

**Prior Selection in Estimating Population Size Based
on Capture-recapture Model**

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Sunfish Example:

- Gerking (1953) gave a survey of the number of redear sunfish caught at Gordy Lake, Indiana.

Redear sunfish counts														
Sampling occasion i	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Animals caught n_i	10	27	17	7	1	5	6	15	9	18	16	5	7	19
Total animals captured n	138													

- Unknown parameters:
 - population size: N
 - capture probability: $\mathbf{p} = (p_1, p_2, \dots, p_{14})$
- Priors (Castledine 1981, Smith 1988, 1991, George & Robert 1992)

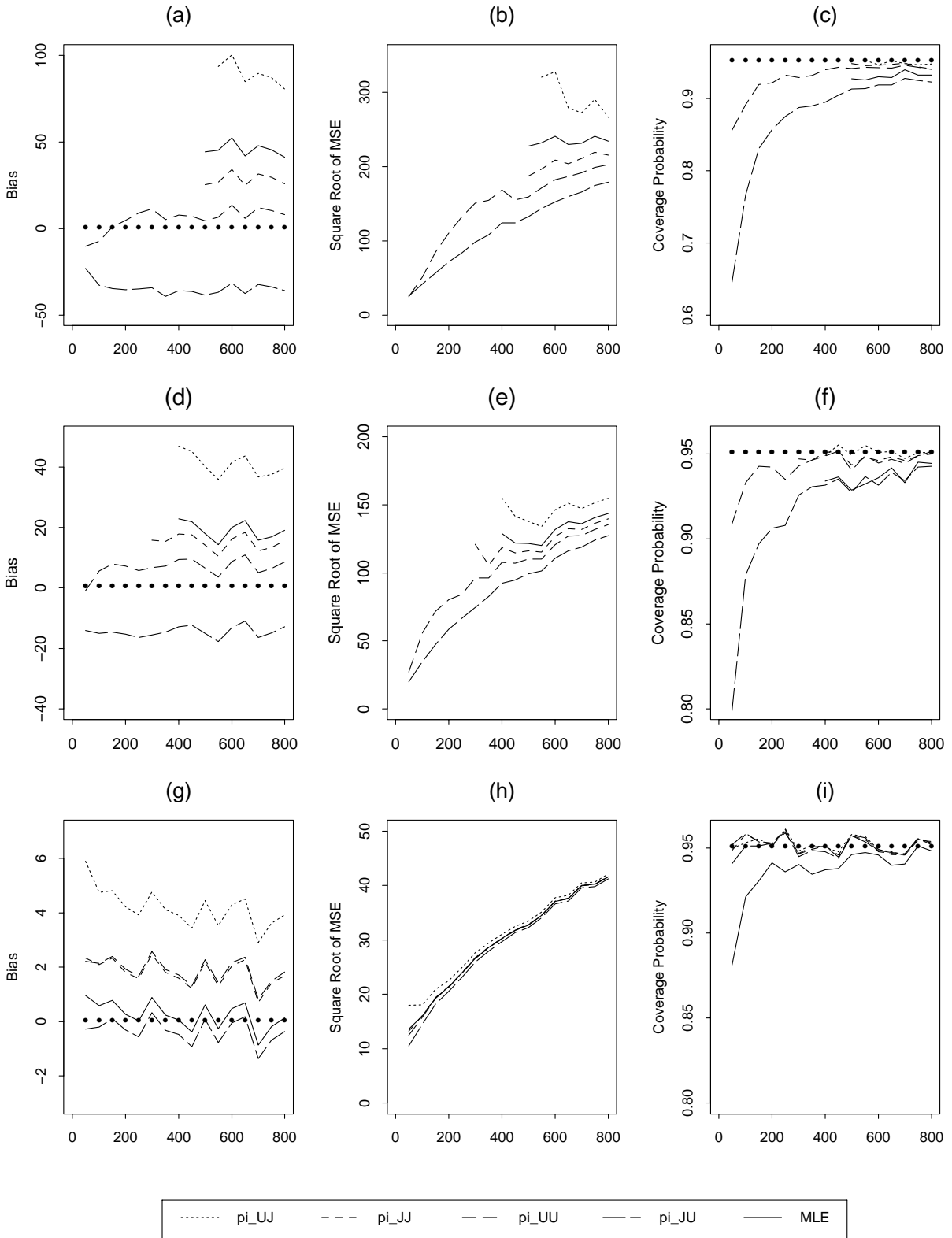
$$\pi_r(N) \propto \frac{1}{N^r} \quad \text{and} \quad \pi(p_j) \propto p_j^{a_j-1} (1-p_j)^{b_j-1}$$

