

Supplemental Information

Derived Age at Maturity

We derived age at maturity estimates by transforming the length-based logistic maturity ogives using the sex-specific von Bertalanffy growth function (VBGF) from Shane et al. (2025). For each TL value, the corresponding predicted age was calculated from the published growth model, and the fitted logistic ogive was re-expressed as a function of age rather than length. This transformation allowed estimation of the ages at which 5%, 50%, and 95% of individuals were mature (A_5 , A_{50} , and A_{95} , respectively). Age-based maturity estimates inherit uncertainty from the length-based maturity ogive but do not incorporate uncertainty in VBGF parameter estimates; therefore, confidence intervals reflect only variation in the length at maturity model. Consequently, age at maturity estimates should be interpreted as derived approximations and viewed in the context of uncertainty in the underlying growth model. Age-based maturity relationships were included to facilitate comparison with other studies and to provide metrics commonly used in stock assessment and life history synthesis.

Female Derived Age at Maturity.—To express maturity on the age scale for females, we transformed the FR length-based ogive using the female von Bertalanffy growth function from Shane et al. (2025; $L_\infty = 1,588$ mm TL, $K = 0.126$ yr⁻¹, $t_0 = -1.344$ yr). The resulting age at maturity curve yielded $A_5 = 4.3$ y (95% CI: 4.1–4.5 years; $L_5 = 811$ mm TL), $A_{50} = 5.2$ y (95% CI: 5.0–5.4 years; corresponding to $L_{50} = 895$ mm TL), and $A_{95} = 6.3$ y (95% CI: 6.0–6.6 years; $L_{95} = 979$ mm TL; Fig. S1a; Table 2). The age corresponding to the current minimum size limit (711 mm TL) was 3.4 y, indicating that most females transitioned to maturity between approximately 4.3 and 6.3 years.

Male Derived Age at Maturity.—To express maturity on the age scale for males, we transformed the male length-based ogive using the male von Bertalanffy growth function from Shane et al. (2025; $L_\infty = 1,306$ mm TL, $K = 0.167$ yr⁻¹, $t_0 = -1.238$ yr). The resulting age-at-maturity curve yielded $A_5 = 2.2$ y (95% CI: 2.0–2.6 y; $L_5 = 575$ mm TL), $A_{50} = 3.2$ y (95% CI: 3.0–3.4 y; corresponding to $L_{50} = 683$ mm TL), and $A_{95} = 4.3$ y (95% CI: 4.1–4.6 y; $L_{95} = 790$ mm TL) (Fig. S1b; Table 2). The age corresponding to the current minimum size limit (711 mm TL) was 3.5 y, indicating that most males transitioned to maturity between approximately 2.2 and 4.3 years.

Spawning Seasonality Based on Histology

Existing descriptions of white seabass reproduction are largely based on observations from southern California, and reproductive activity has not previously been evaluated in northern California. To our knowledge, this study provides the first histological confirmation of spawning activity in white seabass from northern California, extending direct evidence of reproductive activity beyond regions where spawning has historically been documented. Histological confirmation of spawning indicates that reproductive activity occurs in northern California; however, additional work is needed to determine whether spawning contributes to successful fertilization, larval survival, or local recruitment.

To examine seasonal timing of reproduction based on histology, we summarized the gonadosomatic index (GSI) by month using only females classified histologically as spawning. Histology was completed for 304 females, of which 85 were classified as spawning and considered eligible for this analysis. Gonad and body weight data required to calculate GSI were available for 61 of the 85 spawning females (6 from northern California and 55 from southern California). Restricting analyses to females histologically classified as spawning provided high confidence in assigning active reproductive condition, but reduced sample size because histological evidence of spawning is ephemeral and detectable only during a relatively brief portion of the reproductive cycle.

We calculated GSI for females as:

$$GSI = (Gonad\ Weight / Total\ Body\ Weight) \times 100$$

We summarized monthly mean GSI ($\pm$ standard error) for females classified histologically as spawning. Statewide and regional means were computed, and spawning seasonality was interpreted in the context of both monthly GSI patterns and histological evidence of reproductive stage.

The maximum spawning duration observed statewide was April–September (Fig. S2a). Statewide, the mean GSI increased during spring, peaked in May (mean = 6.4; $n = 11$), and remained elevated through July. Within this period, variation in mean GSI among spawning females suggests that reproductive activity was not uniform across the spawning season and may indicate periods of peak spawning activity during May and July statewide.

