

The Value of Enhanced NEO Surveys

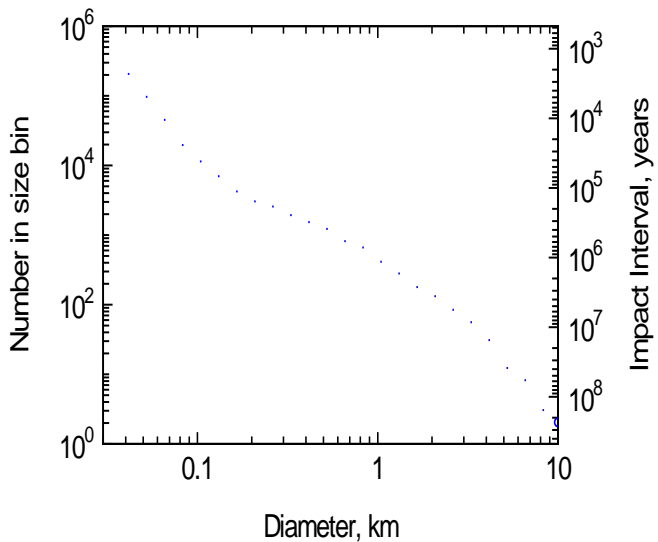
Alan Harris
MoreData! Inc.

Planetary Defense Conference
Flagstaff, AZ, April 14-19, 2013

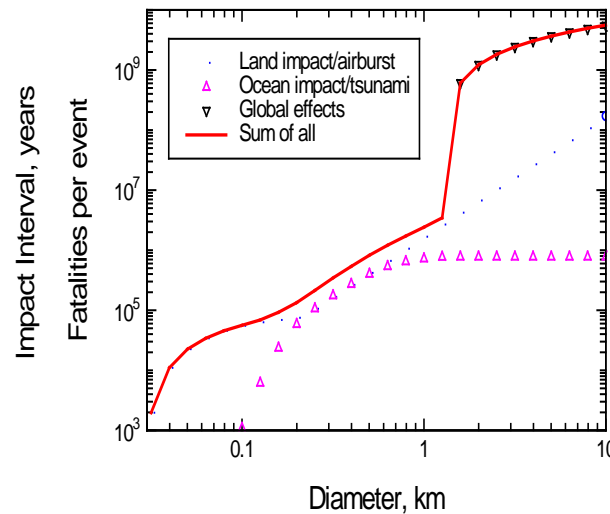
Impact Risk vs. Size of Impactor

$$\begin{array}{l} \text{Risk} \\ \text{Fatalities/year} \end{array} = \begin{array}{l} \text{Impact} \\ \text{frequency} \end{array} \times \begin{array}{l} \text{Consequence} \\ \text{Fatalities/event} \end{array} \times \begin{array}{l} \text{Fraction} \\ \text{undiscovered} \\ (1-\text{Completion}) \end{array}$$

