# Two Statistical Results:
# (1) An empirical Mass-Radius Relation,
# &
# (2) An Estimate of Eta-sub-Earth from Kepler

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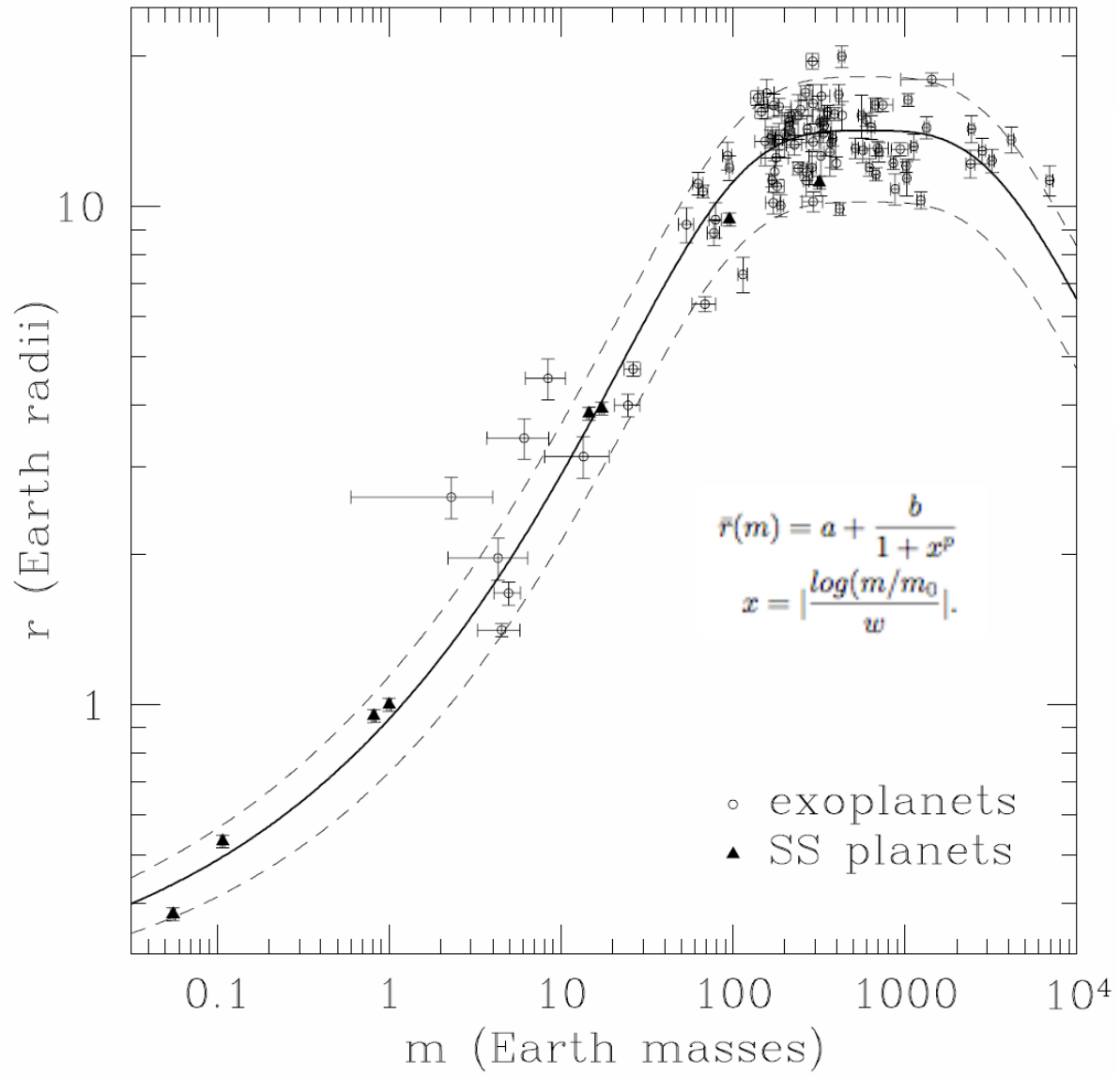
# All measured planet masses & radii