A stacked histogram of total female sample size by month ($n = 304$) shows that most histologically confirmed spawning females ($n = 85$) were collected from late spring through summer, supporting a core spawning season of May–July statewide (Fig. S2b). Sampling effort was limited outside of known spawning periods.

In southern California, the maximum spawning duration extended from April through August, whereas in northern California, the maximum spawning duration was delayed and extended from May through September (Fig. S2c). Maximum spawning duration was defined by the occurrence of at least one histologically confirmed spawning female within a given month and therefore does not reflect spawning intensity (Lowerre-Barbieri et al. 2023). For both regions, GSI peaked in May and elevated GSI values persisted into summer, although interpretation should be considered in the context of variable monthly sample sizes and limited observations in northern California. Histological confirmation of spawning females in northern California extends direct evidence of reproductive activity beyond regions where white seabass spawning has historically been emphasized.

Length Distribution of White Seabass Catch

To provide context for the estimated FR female length at 50% maturity (L_{50}), we summarized available fishery-dependent length data collected by CDFW from commercial and recreational catch between 2008 and 2025. All available length data were used to construct percent frequency histograms describing the relative length distributions of white seabass sampled from

commercial (Fig. S3a) and recreational fisheries (Fig. S3b). These summaries were intended to provide fishery context for maturity estimates and were not used to estimate maturity parameters.

Commercial sampling data included dockside and at-sea collections from directed white seabass monitoring efforts ($n = 4,599$). Recorded information included species identification, length, weight, disposition (retained or discarded), fishing method, catch location, and date. For commercial dockside sampling events where only head length was recorded, measurements were converted to TL using the conversion equation described in Methods (M. A. Shane, Hubbs-SeaWorld Research Institute, pers. comm.).

Recreational data included CDFW's directed white seabass monitoring efforts and California Recreational Fisheries Survey (CRFS) observations ($n = 3,042$). CRFS collected length and weight measurements from a subsample of retained catch. Numbers of discards are recorded across fishing modes, and discard lengths are opportunistically collected onboard CPFVs. CRFS sampling was dominated by private and rental boat modes (87%), with smaller contributions from CPFVs (12%) and shore-based (beach/bank and man-made/jetty) modes (1%); therefore, observed length distributions should be interpreted as sampled distributions and may not fully represent the recreational fishery.