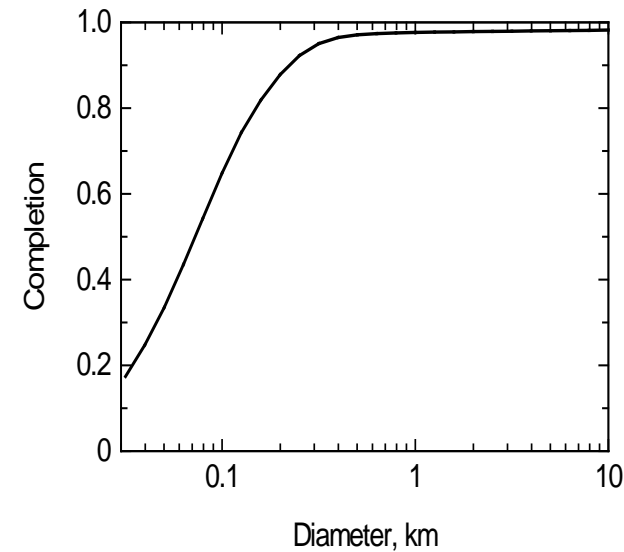
Estimated population



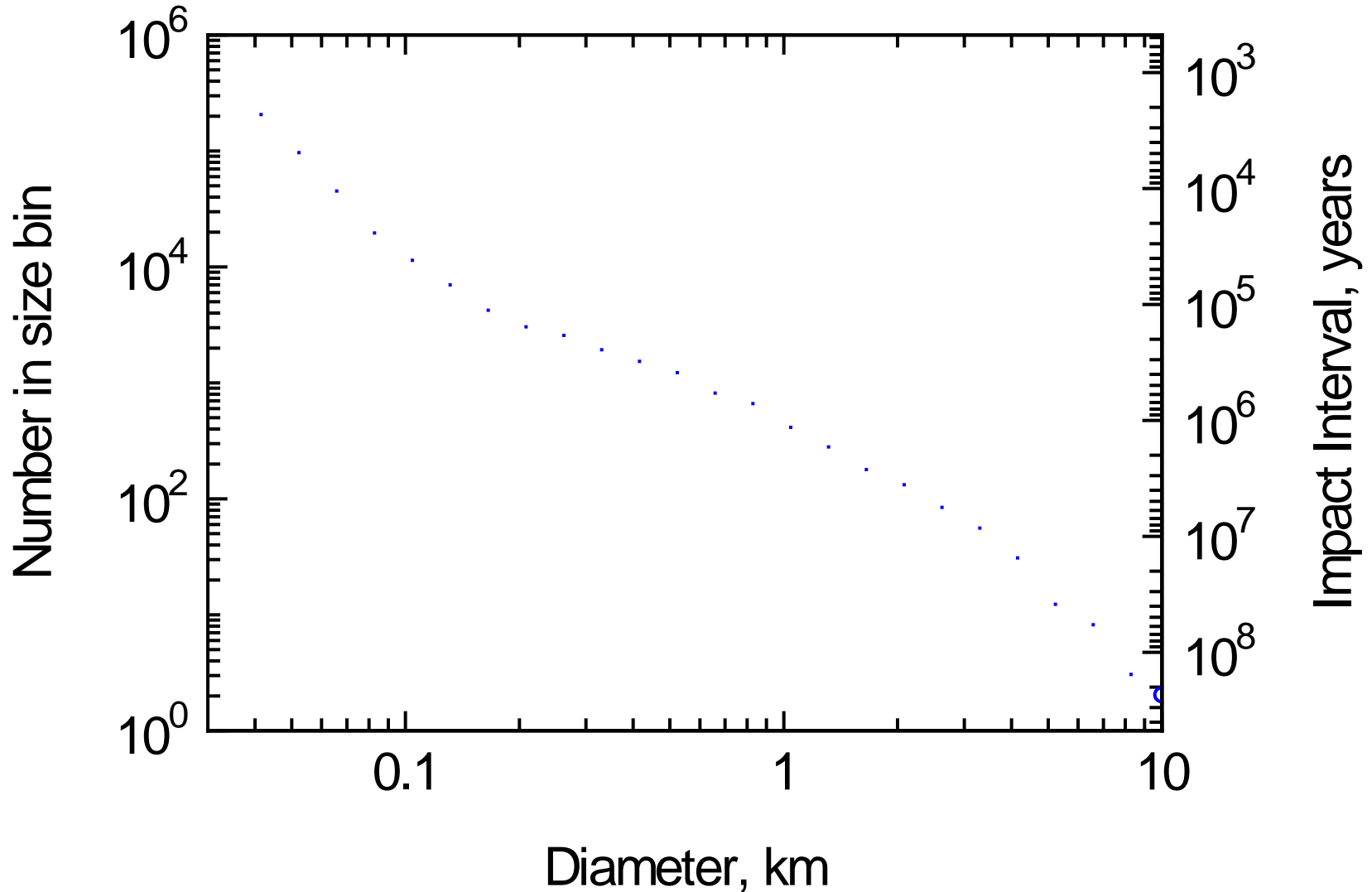
Revised Kill Curve



Completion Curve

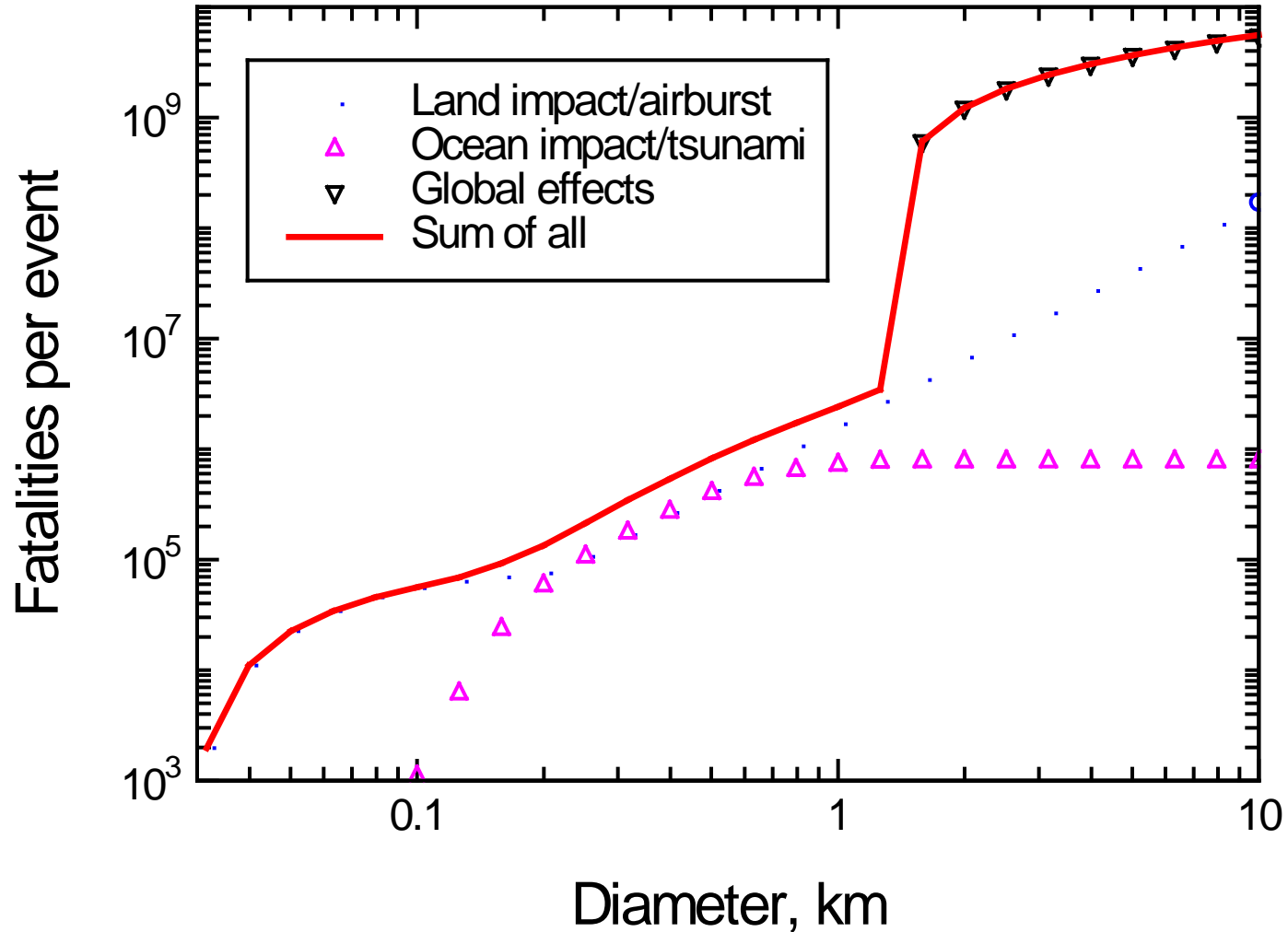


