Appendix A

Cumulative distribution function can completely describe the probability distribution of a random variable *x*, which was used to represent the probability that *x* was smaller than or equal to a given value *y*. The probability that *x* is in the semi-closed interval (a, b; where a<b) can be calculated according to the distribution function. The cumulative probability of a given value of *y* can be calculated, and CDF was used in determining the probability that random observations taken from the population will be less than or equal to a specific value. The CDF can be used to determine the probability that an observation is greater than a specific value or within an interval. Therefore, this method can be used in predicting the specific value of the *P. trituberculatus* recruitment at a certain probability level and can be used in calculating its distribution range. This method is extremely helpful in expressing the probability of data points appearing in a certain interval. The true cumulative distribution function at the time of the cumulative distribution function is unknown, and it is usually defined as the integral of the histogram distribution:

$$CDF(x) \approx \int_{-\infty}^{x} dt\ histo(t) \qquad (A1)$$

Appendix B

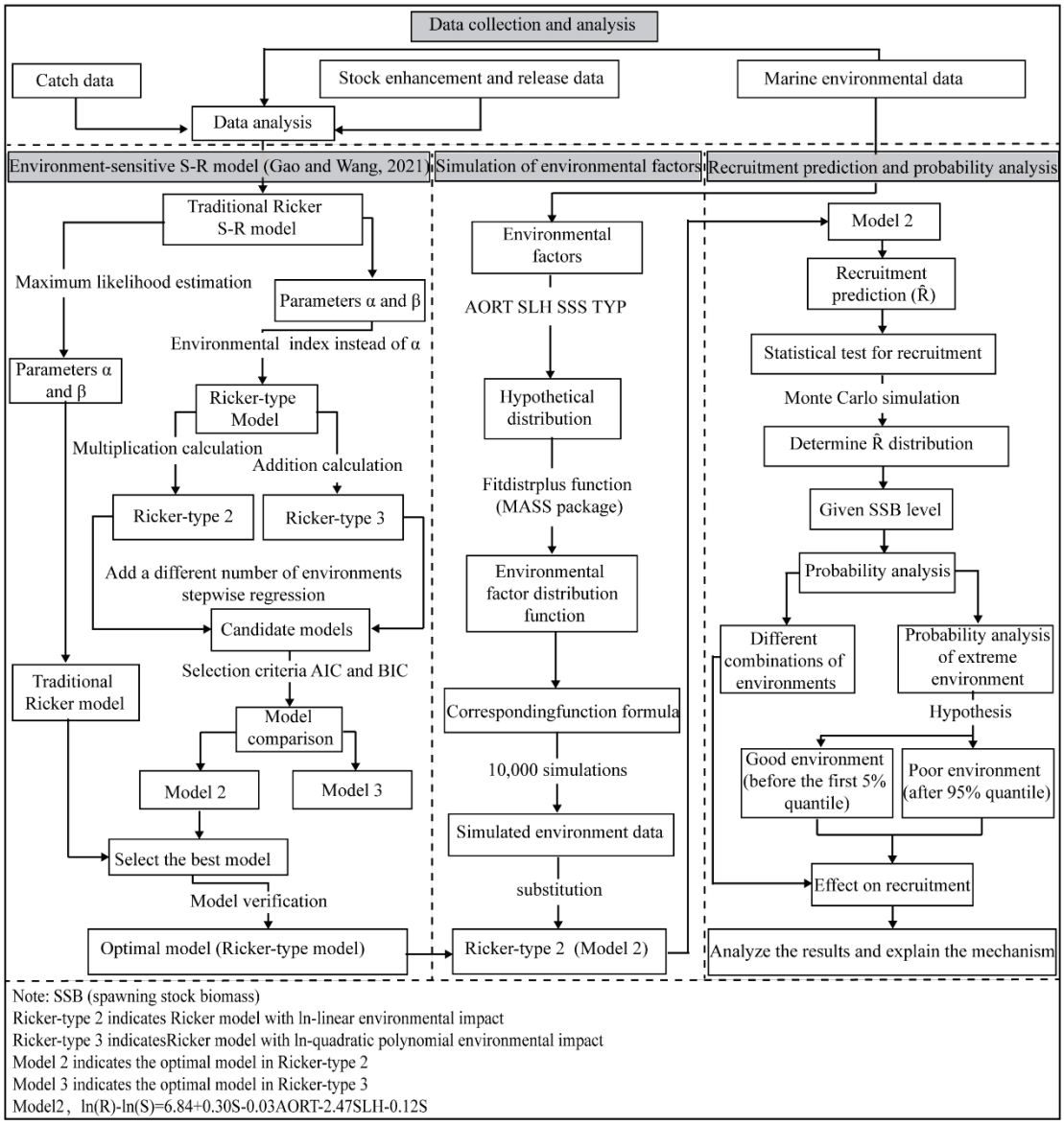
The Akaike information criterion (AIC) and the Bayesian information criterion (BIC) are greatly important for model selection and evaluation (the model with the lowest AIC or BIC value is the best model). The two criteria were used together to find the models they both support. When the criteria agree on the best model, the robustness of the selection is guaranteed (Kuha, 2004). The formulas are as follows:

$$AIC = 2k - 2\,ln(L) \qquad (B1)$$

$$BIC = k\,ln(n) - 2\,ln(L) \qquad (B2)$$

where *k* and *n* represent the number of parameters and observed data, respectively. And L is the likelihood function.

FIGURE A1 The Research Process Flow Chart.



Note: SSB (spawning stock biomass)
Ricker-type 2 indicates Ricker model with ln-linear environmental impact
Ricker-type 3 indicatesRicker model with ln-quadratic polynomial environmental impact
Model 2 indicates the optimal model in Ricker-type 2
Model 3 indicates the optimal model in Ricker-type 3
Model2，ln(R)-ln(S)=6.84+0.30S-0.03AORT-2.47SLH-0.12S

TABLE A1 Significant test results of the Ricker-type S-R model (an environment-based Ricker model in which with log-linear environmental impact) for *Portunus trituberculatus* in the northern East China Sea (Gao and Wang, 2021).

Parameters	**Coefficients**	**Estimate**	**Std. Error**	***t* value**	***P* value**
	Intercept	6.841	1.211	5.65	0.000 ***
S	Coefficients of S	-0.300	0.079	-3.785	0.005 **
AORT	Coefficients of AORT	-0.031	0.013	-2.406	0.043 *
SLH	Coefficients of SLH	-2.469	0.830	-2.974	0.018 *
SSS	Coefficients of SSS	-0.118	0.036	-3.261	0.012 *
TYP	Coefficients of TYP	-0.258	0.092	-2.809	0.023 *

Note: "***" means *P* value $\in$ [0, 0.001]. Generally, the *P* value less than 0.05 (typically $\leq$0.05) means statistically significant.

References

Gao, L., and Wang, Y. (2021). Influences of environmental factors on the spawning stock-recruitment relationship of *Portunus trituberculatus* in the northern East China Sea. *Acta Oceanologica Sinica* 40**,** 145-159. doi: 10.1007/s13131-021-1801-7

Kuha, J. (2004). AIC and BIC: Comparisons of assumptions and performance. *Sociological methods & research* 33**,** 188-229. doi: 10.1177/0049124103262065