$$r(m) = a + \frac{b}{1+x^p}$$

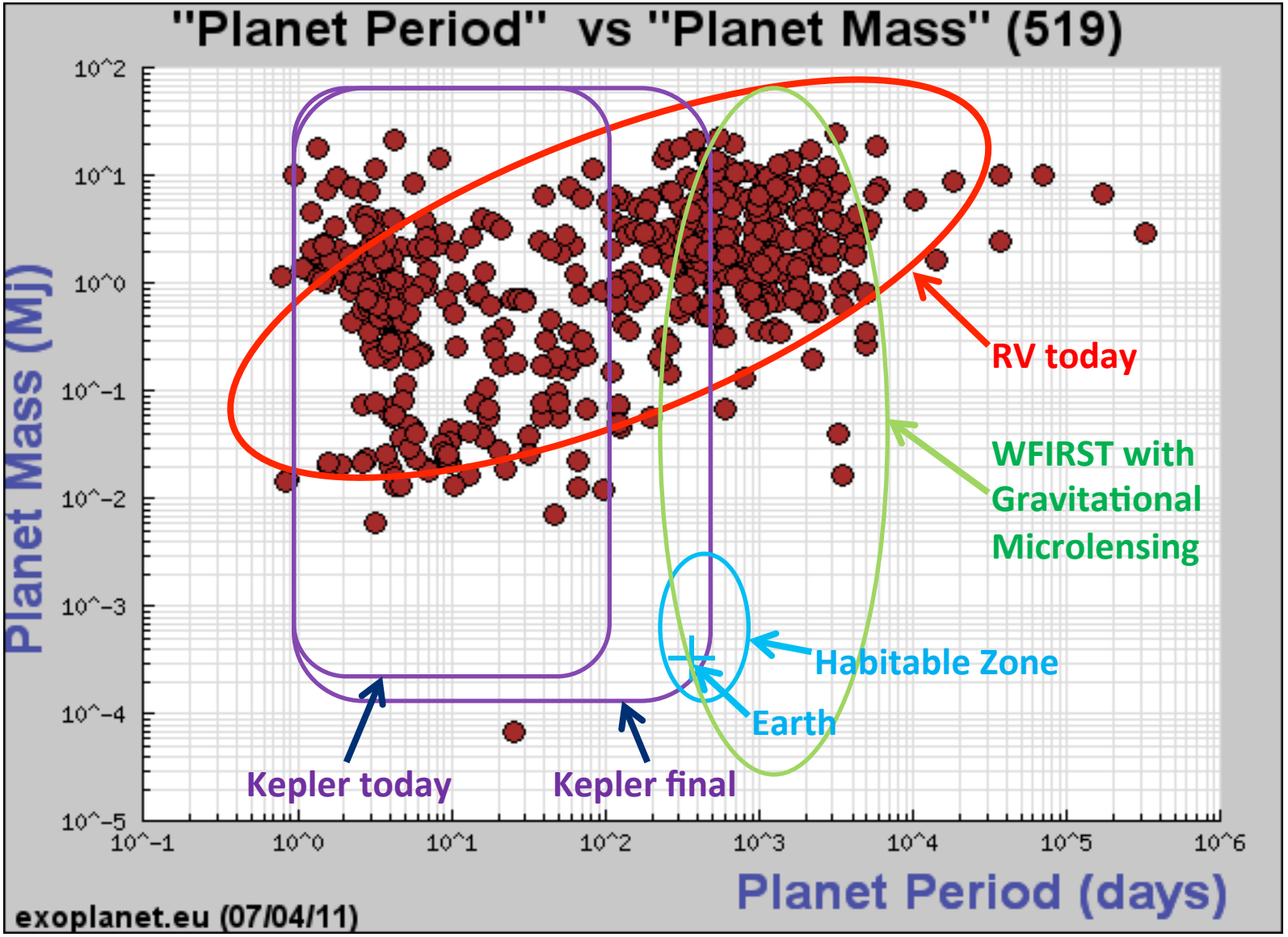
$$x = |\frac{log(m/m_0}{w}|.$$

$$P(r|m) \sim e^{-(s/\sigma_s)^2/2}$$