Population – Impact frequency

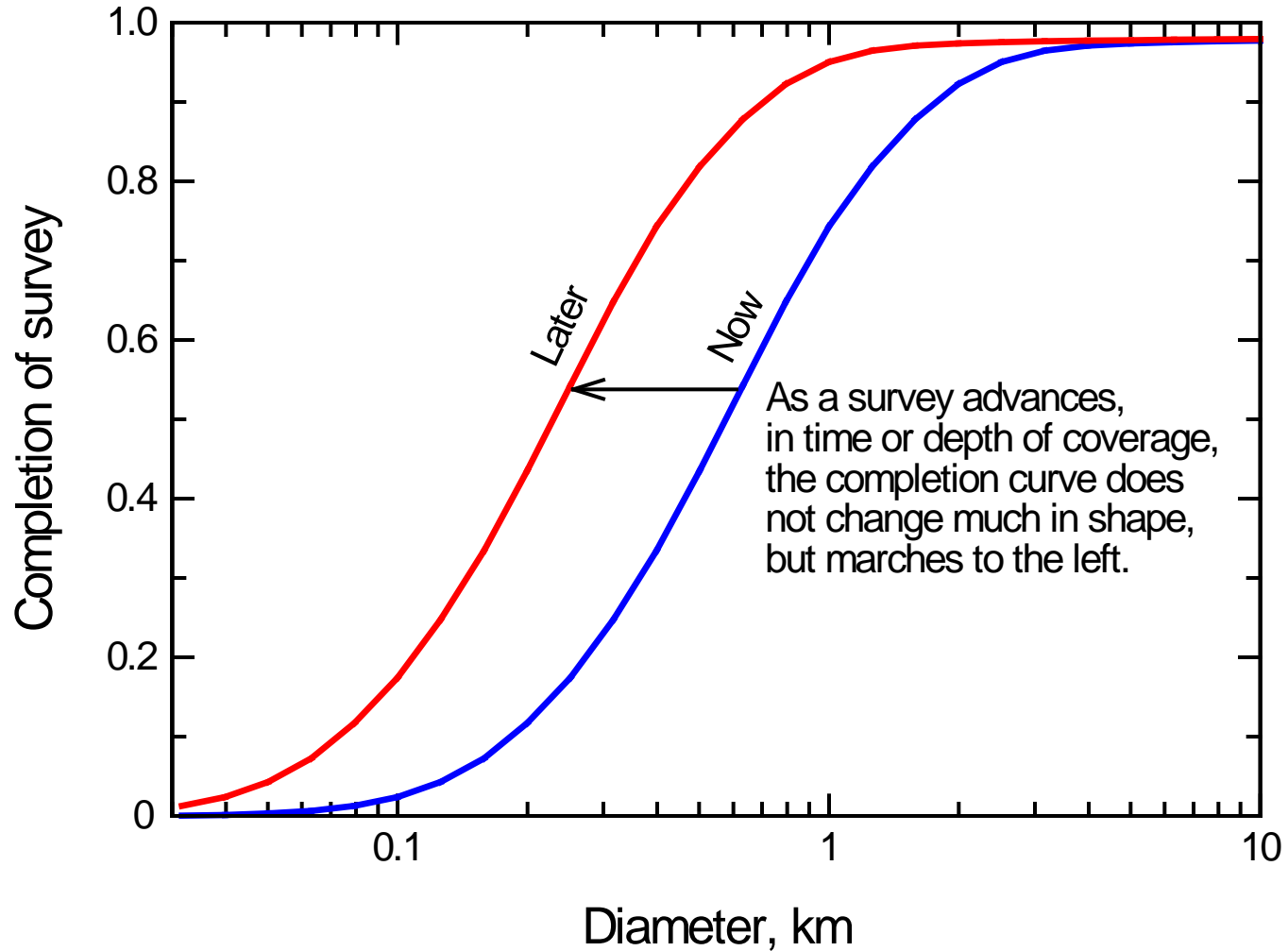


Each size bin spans about a factor of 2 in mass, or $2^{1/3}$ in diameter.

