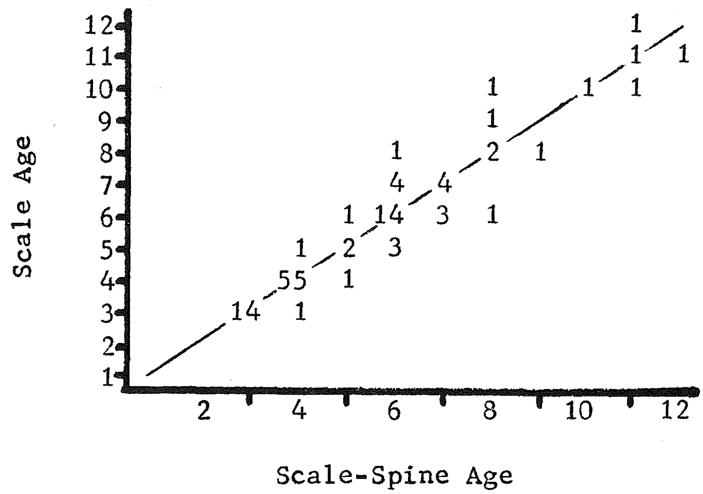


Fig. 2. Reader 2 comparisons of Lake Winnibigoshish walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader.



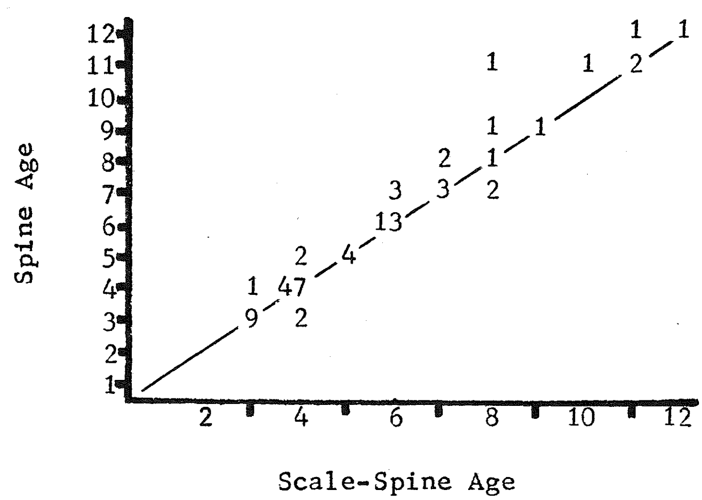


Fig. 3. Reader 3 comparisons of Lake Winnibigoshish walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader.

