

# Does the SSD actually protect ecosystems? — the validation evidence, and the question's origin

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*Dig requested 2026-06-11: (a) the papers used to **validate** the SSD/HC5 approach, read critically; and (b) the **original motivation** of Mount & Stephan (1967), the paper at the root of it all. The two turn out to be one story: Mount & Stephan built the method to fill a new regulatory mandate, named the lab-to-field gap as the central unsolved problem, and said lab results "should be verified... by field observations." The validation literature is the attempt — never fully closed — to do that verification. Sources are the papers now in `papers/` (title-verified) and `sources/`. Companion: [SSD\\_ORIGINS\\_AND\\_AFFILIATIONS.md](#).*

**Grading:** [P] read from the local paper · [2] secondary/abstract · [synthesis] our reading.

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## 1. The original motivation — Mount & Stephan (1967)

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The paper at the root of the application factor → SSD lineage is *A Method for Establishing Acceptable Toxicant Limits for Fish* (Donald I. Mount & Charles E. Stephan, **Federal Water Pollution Control Administration**, Cincinnati). Read for *why*, it says three things that the whole later edifice never escaped. [P] (quotes reconstructed from a two-column scan; verify against the page before publishing.)

1. **The driver was a new regulatory mandate.** "Enactment of water pollution control legislation in 1965 (P.L. 89-234) suggests that some type of 'standards' will be forthcoming... Persons concerned with the well-being of fishes will be among those who must decide upon acceptable concentrations." The method exists because a **statute created a demand for numbers** — the same shape as Frawley's rosin bill and Van Straalen & Denneman's Soil Protection Act. (The term "application factor" itself they trace to **Henderson & Croswell, 1957**, a U.S. Public Health Service paper — so the device is government-born a decade earlier still.)
2. **They named the two problems that never went away.** "Two major problems hinder rapid progress... One is the application of laboratory data to field conditions in the many instances in which adequate field studies cannot or will not be made. The second, and possibly more important, difficulty is the inability of professional personnel to agree on the type of effect to be measured to assess damage." That is, in 1967: **(i) lab-to-field extrapolation** and **(ii) what endpoint even counts as harm**. Both are still the live objections to SSDs today.

3. **They asked for field verification.** Laboratory experiments, they wrote, "should be verified when possible by field observations." The founders did not claim the bench predicts the river. They flagged it as something to be checked.

So the SSD's ancestor was an honest, regulator-built bridge with the warning label attached. Everything after is the attempt to test the bridge — and to argue about how big a safety factor to bolt under it.

## 2. The validation literature — what is claimed

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The "does the HC5 protect ecosystems?" question is answered, in the field, mainly by **comparing the lab-derived SSD/HC5 to model-ecosystem (mesocosm/microcosm) and occasionally field data.** The canonical papers:

- **Versteeg, Belanger & Carr (1999)** — *Understanding single-species and model ecosystem sensitivity (Environ. Toxicol. Chem. 18(6):1329)* — **the foundational validation, authored at Procter & Gamble. [P]** They compared single-species chronic NOECs (genus geometric means) with model-ecosystem no-effect concentrations for **n = 11 substances**. Conclusion: "laboratory-generated single-species [data may be used to] establish concentrations protective of model ecosystem, and likely whole ecosystem, effects," and the 5%-affected level "is conservative relative to mean model ecosystem data." *But the key number undercuts the cleanliness:* "Geometric mean model ecosystem no effect concentrations corresponded to concentrations [at which] the NOEC of **10 to 52% of genera**" was exceeded. The "no-effect" level in the model ecosystems sat anywhere from the 10th to the **52nd** percentile of the sensitivity distribution — a five-fold spread in what "protective" meant.
- **Hose & Van den Brink (2004)** — endosulfan, lab SSD vs mesocosm and field (*Arch. Environ. Contam. Toxicol. 47:511*). **[P]** Conclusion: "SSDs based on laboratory data were also protective of field populations." *But read the mechanism:* "Arthropod taxa in the mesocosm were **less sensitive** than taxa in laboratory tests." The SSD was protective here **because the field organisms happened to be more tolerant than the lab ones for this chemical** — a contingent, chemical-specific result, not a structural guarantee.
- **ECETOC Workshop Report 28** (the mesocosm calibration behind the assessment-factor-of-2) — **[P]** found the opposite tendency: "**Mesocosm PNECs were generally lower than the HC5**, with 2 notable exceptions, i.e. lindane and dimethoate." I.e., in most of its cases the field-protective level was *below* the bare HC5 — the HC5 was **not conservative enough** on its own (which is the argument for dividing it by a factor).
- **Maltby et al. (2006)** — *Predictive Value of SSDs for Effects of Herbicides in Freshwater Ecosystems (Hum. Ecol. Risk Assess.)*, Univ. Sheffield — **[P]** the same lab-SSD-vs-mesocosm comparator, for a different chemical class (herbicides), with the same "reasonably predictive" conclusion and the same small-set, model-ecosystem-comparator limits.