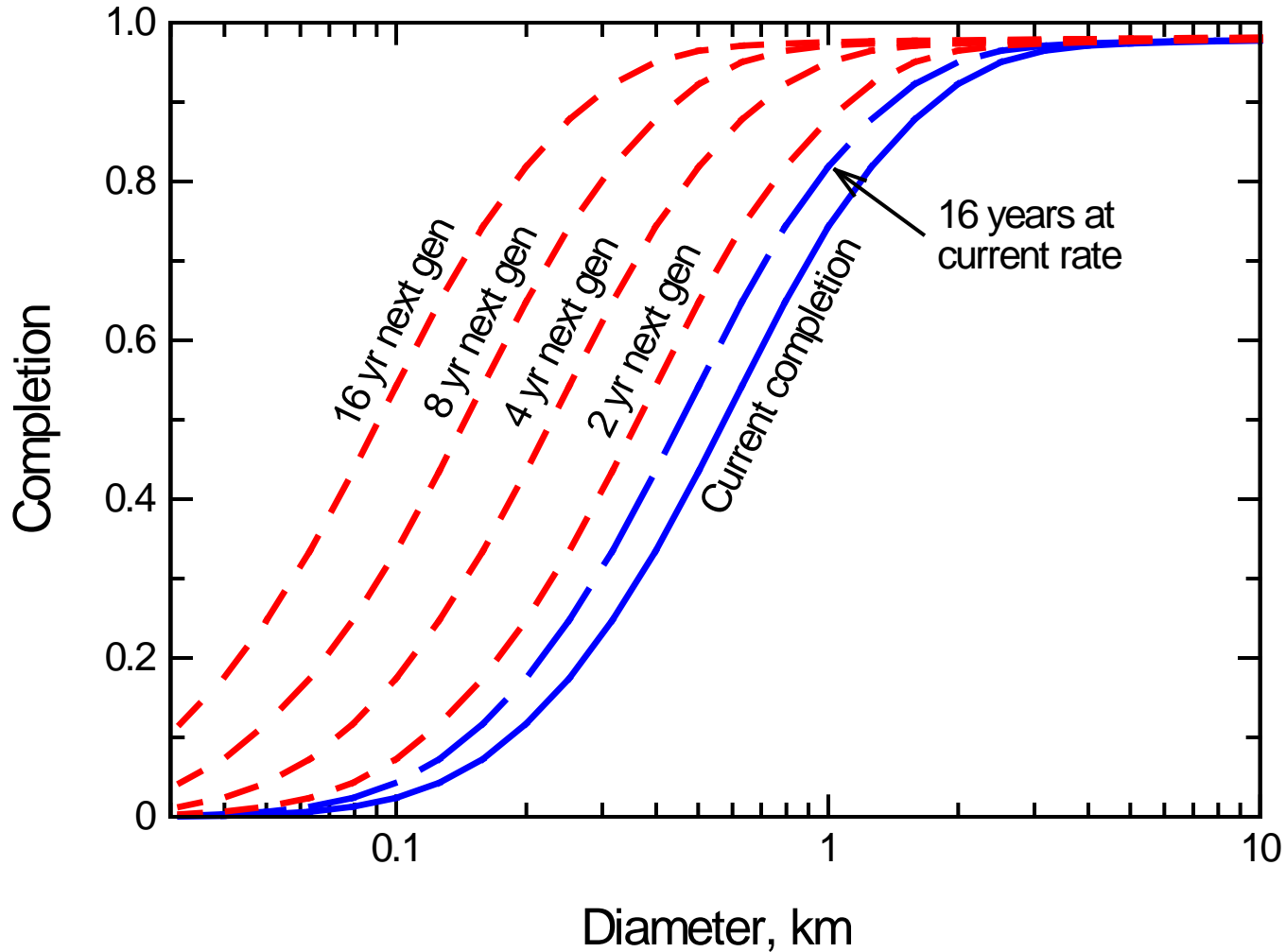
Kill Curve – Damage per event



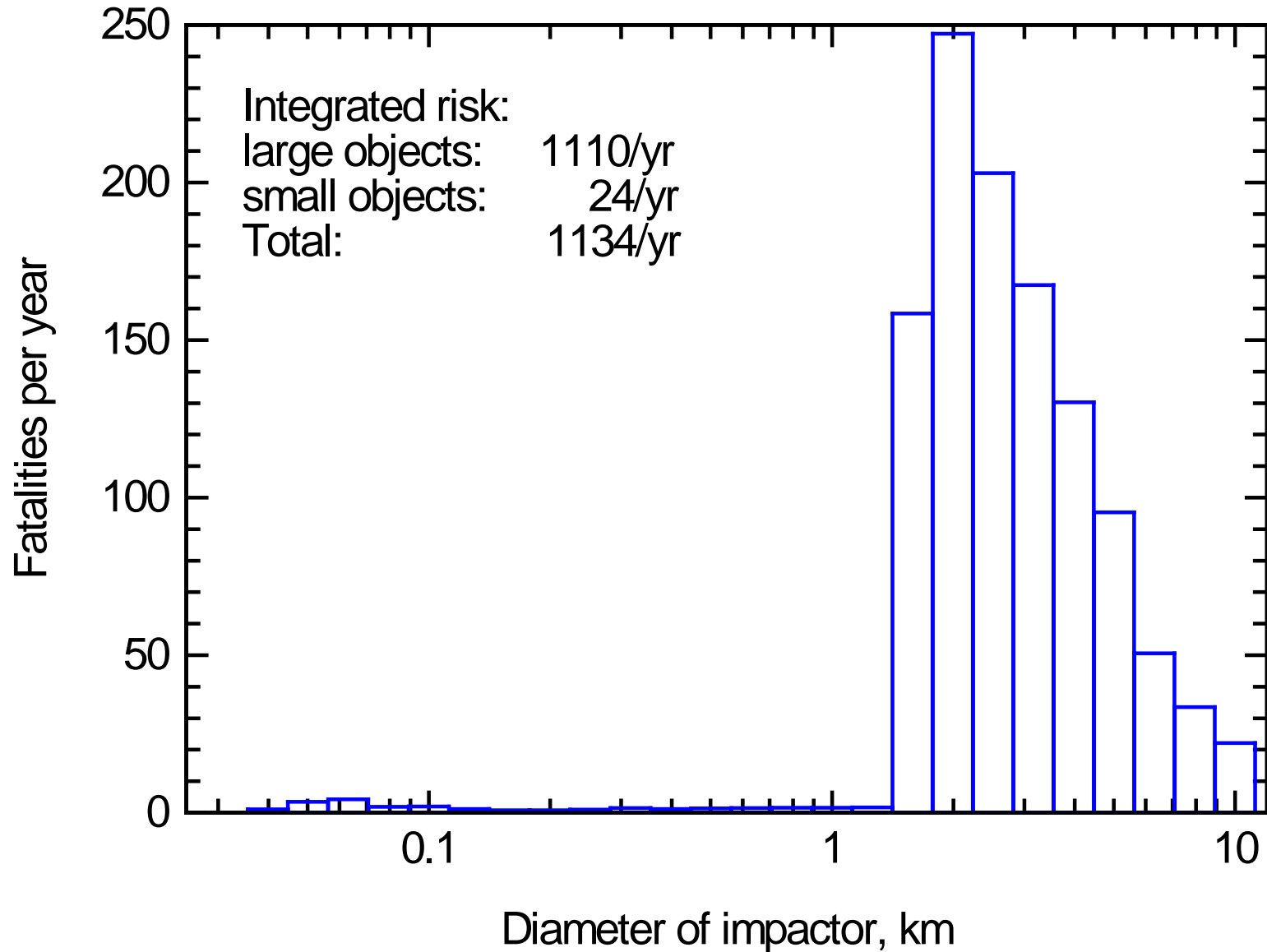