$$s/\sigma_s = \frac{r - \bar{r}}{0.19\bar{r}}$$

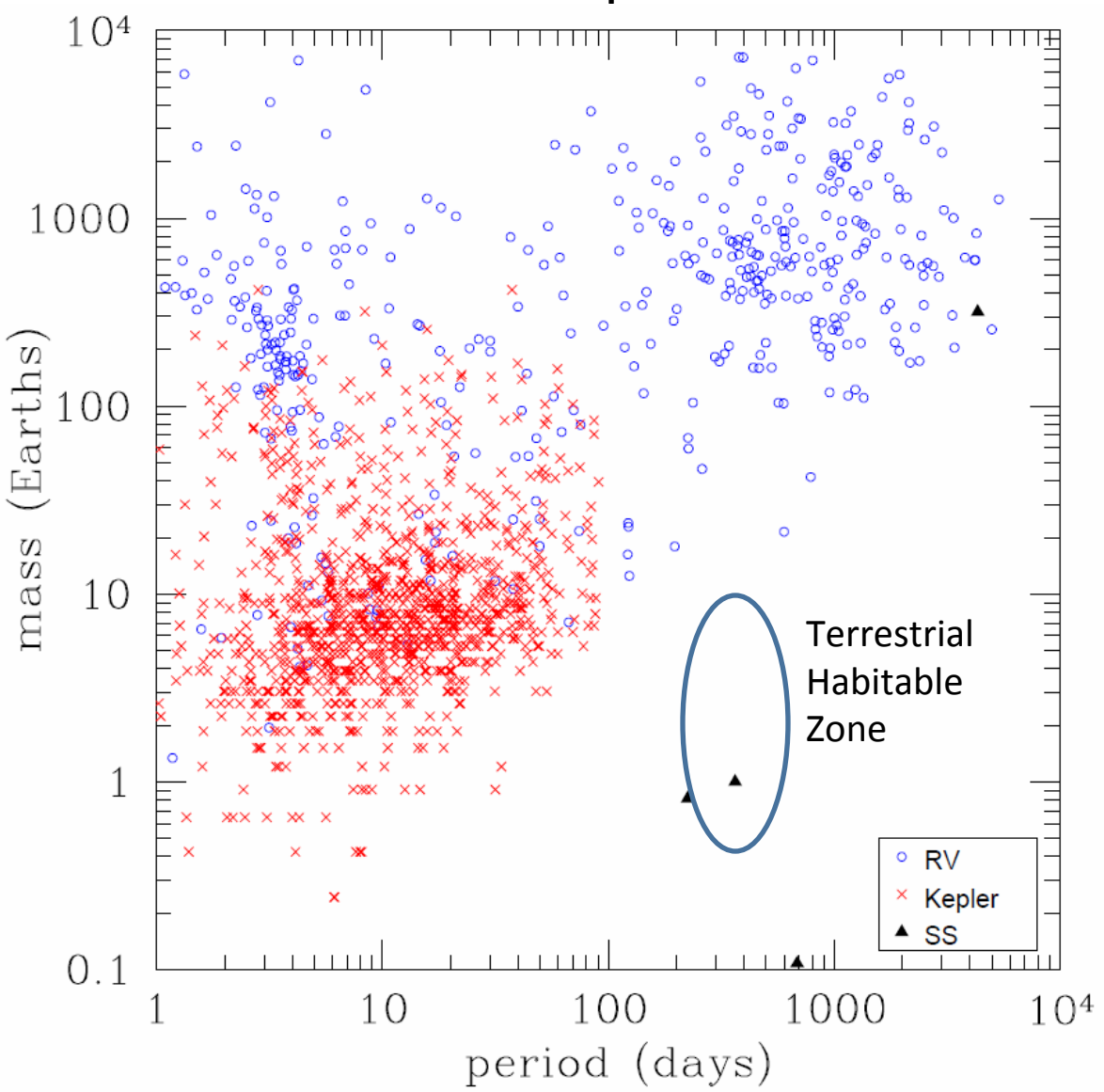
Smooth curve is a best fit to all data.
Curve can be used to convert Kepler's radii to Kepler masses.