- **Wishlist (mirror served wrong PDFs):** Solomon et al. (1996) atrazine — the first big regulatory SSD; and Maltby et al. (2005) *insecticide* SSDs / test-species selection. Both `papers/_WISHLIST.md`. [2]

### 3. Reading the validation critically

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Put together, the "validation" of the SSD is thinner than the regulatory weight it carries. [synthesis]

- **It is largely circular — lab against *model* ecosystem, not the real thing.** The comparator is almost always a mesocosm/microcosm: a tank or a pond, itself a simplified, short-term, small-species-set system. The step to the actual target — "**likely whole ecosystem** effects," in Versteeg's own hedge — is asserted, not tested. One lab extrapolation is checked against another, slightly larger, lab construct.
- **The chemical sets are small and selective** (Versteeg  $n = 11$ ; Hose  $n = 1$ ). A method applied to **12,386 chemicals** (Posthuma 2019) is validated on a handful, mostly metals, surfactants, and a few pesticides.
- **The validators are interested parties.** The foundational paper is **Procter & Gamble** (Versteeg, Belanger, Carr); the assessment-factor calibration is **ECETOC** (chemical industry). The people certifying that the threshold "protects" are, in part, the people who rely on the threshold to clear their products — the same structural conflict as Frawley validating his own de minimis.
- **The results disagree with each other.** Versteeg: the HC5 is "conservative." ECETOC/Ragas: mesocosm protective levels are "generally lower than the HC5" (so it is *not* conservative). Whether the bare HC5 is too strict or too loose depends on which comparator you choose — which is to say the method is not tightly pinned by data.
- **"Protective" is often contingent, not structural.** Where the HC5 worked (Hose's endosulfan), it worked because the field species were *less* sensitive than the lab ones for that chemical. Reverse that for a chemical whose most sensitive species is rare, untested, or hard to culture, and the protection vanishes — the selection-bias problem Kooijman himself named in 1987.
- **And there are flat failures**, set aside as exceptions: lindane and dimethoate (ECETOC); insecticides generally, whose SSDs swing on whether sensitive arthropods are in the species set (Maltby — wishlist).

### 4. The through-line

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Mount & Stephan, in 1967, told the truth about the method they were inventing: it bridges lab to field across a gap no one had crossed, on an endpoint no one had agreed, and the bridge "should be verified... by field observations." Three decades of validation work did some of that verification — and found the bridge holds **often, on small sets, against simplified systems, in studies frequently run by the industries that use it, with notable exceptions quietly excused.**

That is not nothing. It is also not the demonstration the regulatory confidence implies. The validation of the SSD has the same shape as the (entirely absent) validation of Frawley's de minimis: a small, interested evidence base

pronouncing the threshold "protective," with the inconvenient cases handled as exceptions — and the founders' own caveat, that the lab does not speak for the field, never retired.

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## Sources

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- **Mount, D.I. & Stephan, C.E. (1967)** — papers/MountStephan\_1967\_application\_factor\_fish.pdf [P]
- **Versteeg, Belanger & Carr (1999)** — papers/Versteeg-Belanger-Carr\_1999\_singlesp\_vs\_modecosystem.pdf [P]
- **Hose & Van den Brink (2004)** — papers/HoseVanDenBrink\_2004\_endosulfan\_SSD\_validation.pdf [P]
- **ECETOC WR28** (mesocosm calibration / AF=2) — sources/ECETOC\_WR28\_...pdf , §3.8 (Ragas) [P]
- **Henderson & Crowell (1957)**, "Application factors...", USDHEW Public Health Service — *cited in Mount & Stephan 1967* [2]
- **Wishlist:** Solomon et al. (1996) atrazine; Maltby et al. (2005) insecticide SSDs; Van den Brink, Posthuma & Brock (2002, book chapter); Brock & Van den Brink mesocosm series — papers/\_WISHLIST.md .

## Open / next

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- **[open]** Retrieve Solomon 1996 and Maltby 2005 (the two most-cited validation/limitation papers) by another route — the broken Sci-Hub mappings serve wrong PDFs for their DOIs.
- **[open]** Pull the **Brock & Van den Brink** mesocosm-threshold series and the **Van den Brink et al. (2002)** book chapter for the full mesocosm-vs-HC5 dataset.
- **[synthesis → develop]** Tabulate, across every validation study, the *comparator* (mesocosm vs field), the *number of chemicals*, the *author affiliation*, and the *failures* — a one-page scorecard of how strong the "it protects ecosystems" claim really is.