Survey Completion



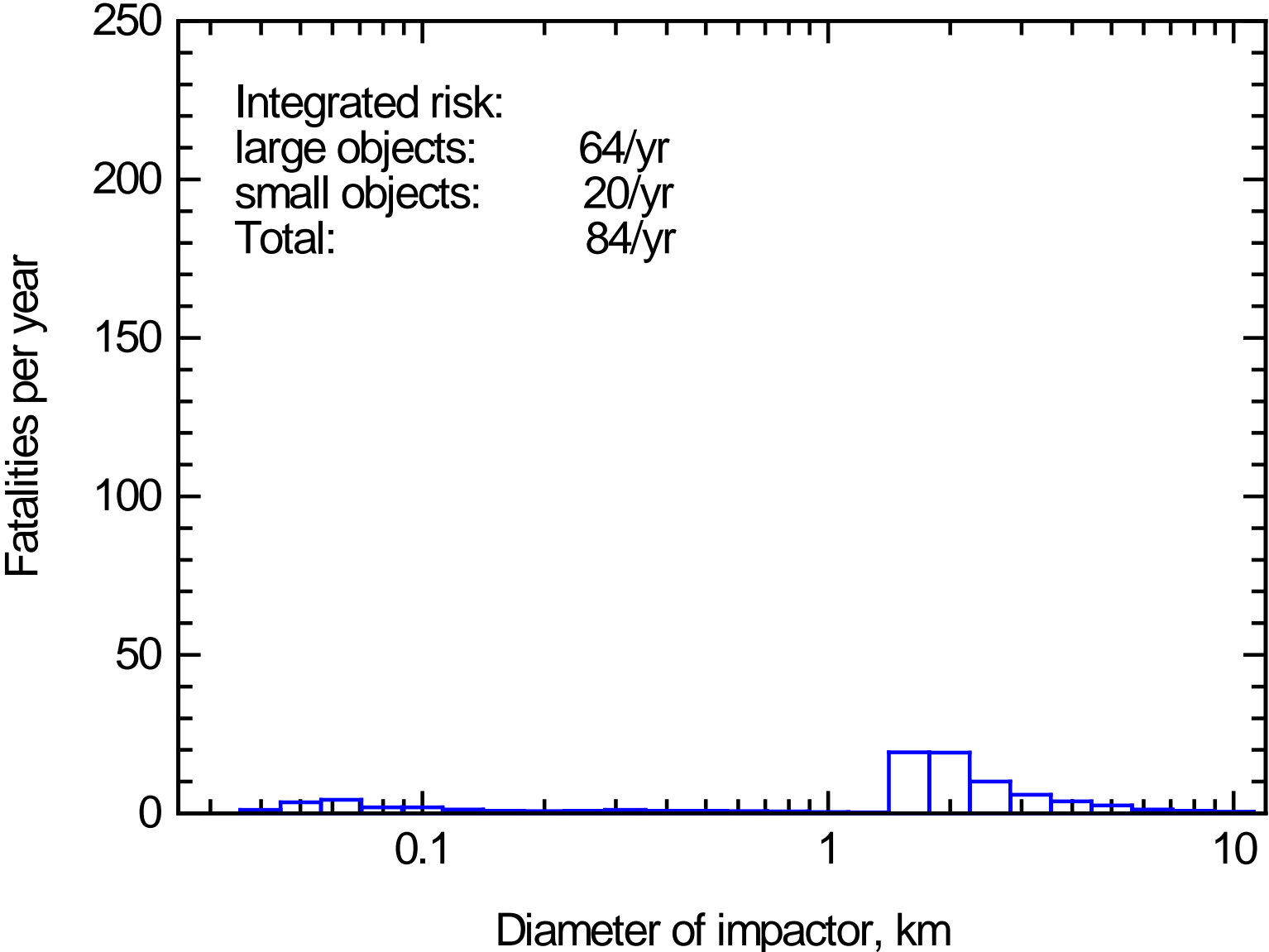
Future Survey Completion