# Exoplanet Period-Mass Diagram

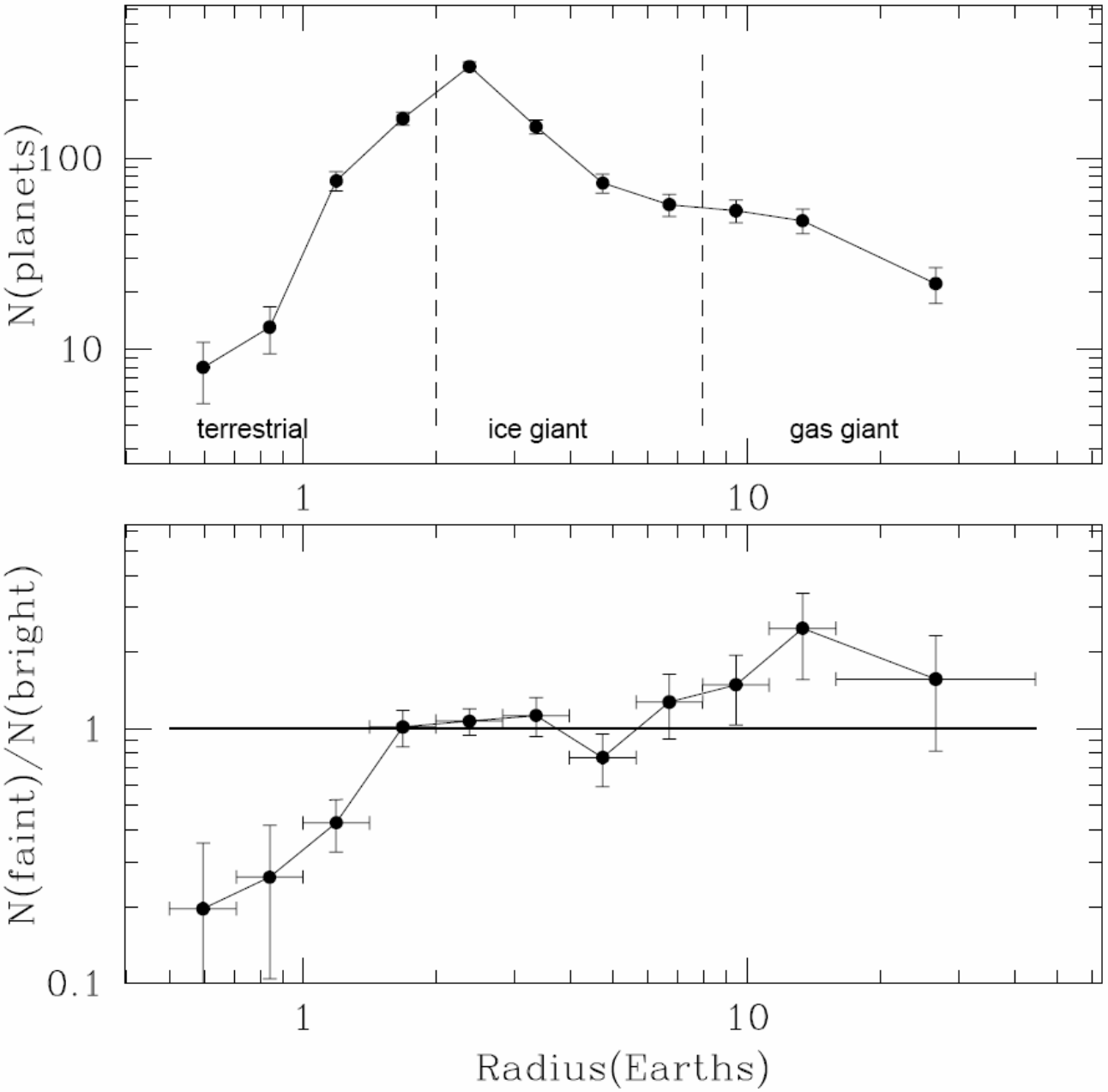



The statistics from Kepler & WFIRST will overlap in the crucial terrestrial HZ region.

# All exoplanet Msin(i) and M(Kepler, est.) masses vs orbital period



# All planets, FGK stars, log(r) bins




For faint stars (V>14) only 38% of small planets (r < 1.41) are detected.