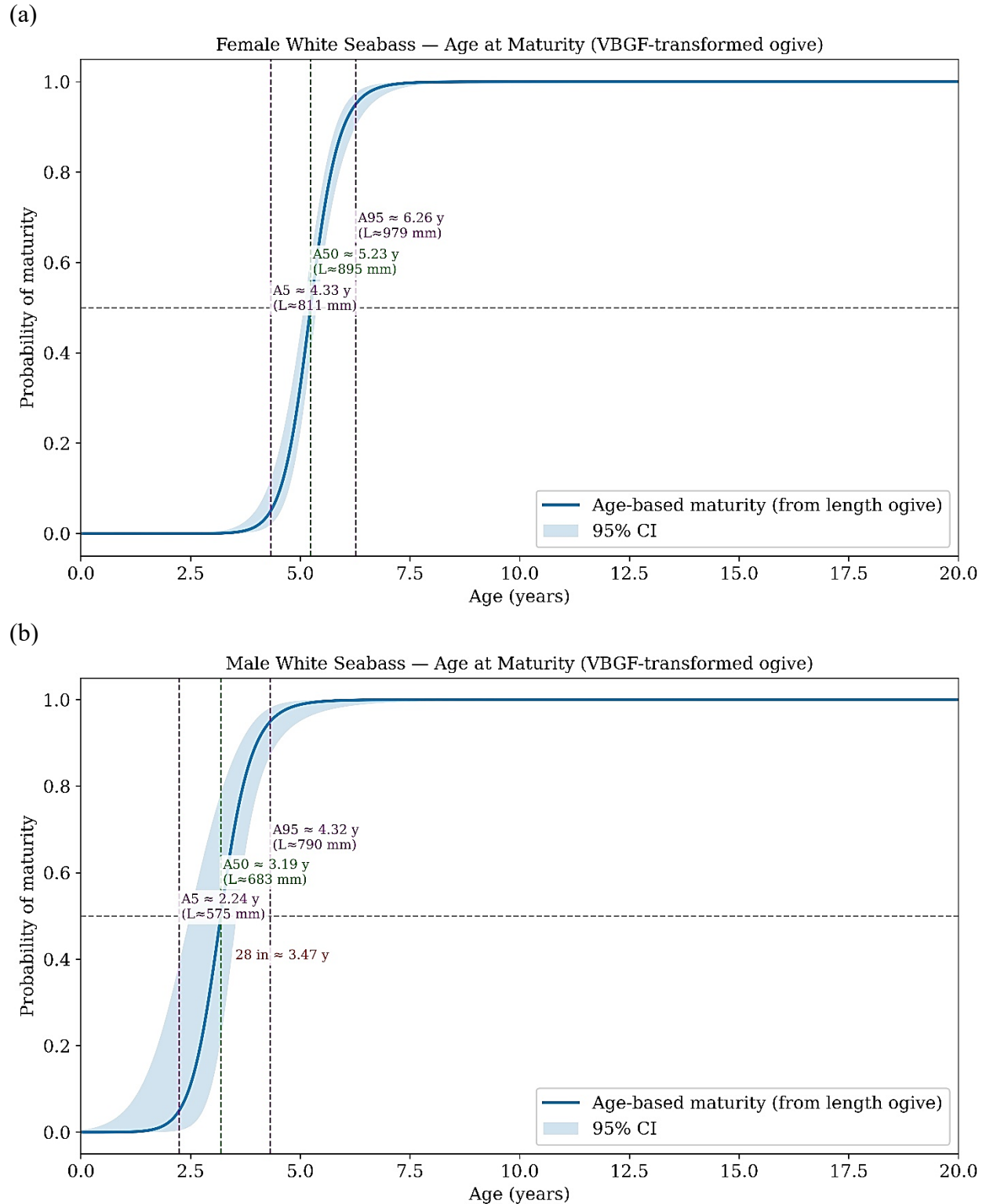
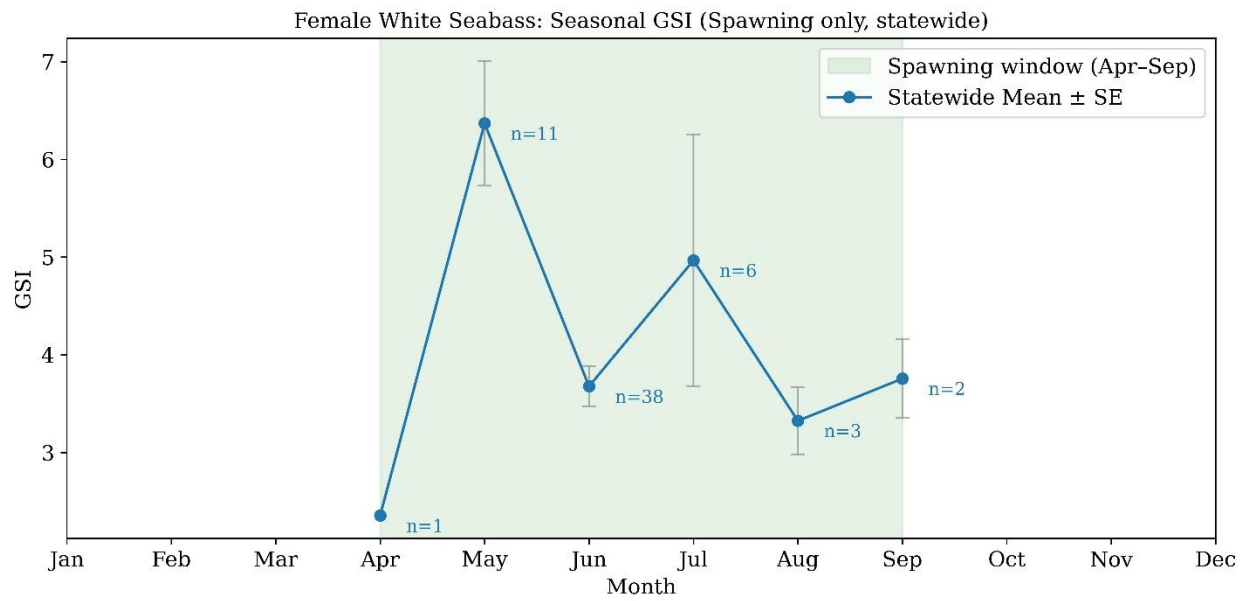