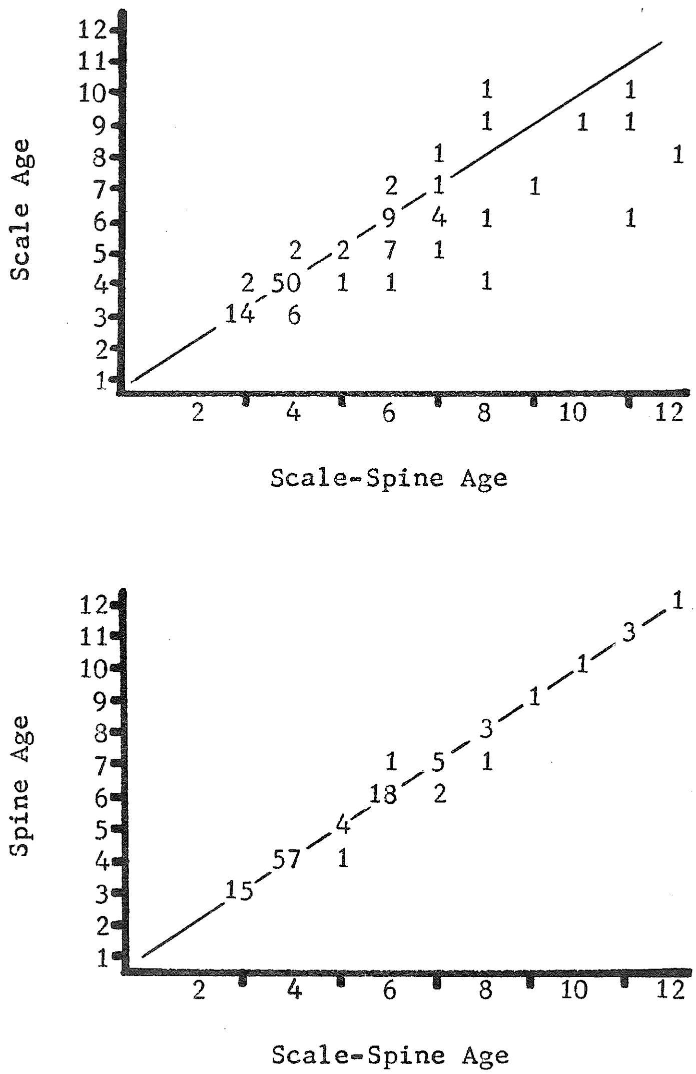


Fig. 4. Reader 4 comparisons of Lake Winnibigoshish walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader.

Reader 1 consistently interpreted more marks as valid annuli on scales than on spines (Figure 5). Reader 2 tended to record more year-marks on scales of younger walleyes and fewer year-marks on scales of older walleyes and tended to record fewer year-marks on spines of younger walleyes (Figure 6). Reader 3 recorded more marks on scales and on spines when they were viewed separately than when they were examined together (Figure 7). Reader 4 recorded fewer year-marks on scales and on spines when viewed separately than when the structures were examined concurrently. This tendency to identify fewer marks as year-marks is most apparent for scales of older walleyes (Figure 8).

DISCUSSION

High agreement among readers in interpreting scale and spine ages of younger walleyes collected from Lake Winnibigoshish indicates that readers recognized common criteria in aging walleyes from this discrete population. However, lack of agreement among readers characterized age determinations for older walleyes when structures were examined without designated fish-length or location of capture. Knowledge of a fish's length suggests a probable age to experienced readers and thereby enhances agreement. A reader's knowledge of fish-length might also result in increased accuracy when aging younger age classes having little overlap in size ranges, but this knowledge can not be expected to improve aging accuracy of older fish where age-class size ranges widely overlap.

When aging walleyes from various Minnesota lakes readers were without population growth characteristics to aid in interpreting year-marks. Each reader was compelled to rely only on the prominence and proximity of marks to judge false checks from true year-marks. Though readers were experienced in aging walleye scales and had not previously aged spine sections they agreed