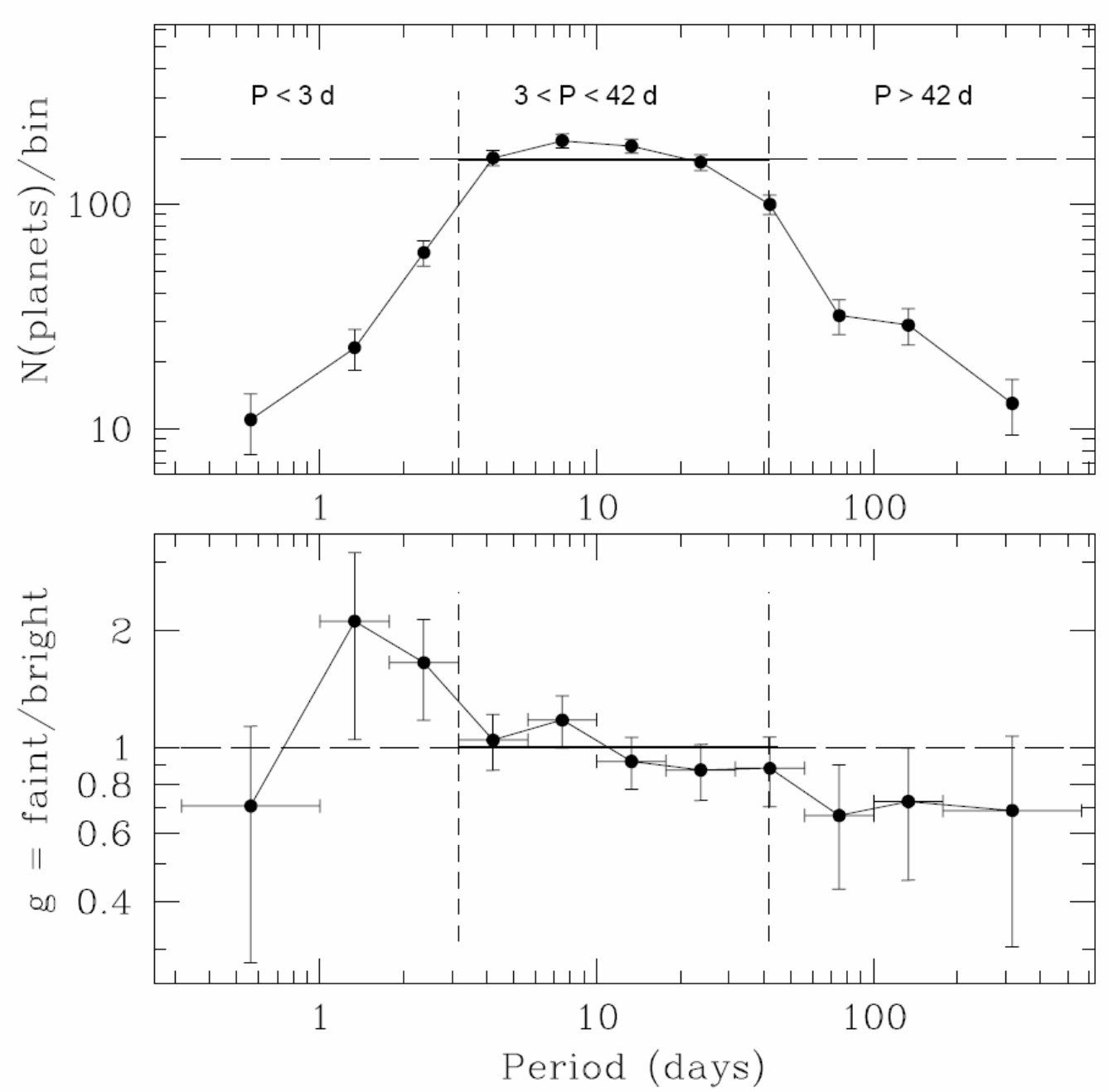
Table 2. Radius Distribution vs Spectral Type

| planet type | $log(r)$ (min, max) | n($K_p < 14$) (F) | n($K_p < 14$) (G) | n($K_p < 14$) (K) |
|---|---|---|---|---|
| terrestrial | -0.30, 0.30 | 39 (35%) | 55 (32%) | 24 (33%) |
| ice giant | 0.30, 0.90 | 60 (55%) | 106 (61%) | 41 (57%) |
| gas giant | 0.90, 1.65 | 11 (10%) | 12 (7%) | 7 (10%) |
| totals | | 110 (100%) | 173 (100%) | 72 (100%) |