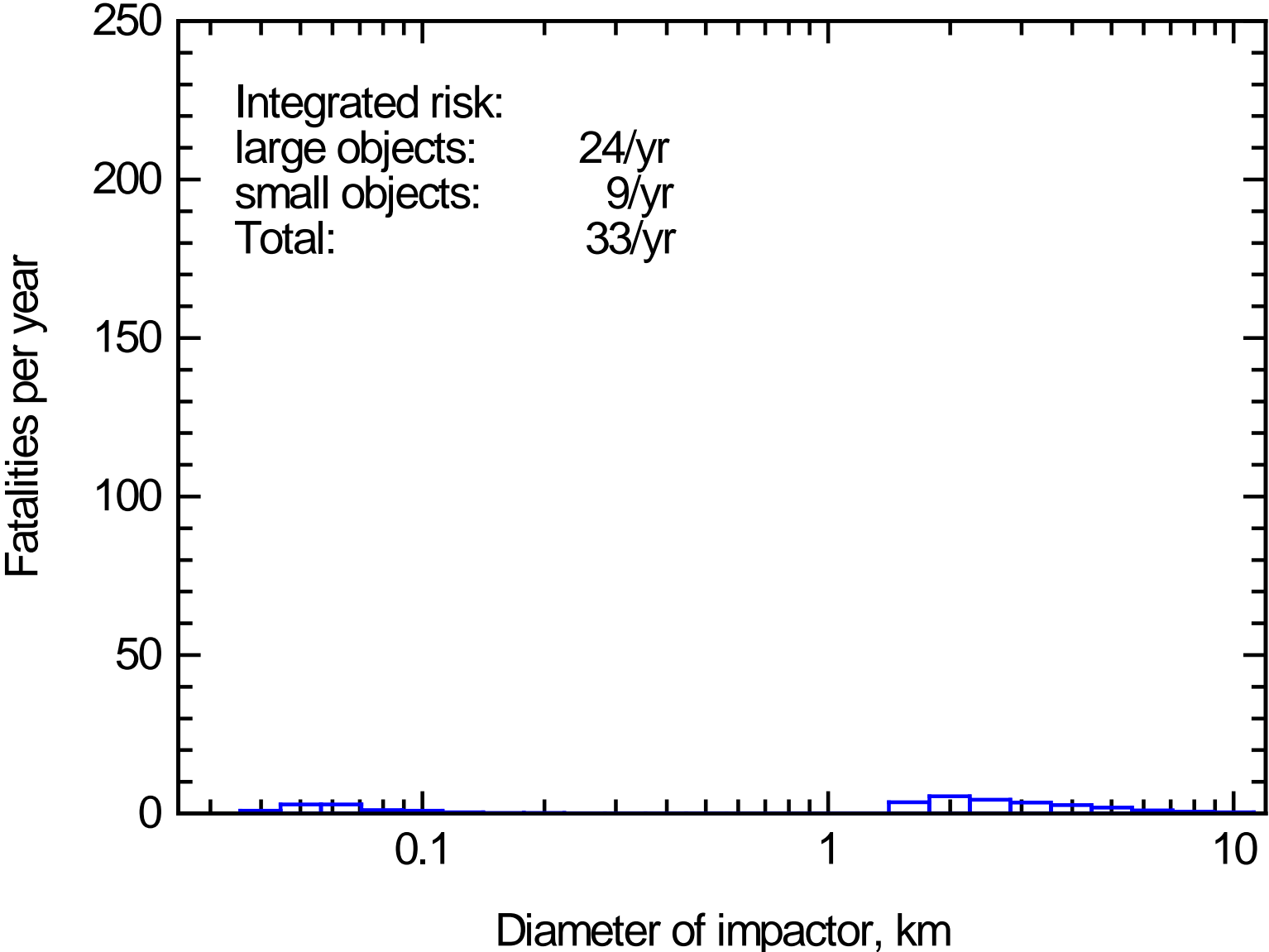
Intrinsic impact risk, before any discovered



