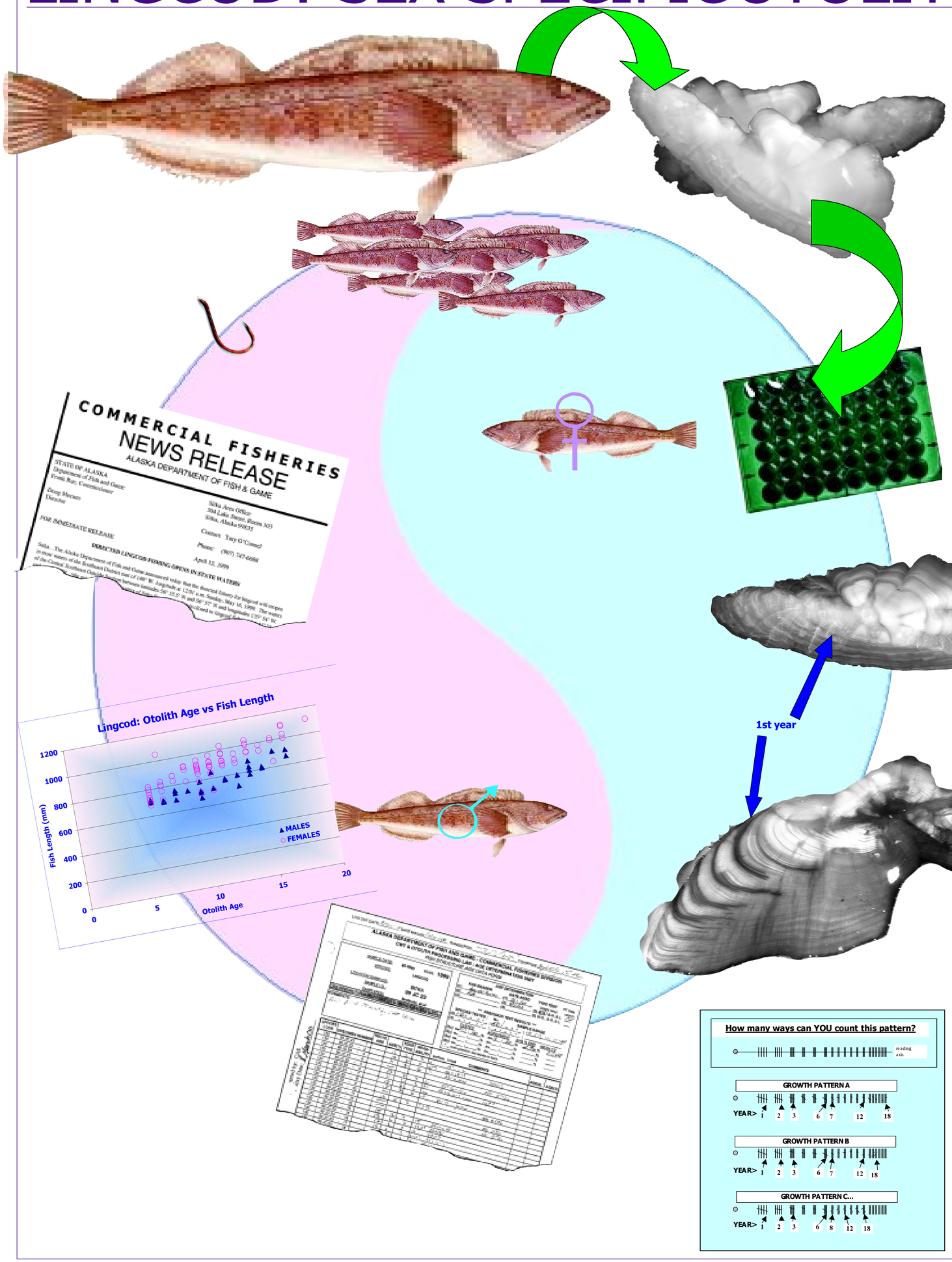
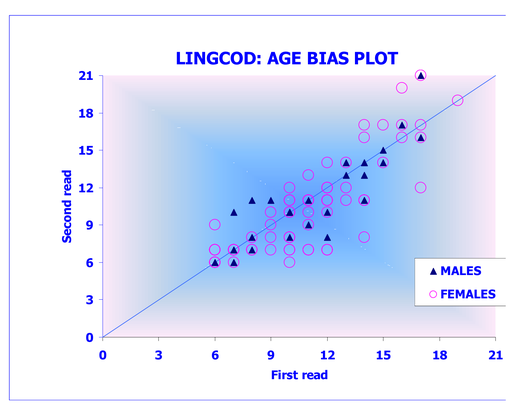
LINGCOD: SEX-SPECIFICOTOLITH AGE-READING ERROR