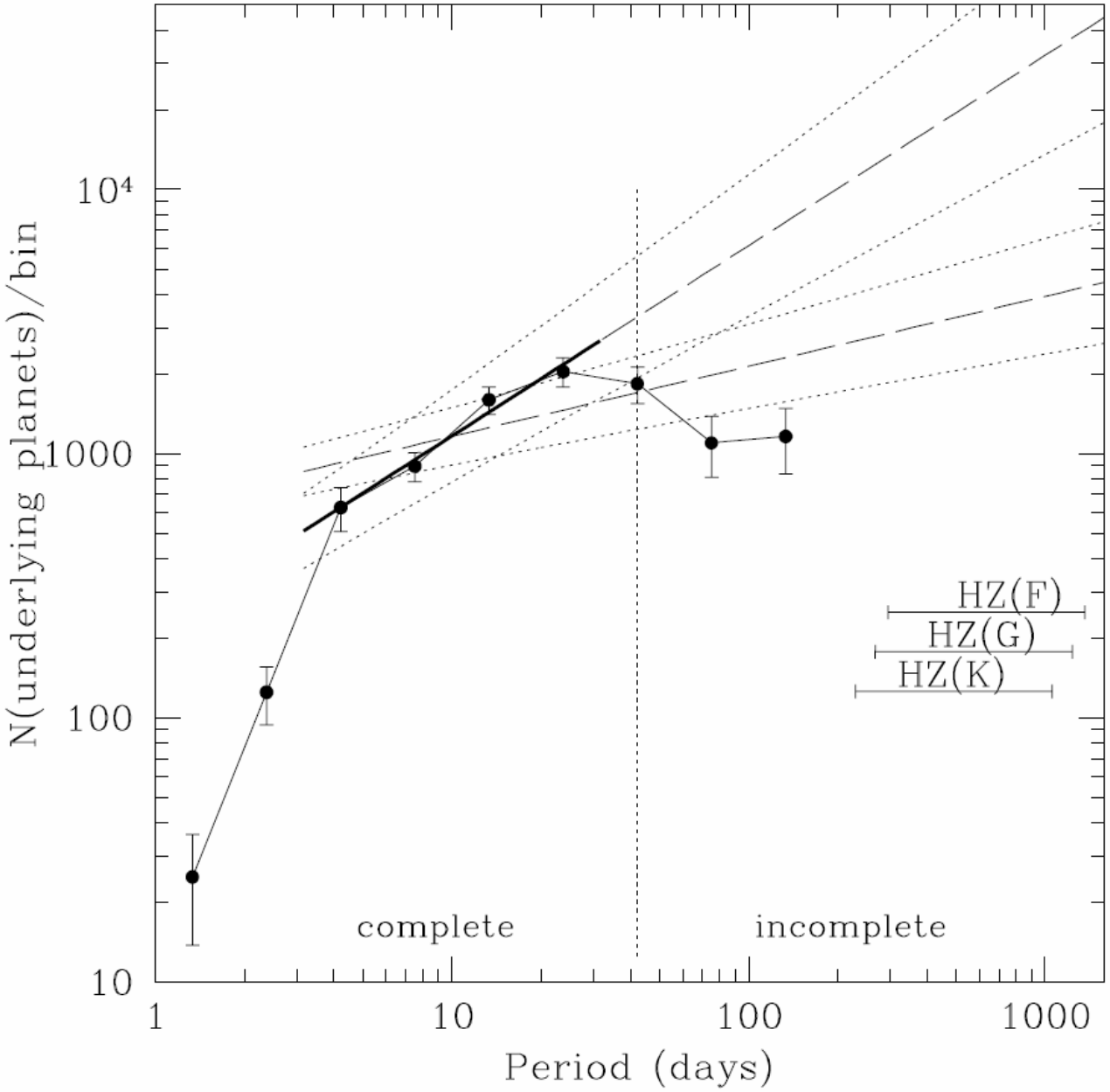
F: 6000-6500 K
G: 5500-6000 K
K: 5000-5500 K