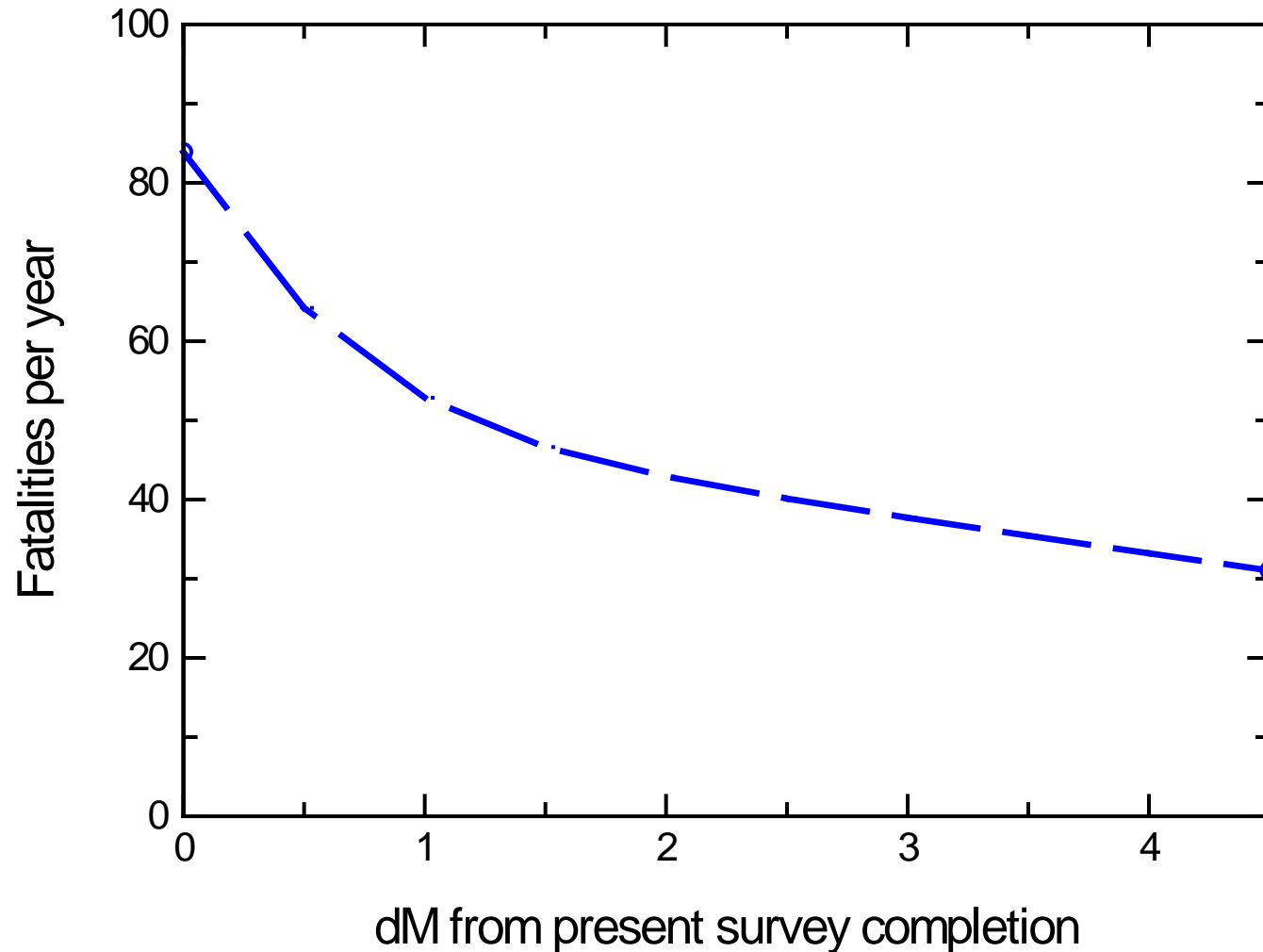
Remaining impact risk, current completion