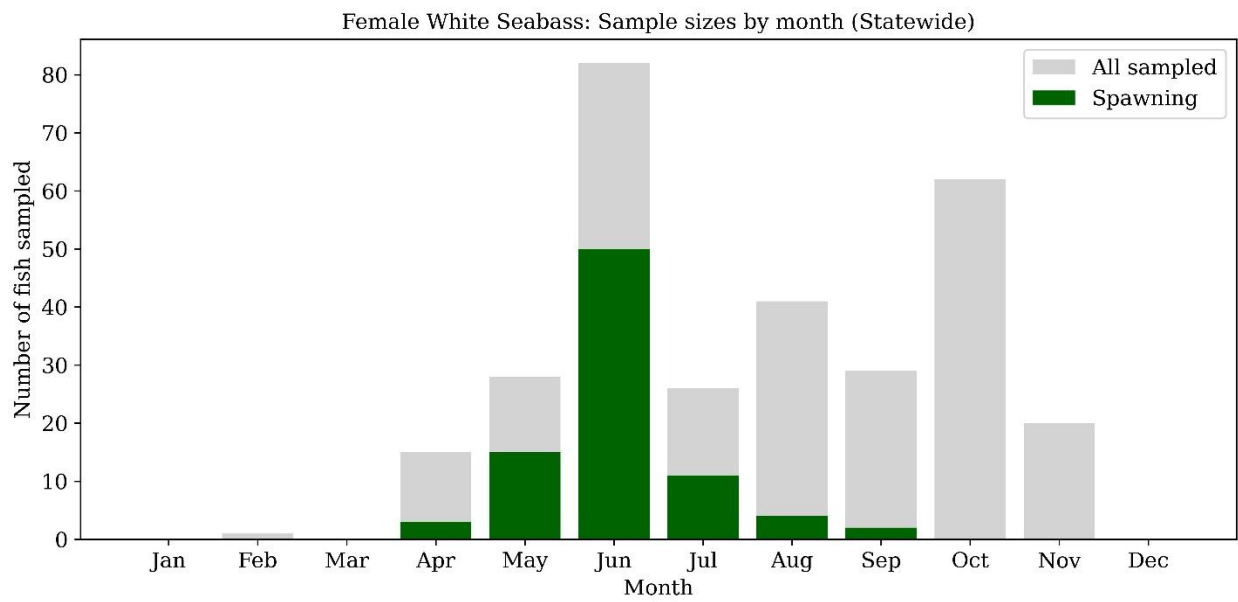
Figure S1. (a) Female white seabass (*Atractoscion nobilis*) age-based maturity ogive obtained by transforming the fitted length-based logistic model through the female von Bertalanffy growth curve ($L_{\infty} = 1,588$ mm, $K = 0.126$ yr $^{-1}$, $t_0 = -1.344$ yr; Shane et al. 2025). The solid line shows predicted probability of maturity versus age; the shaded band is the 95% confidence interval of

the logistic fit projected onto age (growth parameter uncertainty not propagated). Vertical dashed lines mark $A_5 = 4.3$ y (purple), $A_{50} = 5.2$ y (green), and $A_{95} = 6.3$ y (purple); the horizontal dashed line marks 50% probability of maturity. (b) Male white seabass age-based maturity ogive obtained by transforming the fitted length-based logistic model through the male von Bertalanffy growth curve ($L_\infty = 1,306$ mm, $K = 0.167$ yr⁻¹, $t_0 = -1.238$ yr; Shane et al. 2025). The solid line shows predicted probability of maturity versus age; the shaded band is the 95% confidence interval of the logistic fit projected onto age (growth parameter uncertainty not propagated). Vertical dashed lines mark $A_5 = 2.2$ y (purple), $A_{50} = 3.2$ y (green), and $A_{95} = 4.3$ y (purple); the horizontal dashed line marks 50% probability of maturity.