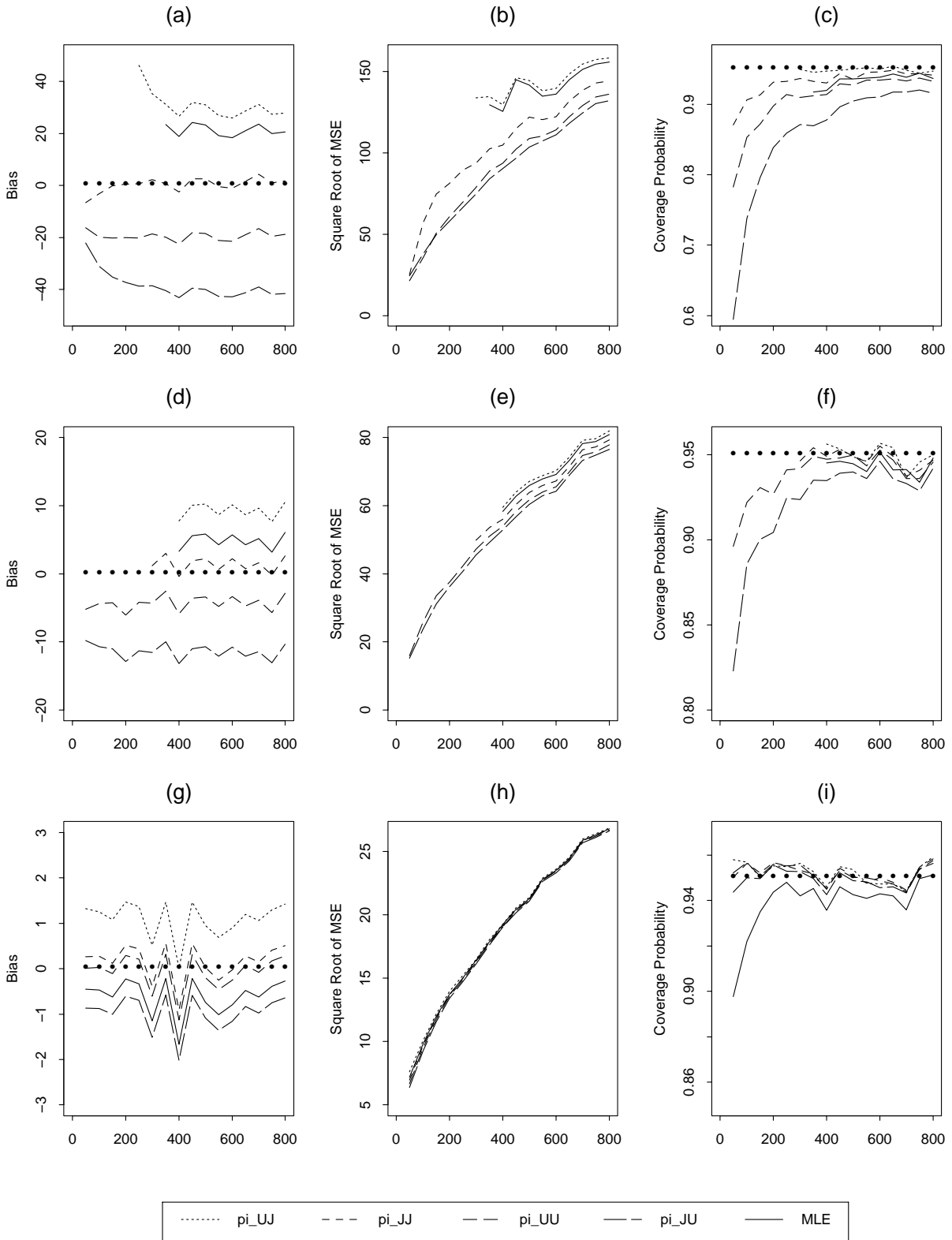
Bayesian estimates of N for different priors