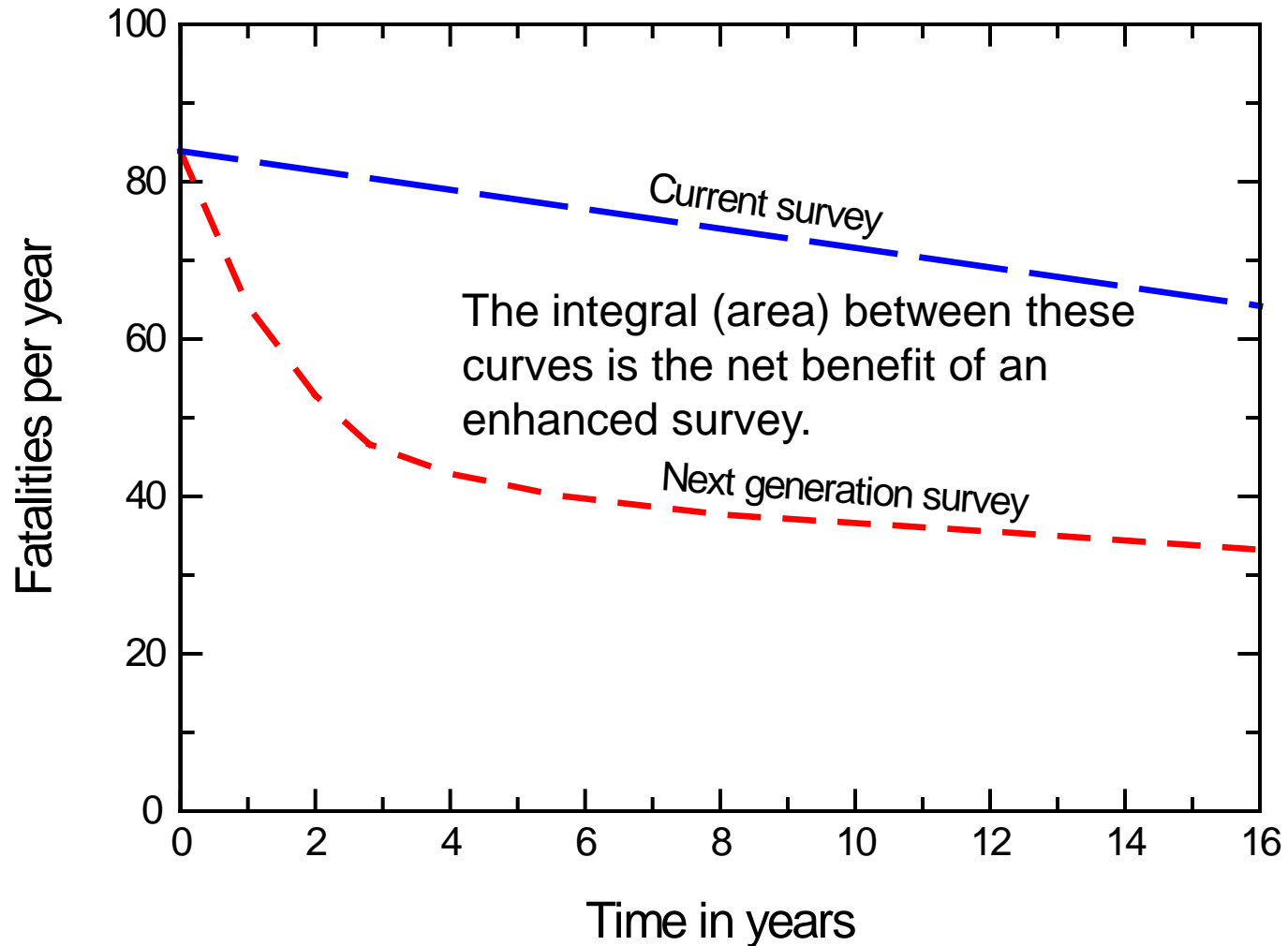
Remaining risk after next gen. survey



Reduction of risk as survey progresses



Reduction of risk vs. time



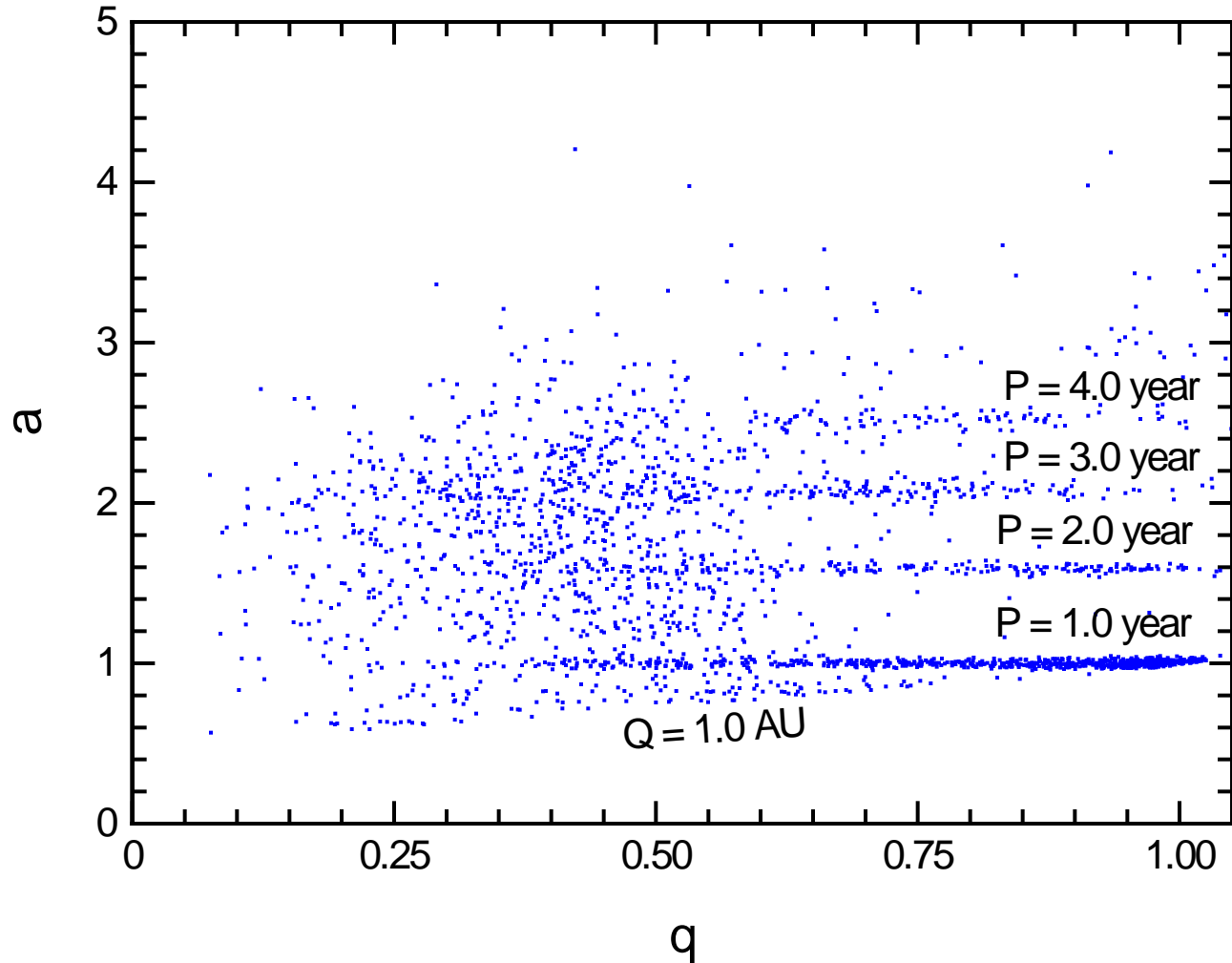
Net value (risk reduction)

Integrated reduction in risk over sixteen years:

Continue at current level of survey:	-158 fatalities
Enhanced survey to meet next-gen goal in 16 years:	-673 fatalities
Net benefit of next-gen survey over 16 years:	-515 fatalities
	= -32/year

Whether this is worth the cost of enhanced surveys is a matter of policy and politics, not science. However, the rich treasure trove of scientific discovery that has resulted from current surveys, and promises to continue as surveys probe deeper, provides ample reward for the cost, even aside from the issue of impact hazard reduction.

Where are the undiscovered large PHAs?



This is a plot of the approximately 2% out of 100,000 PHAs in a computer simulation of a typical discovery survey that remained un-detected after ten years, no matter how large the objects or sensitive the survey. They simply never entered the survey field of view.

The clear pattern seen is that most of the undiscovered objects have orbit periods commensurate with the Earth's (1.0, 2.0, etc. years), and effectively "hide" behind the sun at perihelion for longer than the survey duration. The bottom-most sloping line of objects are Atens with aphelia only barely, or even not quite, out to 1.0 AU.