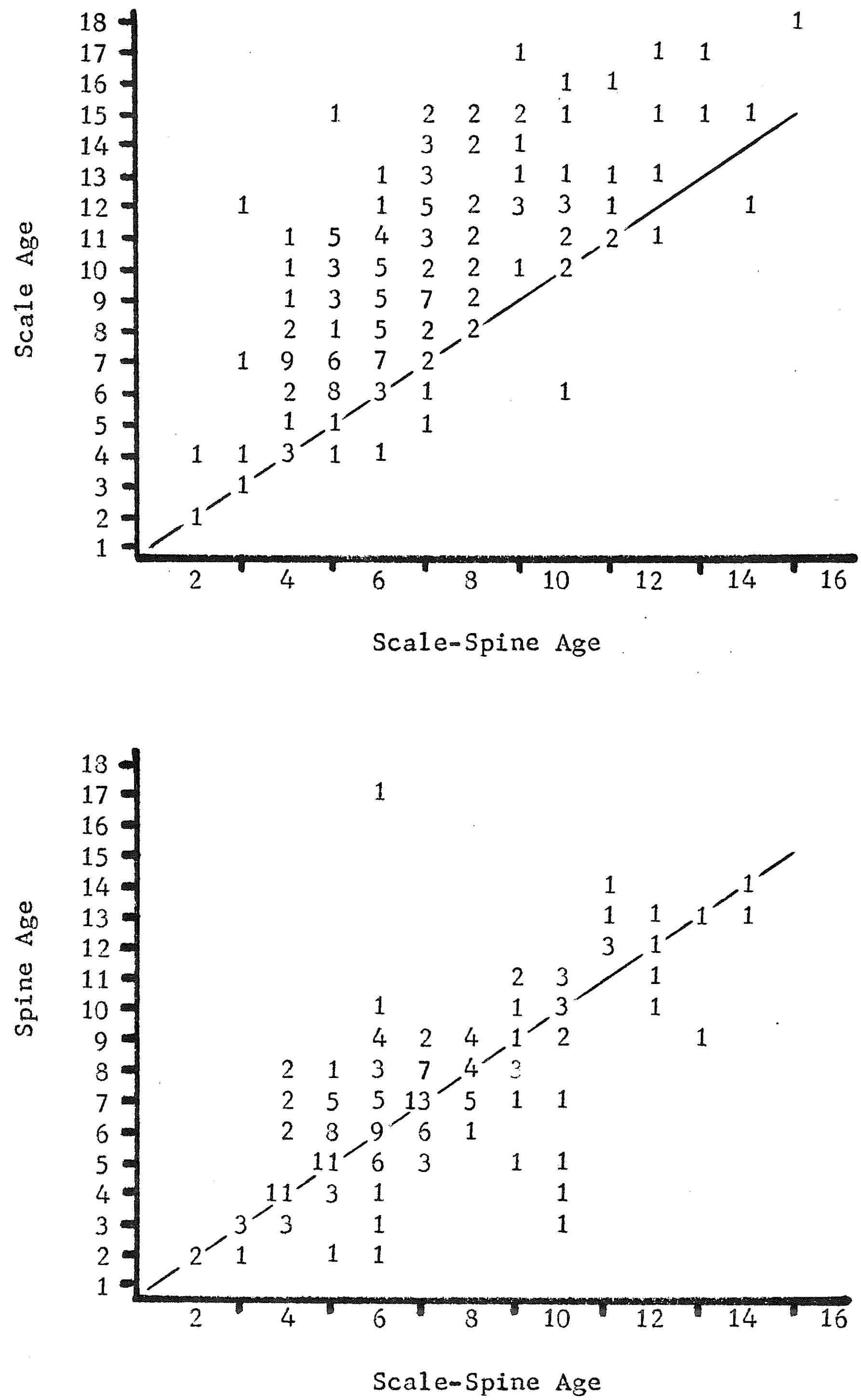


Fig. 5. Reader 1 comparisons of walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader. Walleyes were collected from various Minnesota lakes.