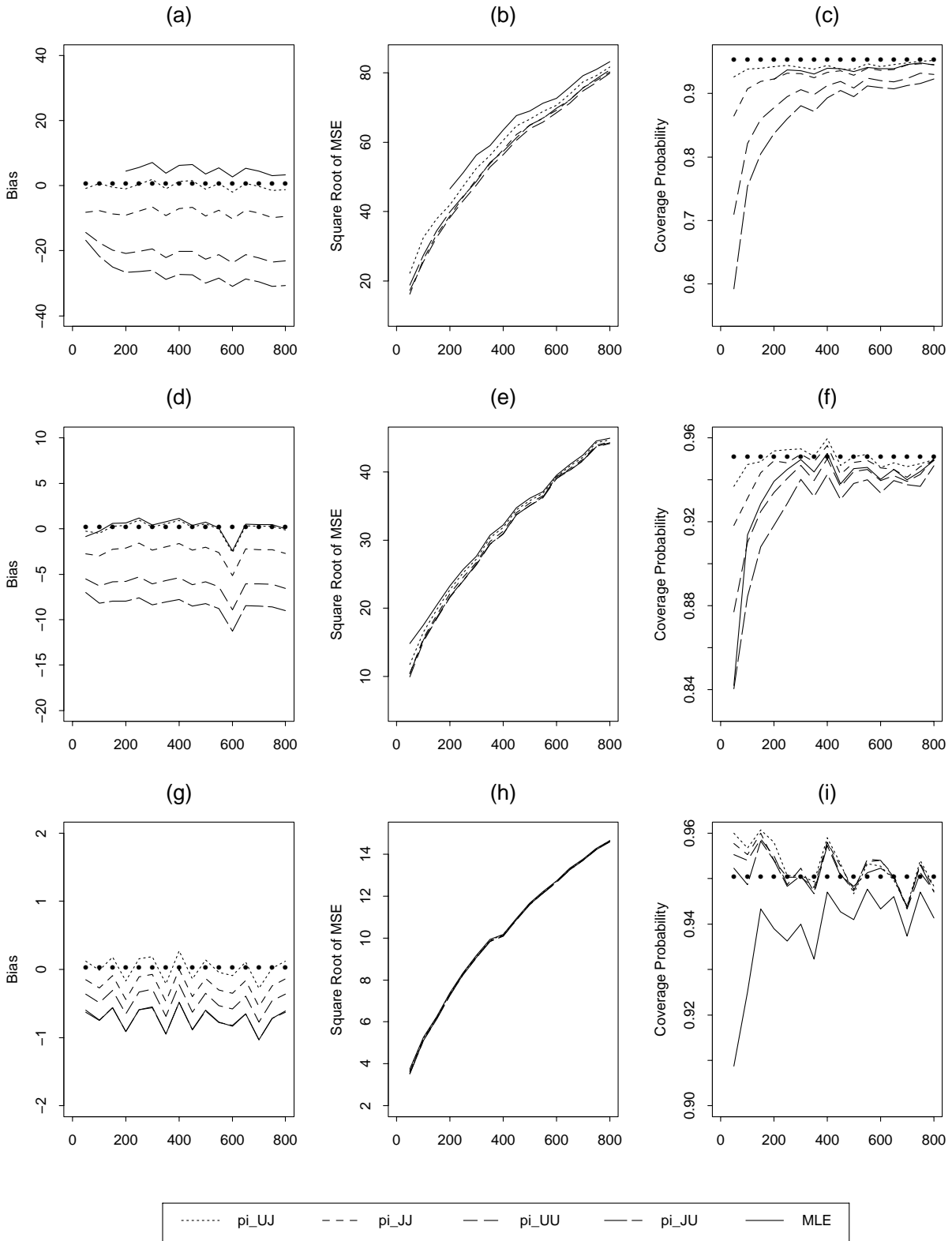
r	a	b	mean of N	std of N	95% CI
0	.5	.5	391	65	(293,455)
0	1	1	338	47	(264,455)
1	.5	.5	380	59	(286,510)
1	1	1	331	46	(256,432)
MLE			445	79	(290,600)