(a)



(b)



(c)

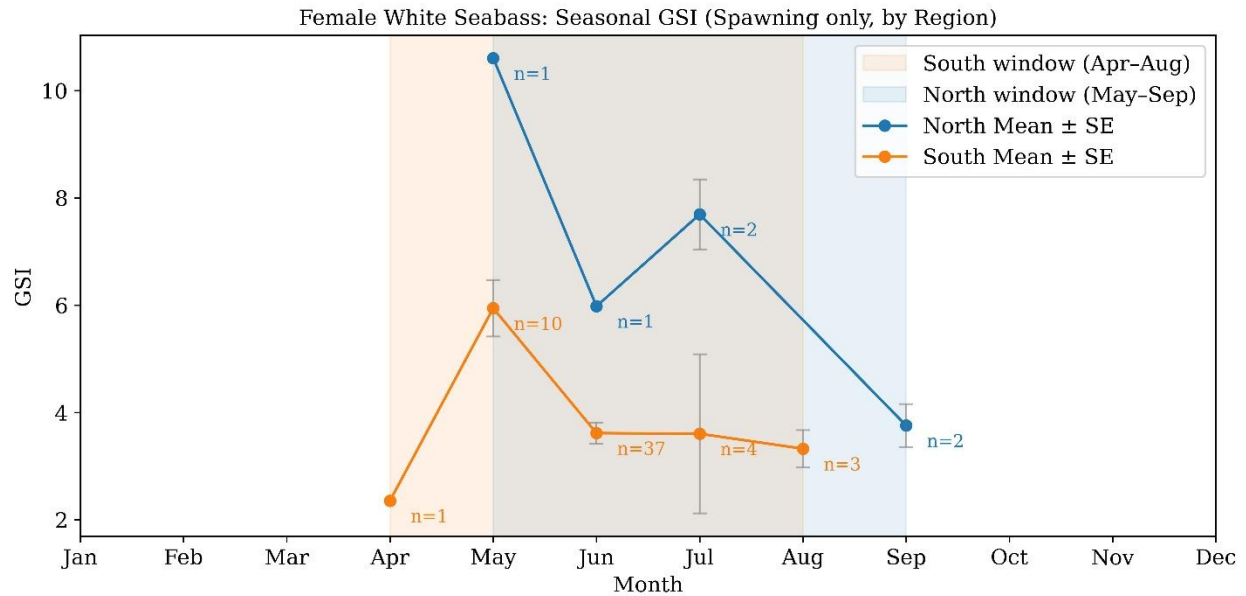
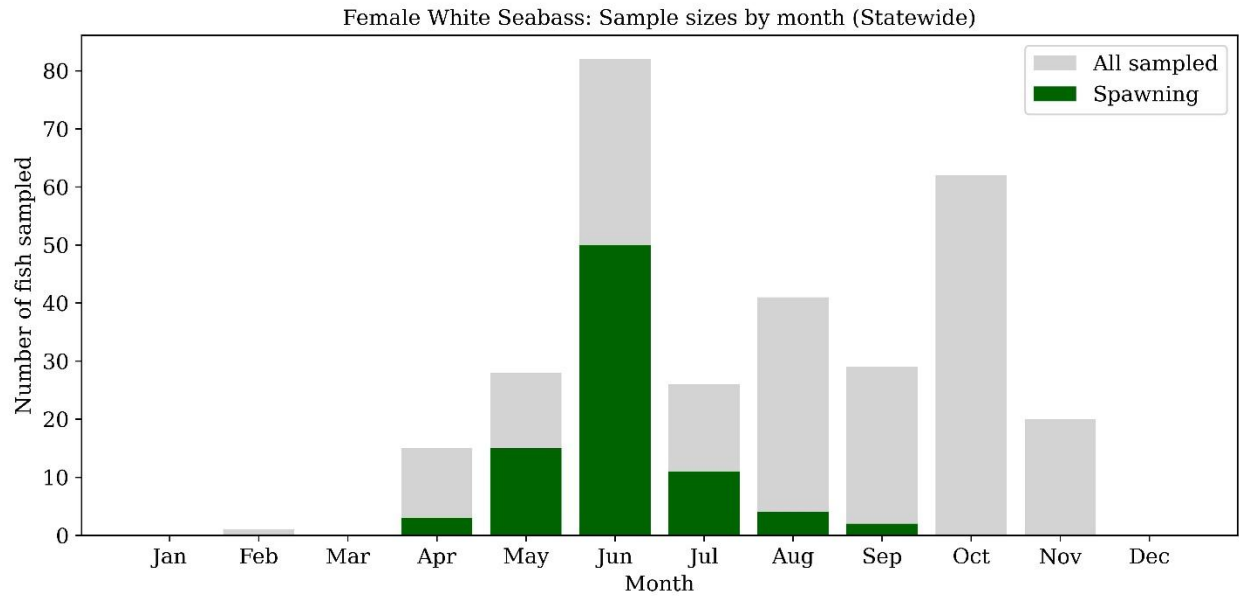