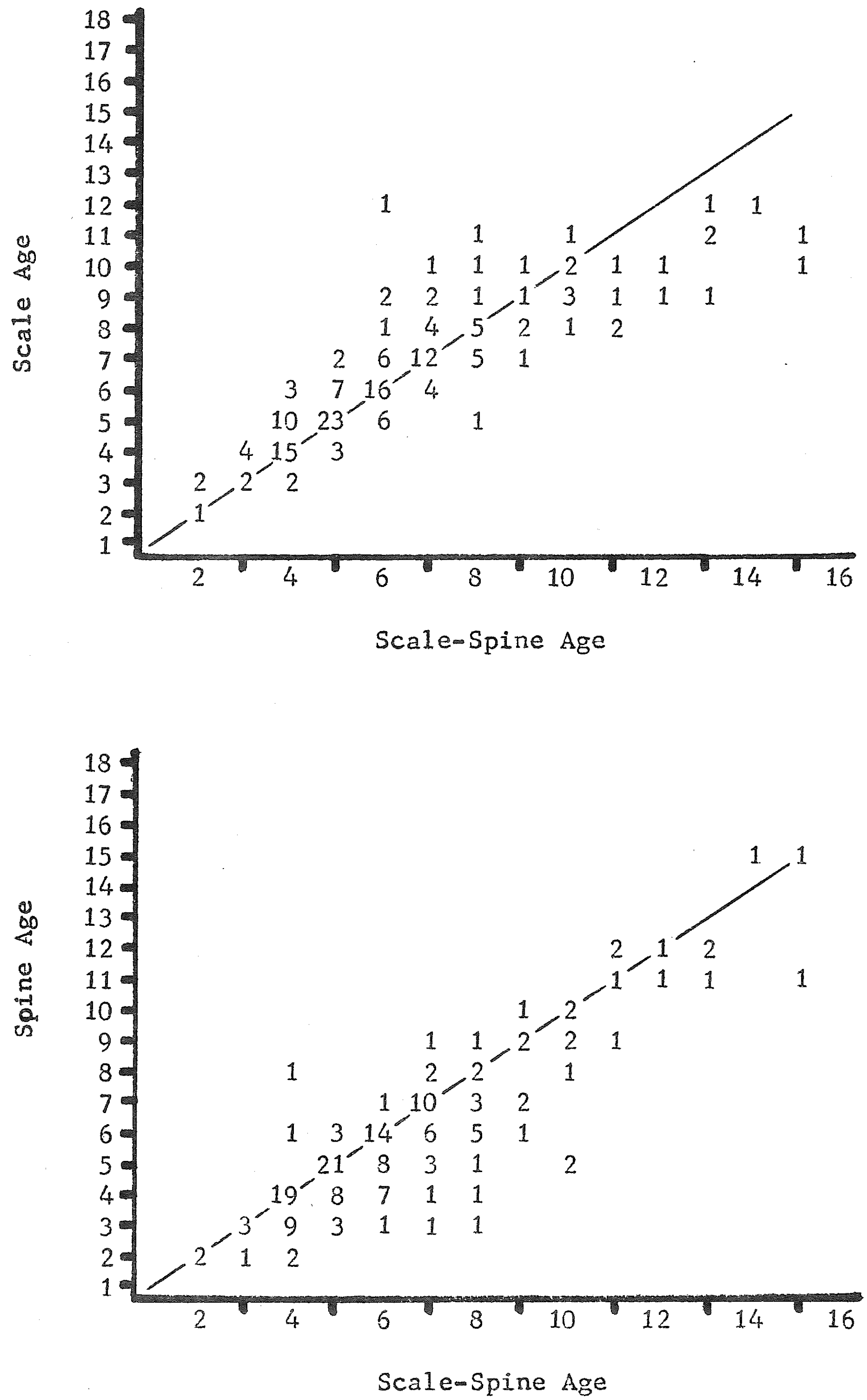
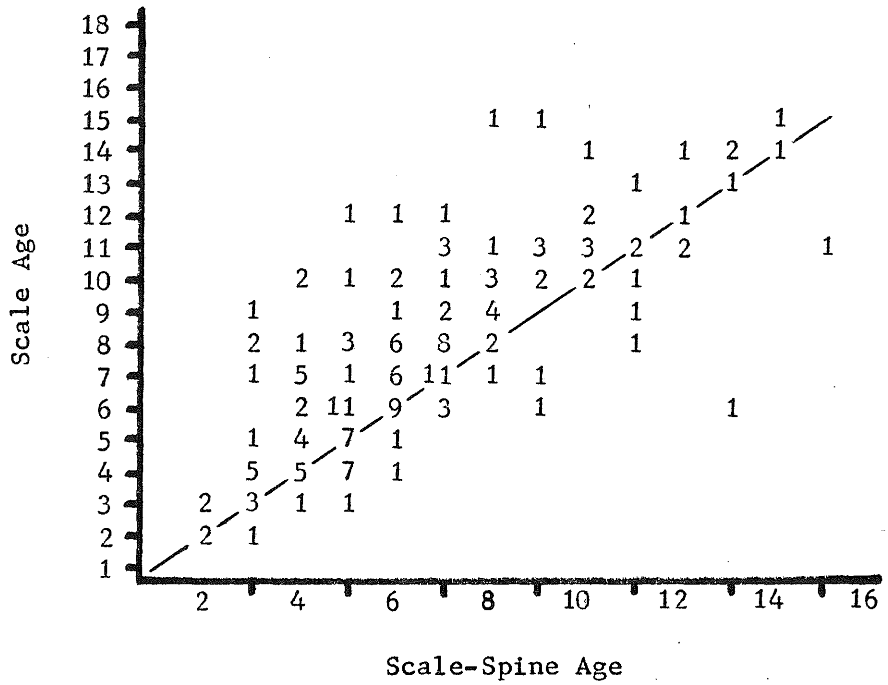


Fig. 6. Reader 2 comparisons of walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader. Walleyes were collected from various Minnesota lakes.