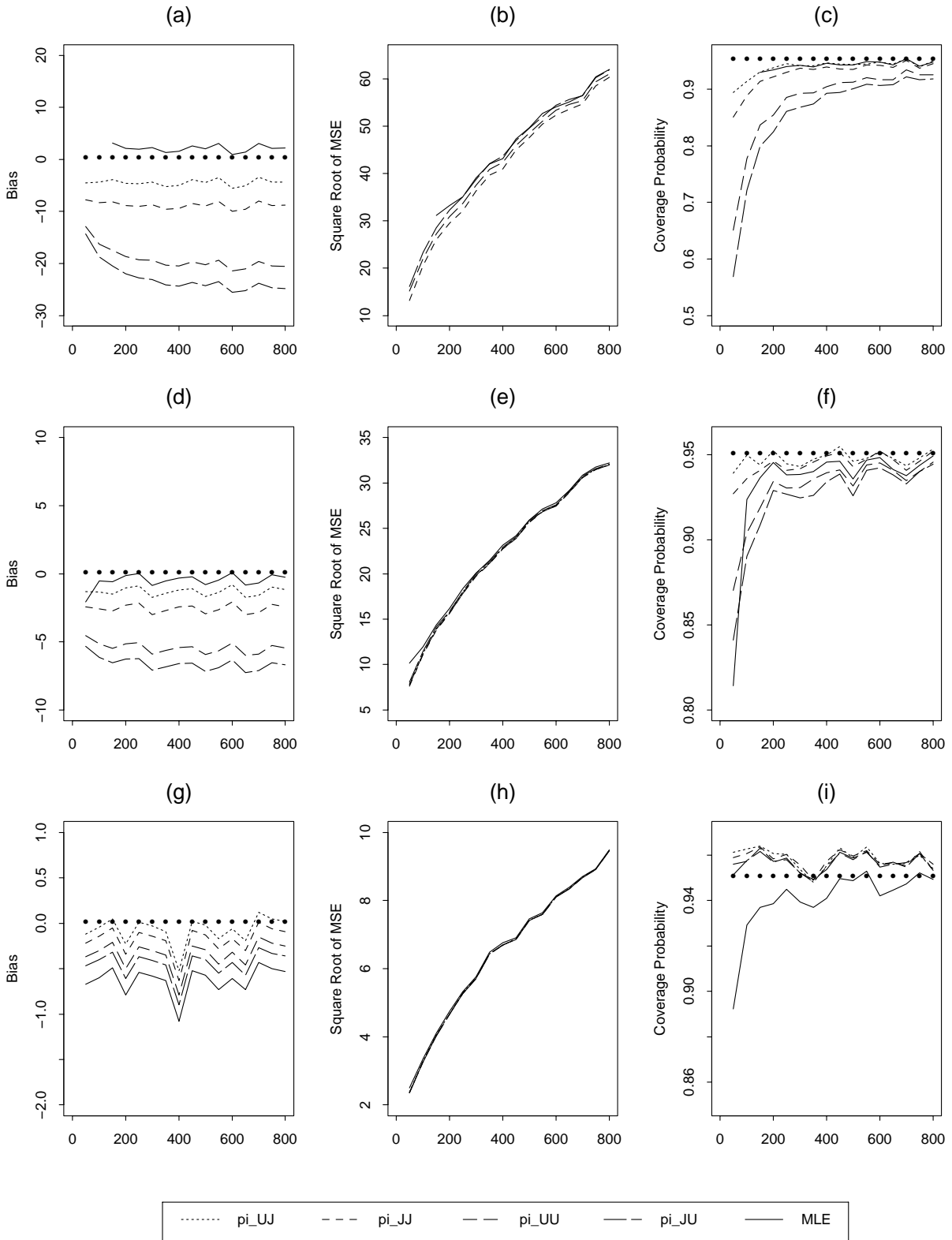
Remarks

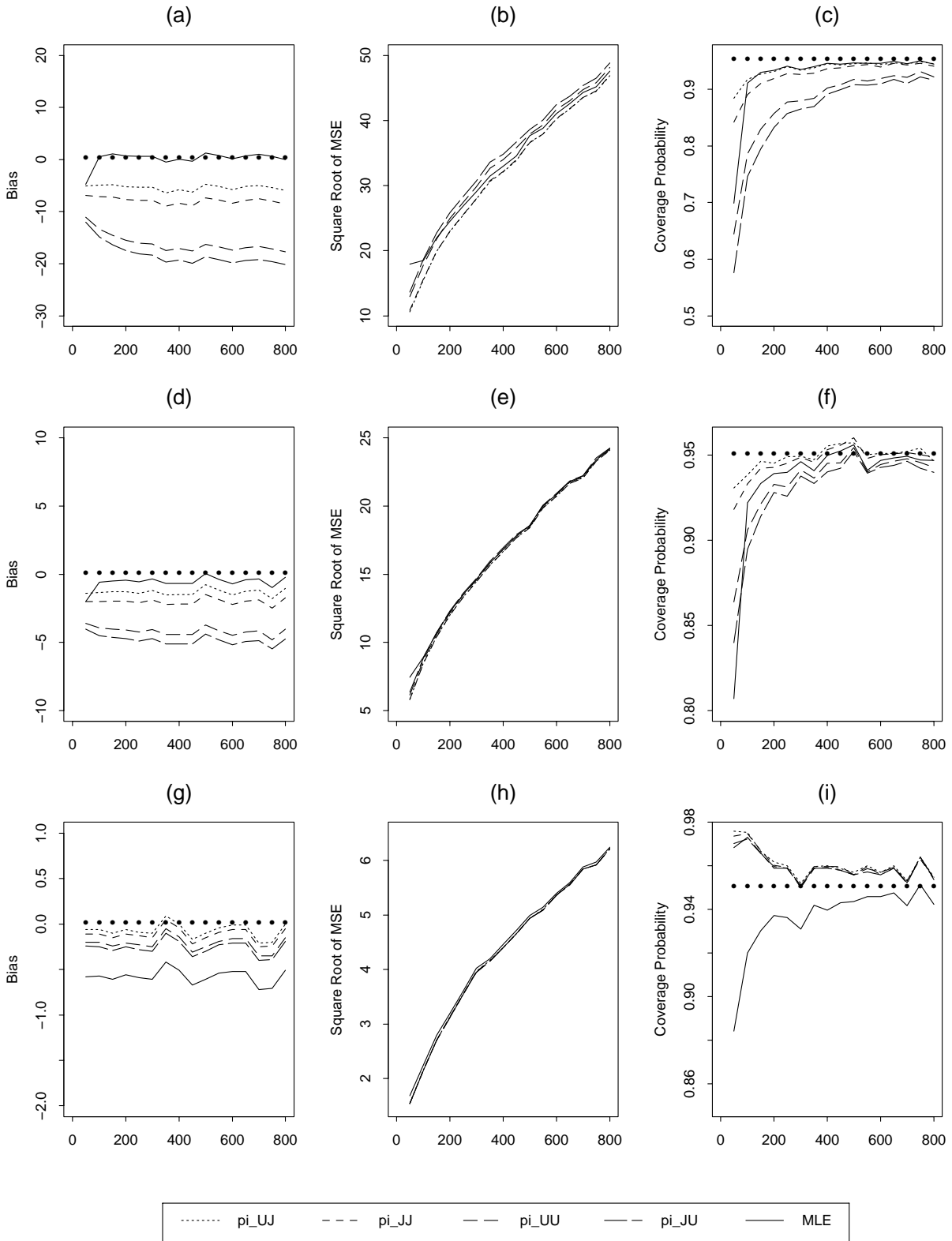
- The Bayesian estimates of population size is sensitive to the choice of noninformative priors when capture probabilities are small.
- The choice of priors depends on the number of sampling occasions.

Figure 1: Simulation Results for $k = 3$

Figure 2: Simulation Results for $k = 4$

Figure 3: Simulation Results for $k = 6$

Figure 4: Simulation Results for $k = 8$

Figure 5: Simulation Results for $k = 10$