INVESTIGATION OF SEX-SPECIFIC OTOLITH AGE-READING ERROR IN LINGCOD (*Ophiodon elongatus*)

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ABSTRACT

Diverse otolith age patterns, possibly resulting from spatial and temporal segregation of lingcod (*Ophiodon elongatus*) populations into female and male components, suggest that error in reproducing age estimates from otolith growth patterns may be partitioned into "female age-reading error" versus "male age-reading error". Otolith ages from 99 lingcod – 68 female and 31 male— were determined using the "cleared" and "break n' burn" techniques, and using lingcod otolith pattern interpretation criteria established at the Alaska Department of Fish and Game, CWT & Otolith Processing Lab's Age Determination Unit. All specimens were second-read by the initial reader to assess within-reader precision. Pooled by sex, within-reader precision was measured to be: average percent error (APE)= 6.63% and coefficient of variation (CV)= 9.38%, %agreement 34.34%, and mean sample variance= 2.03. Sex-specific precision was partitioned as: male APE = 5.39%, male CV = 7.62%, male %agreement= 41.94%, mean male sample var=1.4838, and female APE = 7.19%, female CV = 10.17%, female %agreement=30.88%, mean female sample var=2.2794. The age ranges were (first read/second read): for males age 6/6 to 17/21 (mean age = 10.9/10.65), and females age 6/6 to 19/21 (mean age = 10.93/10.4).

LINGCOD BIOLOGY

Lingcod have unique life history behavior that results in seasonal segregation of the population. In late fall, male lingcod assemble in nearshore regions in preparation for spawning. In January through February, female lingcod move into these areas from deepwater reefs, and commence spawning. Eggs are extruded into rock crevices. Males then begin nest-keeping operations while females migrate away from the nest, relinquishing all further nurturing responsibilities of the progeny to the male.

Male lingcod remain at the nest-site for an average of 7 weeks until hatching is complete. In this time they remove dead eggs, help maintain water circulation throughout the eggmass, and defend the nest from predators. It seems plausible that this limits opportunities for foraging, and, increases stress on the animal.

Female lingcod migrate to deep water after spawning. Without continuing parental responsibilities, it is assumed that nutritional opportunities are not impacted and overall stress is diminished. And with partitioning of the population, it is possible that these opportunities are further improved through reduction of competition.

LINGCOD OTOLITH AGE-READING

Growth history is recorded in various hard structures in fish, including the otoliths (earbones). The otolith growth patterns are examined to estimate the age of the animal. These age data are used in characterizing a population of animals. Error is inherent in evaluating age patterns, so repeatability tests are conducted to estimate this error. An important assumption is that error is random across the entire population. If error is not reflective of the entire population – that is if it could be partitioned by a parameter of the population – then defining this partitioning becomes necessary to more accurately depict the population.

Age-reading is described as an "art" and not a "science", therefore age pattern interpretation methods are generally limited to subjective characterization and recognition of differences in the patterns. These patterns are inherently variable, however a typical lingcod otolith growth pattern is generally "fast growth" with the early years showing relatively large growth up to approximately age 6, followed by moderate slowing through age 12. Up through age 12, growth events – checks, or rings — are often "banded" to make up one annulus when reading a surface transect out the anterior rostrum. After approximately age 12, growth may slow, sometimes with necessary banding, sometimes simply counting each check, known as "splitting".

Error in repeating an age estimate is thought to increase for females because winter zones are speculated to be wider with more checks, or "noise", which requires banding for the annulus. If this noise were not banded, and instead was split out, an older estimate would result. Such an ambiguous pattern would result in dramatically different estimates, for example an age 7 versus age 12. The latter difference produces relatively high average-percent-error, coefficient of variation, and variance. Males are speculated to have more consolidated winter zones – less noisy, which obviates a decision on "banding" vs "splitting". Error in reading these patterns might result from estimates of age 7 vs 8, but not an extreme of 12. Statistical error would be commensurately smaller.

General speculation as to what instigates differences in these patterns can be made to aid in elucidating the pattern. For female lingcod, a combination of more winter feeding opportunities, richer feeding grounds, less stress, as well as possible genetic predisposition to larger and faster growth, are speculated to result in wider growth zones with "noisy" winter zones. For male lingcod, less winter feeding opportunities (time and spatial), increased stress (nest-keeping), and possible genetic predisposition to slower smaller growth are speculated to result in more consolidated winter zones.

What other species incorporate partitioned age-reading error, and to what degree???