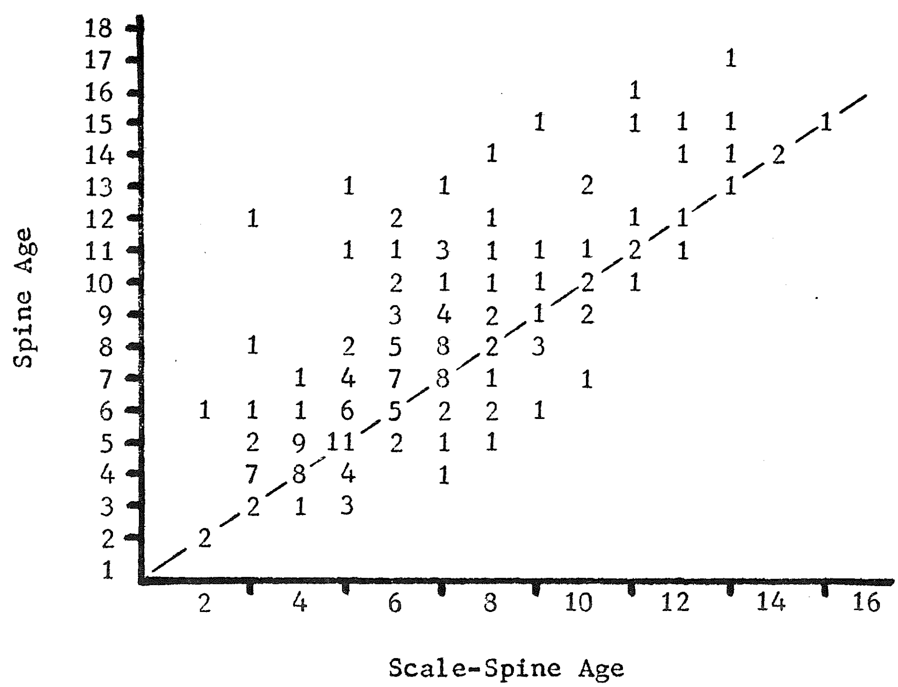
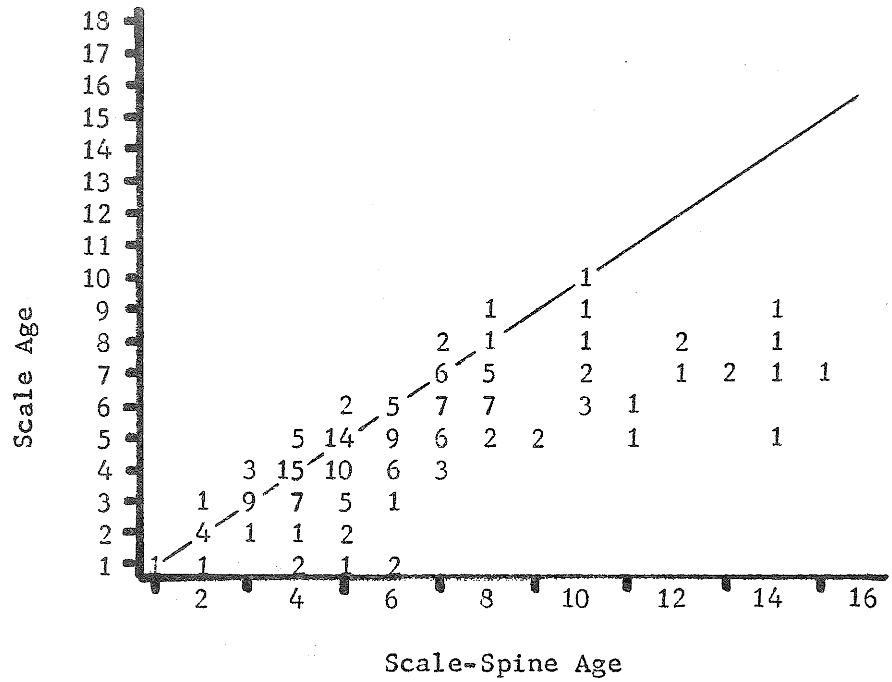


Fig. 7. Reader 3 comparisons of walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader. Walleyes were collected from various Minnesota lakes.