Figure S2. (a) Monthly mean ($\pm$ SE) GSI for histologically confirmed spawning female white seabass (*Atractoscion nobilis*) statewide. Points are annotated with sample sizes (n). The green shaded band denotes the spawning window (Apr–Sept), statewide. GSI peaks in May and remains elevated into summer. (b) Stacked histogram of monthly sample sizes for all females (light gray) and the subset classified as spawning (dark green), statewide. Most spawning-confirmed samples occur from late spring through summer, coincident with months of elevated GSI. (c) Monthly mean ($\pm$ SE) GSI for histologically confirmed spawning female white seabass by region. Points are annotated with sample sizes (n). Shaded bands denote the maximum spawning duration observed in southern California (Apr–Aug) and northern California (May–Sept). Maximum spawning duration was defined by the occurrence of at least one histologically confirmed spawning female within a given month and does not reflect spawning intensity.

(a)



(b)

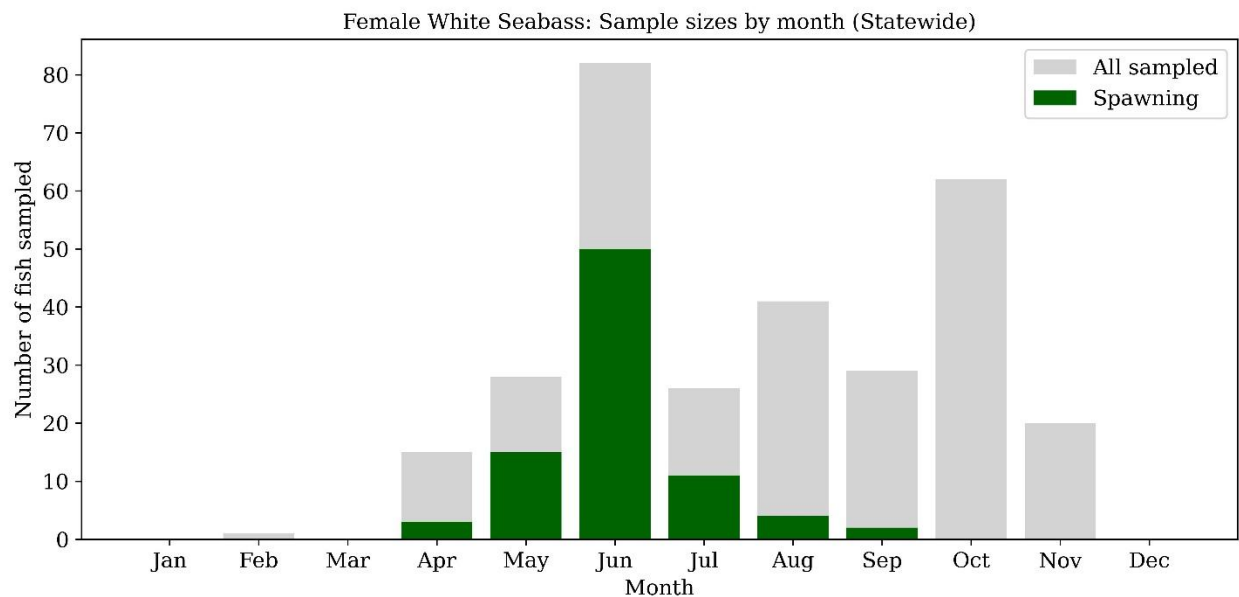


Figure S3. (a) Percent frequency distribution of commercially sampled white seabass (*Atractoscion nobilis*) collected by CDFW statewide from 2008–2025 ($n = 4,599$). Dashed lines indicate estimated female L_{50} (895 mm TL) and the current minimum size limit (711 mm). Fish <700 mm were grouped into the leftmost bin (***). (b) Percent frequency distribution of recreationally sampled white seabass collected by CDFW statewide from 2008–2025 ($n = 3,042$). Dashed lines indicate estimated female L_{50} (895 mm TL) and the current minimum size limit (711 mm). Fish <700 mm were grouped into the leftmost bin (***)