Terrestrials (r = 0.5-2.0 Earth radius)
about 33% for F, G, or K, wrt all r

# All planets, FGK stars, log(P) bins



# All planets, bright FGK stars, log(P) bins



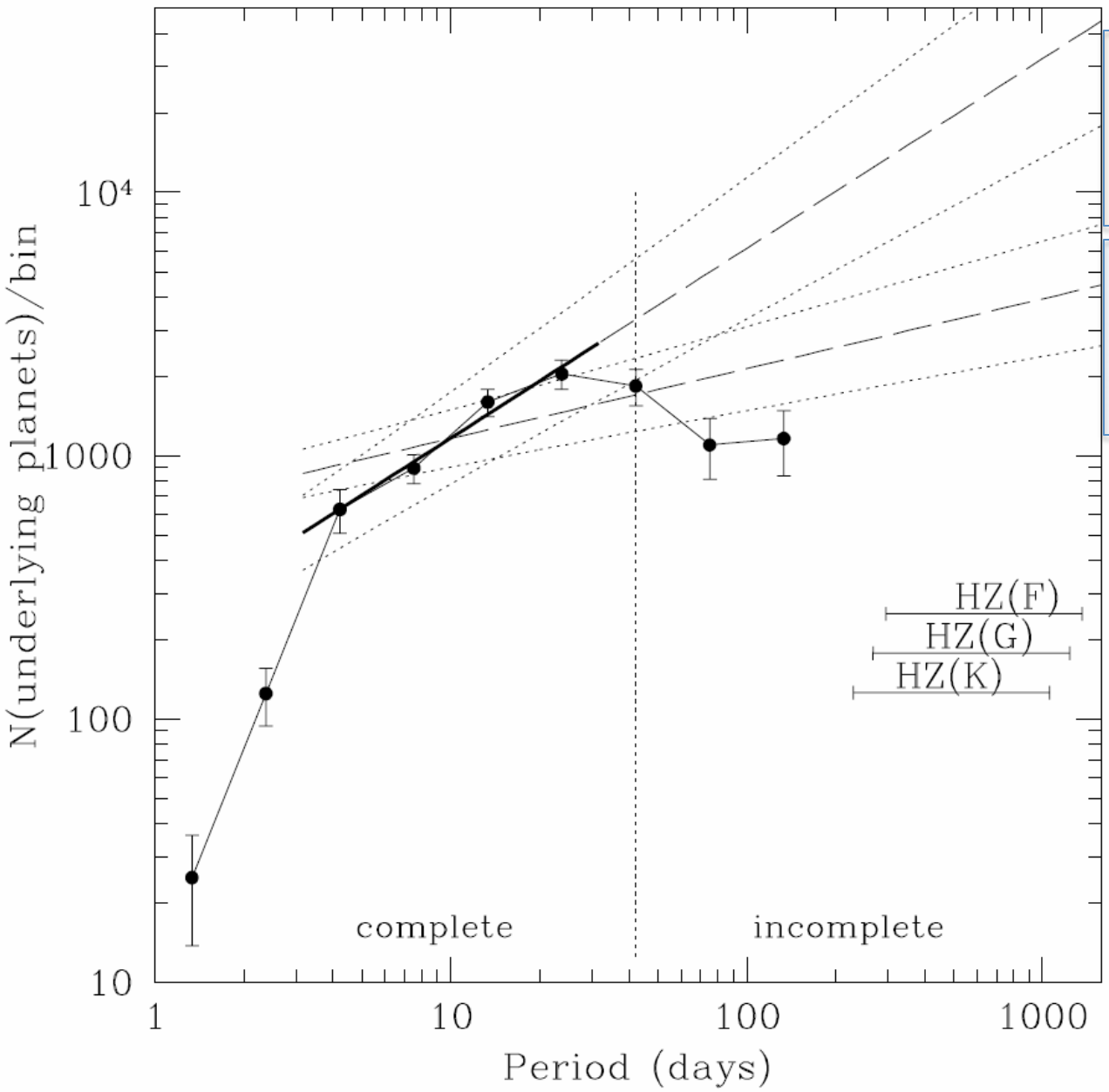

beta = 0.73 +/- 0.12

beta = 0.265 +/- 0.067

$$dN/dP = CP^{\beta-1}$$

HZ: 0.72-2.0 AU
(Kasting, 2011)

# All underlying planets, bright FGK stars, log(P) bins




beta = 0.73 +/- 0.12

eta_Earth = 448%

beta = 0.265 +/- 0.067

eta_Earth = 7%

$$dN/dP = CP^{\beta-1}$$

HZ: 0.72-2.0 AU
(Kasting, 2011)