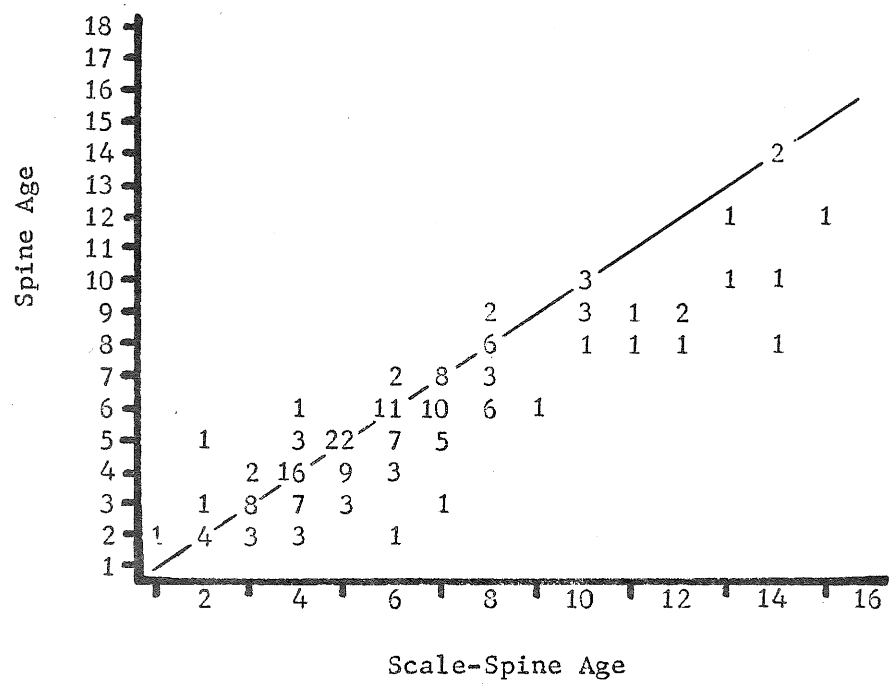


Fig. 8. Reader 4 comparisons of walleye age determinations from scale and spine readings with a third reading when both scales and spines were viewed by the reader. Walleyes were collected from various Minnesota lakes.

more frequently in spine ages than in scale ages. Reader experience is commonly gained without a reliable means for validating age of individual fish. This experience may enhance reader confidence but likely adds little to a reader's ability to separate false checks from true year-marks. Greater confusion in scale aging than in spine aging appears to be associated not only with a failure of annulus formation on scales of older walleyes but also with greater difficulty in distinguishing false checks from true year-marks.

Highest agreement among readers was attained on the third (scale-spine) reading. Scale-spine ages agreed more often with spine ages than with scale ages but differed from both nearly half the time for the walleyes collected from various Minnesota lakes. It appears that three readers changed their concepts of year-mark criteria during the course of investigation which resulted in increased agreement among readers in the third readings. Reader 1 examined scales from a marked walleye of known age returned to him shortly before examining scales for this investigation. By interpreting some less distinct marks as year-marks he was able to detect 16 annuli on scales of this fish. From this experience he opted to record more indistinct marks as annuli when examining walleye scales from various Minnesota lakes but upon examination of spine sections was unable to substantiate the high scale ages.

A change in aging concepts occurred after the second reading for Reader 3 and 4. Scale-spine ages of Reader 3 were predominantly younger than scale or spine ages read separately. Reader 4 recorded more marks when examining structures together than when each was examined separately. These modifications in aging rationale enhanced agreement when scales and spines were viewed together for age determination but may have resulted in part from accumulated experience in the three readings and not solely from concurrent examination of structures. Reader 2 did not show a marked change in aging rationale; scale-spine ages most often agreed with either the scale age or the spine age or with both.

Higher confidence in walleyes ages assessed from boney structures than from scales is reported in other investigations. Campbell and Babaluk (1979) suggest that walleye opercle bones and otoliths offer the most reliable age but recommend the use of dorsal spine sections for practical reasons. Ages from scales in their collection showed good agreement with ages from boney structures through 8 or 9 years, but consistently underestimated ages of older walleyes. Erickson (1979) reported that bone sections (fin ray and otolith) showed a clear annulus for the first year whereas the first annulus was often not detectable on walleye scales. Ages from bone sections and scales were considered precise for exploited populations of young walleyes, but ages from scales were underestimated for unexploited populations.

Growth characteristics of separate walleye populations together with diversities in reader experience and capabilities largely determine reliability of ages assessed from scales. To avoid false interpretations, marks on walleye scales should be considered unreliable indicators of age after 4 or 5 years of age and accepted for research investigations and management decisions only after validation. Validation of year-mark formation in younger fish of a population is not acceptable evidence for projecting valid annulus formation to older fish in a collection.

Marks on walleye dorsal spines are more reliable indicators of fish age than scales, particularly in aging older fish. However, frequent disagreement among readers emphasizes need for validating ages in separate collections.

Scales and dorsal spine sections examined together appear to offer highest precision in age assessment. It is recommended that both structures be collected and examined for at least a partial sample of walleye collections and ages routinely confirmed by independent readers.

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