

# Fosfor - en ljusbärare?

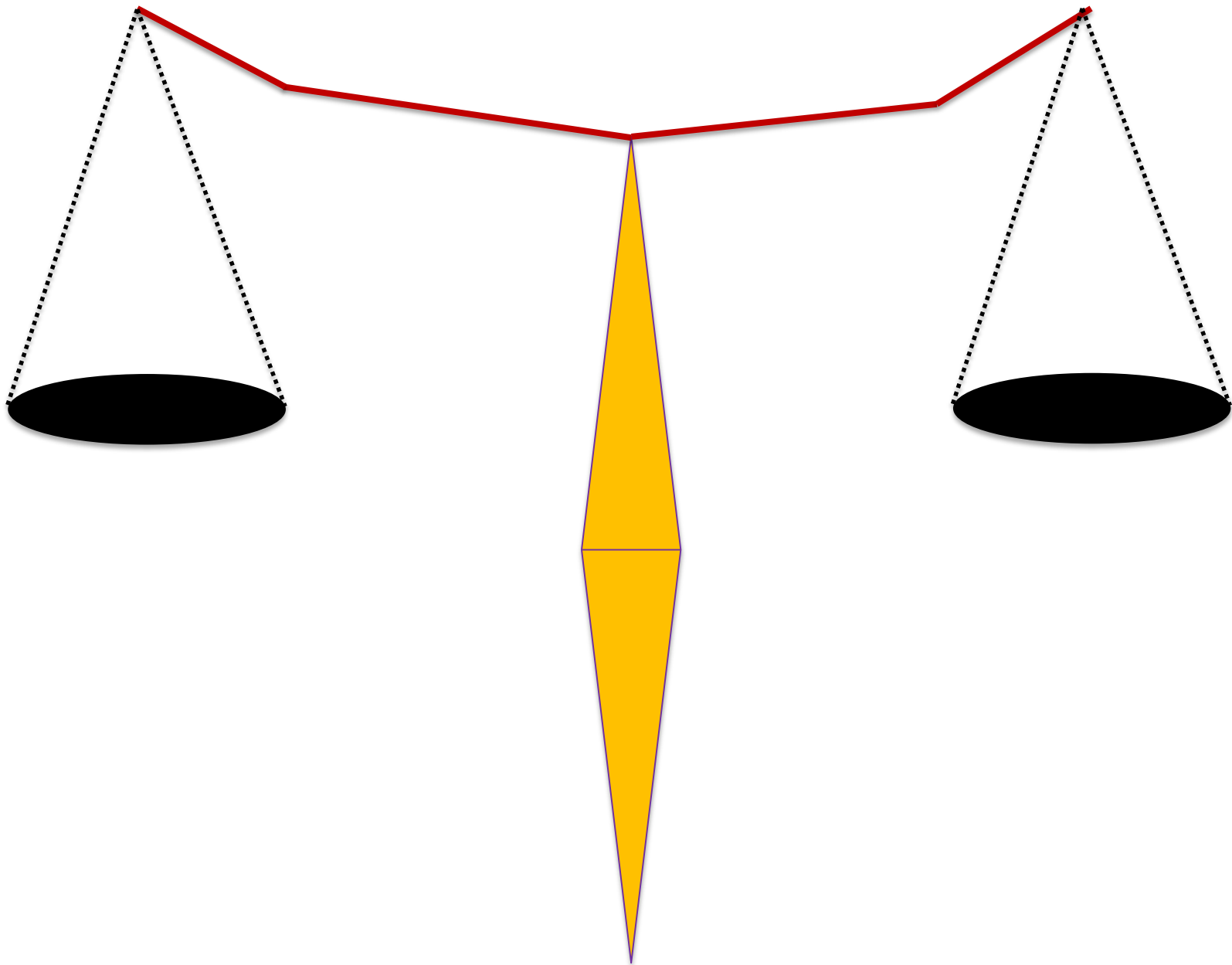
Därför pratar vi om fosfor

Faruk Djodjic, SLU



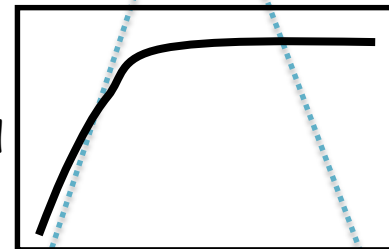
Henning Brand 1669.

“The Alchymist, In Search of the Philosopher’s Stone.” Painted by Joseph Wright in 1771.

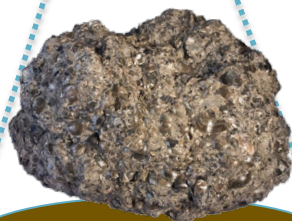




Övergödning



P-halt i marken  
Produktion



Ändlig resurs

# Fosfor – en ändlig resurs

## ● Produktion och reserver

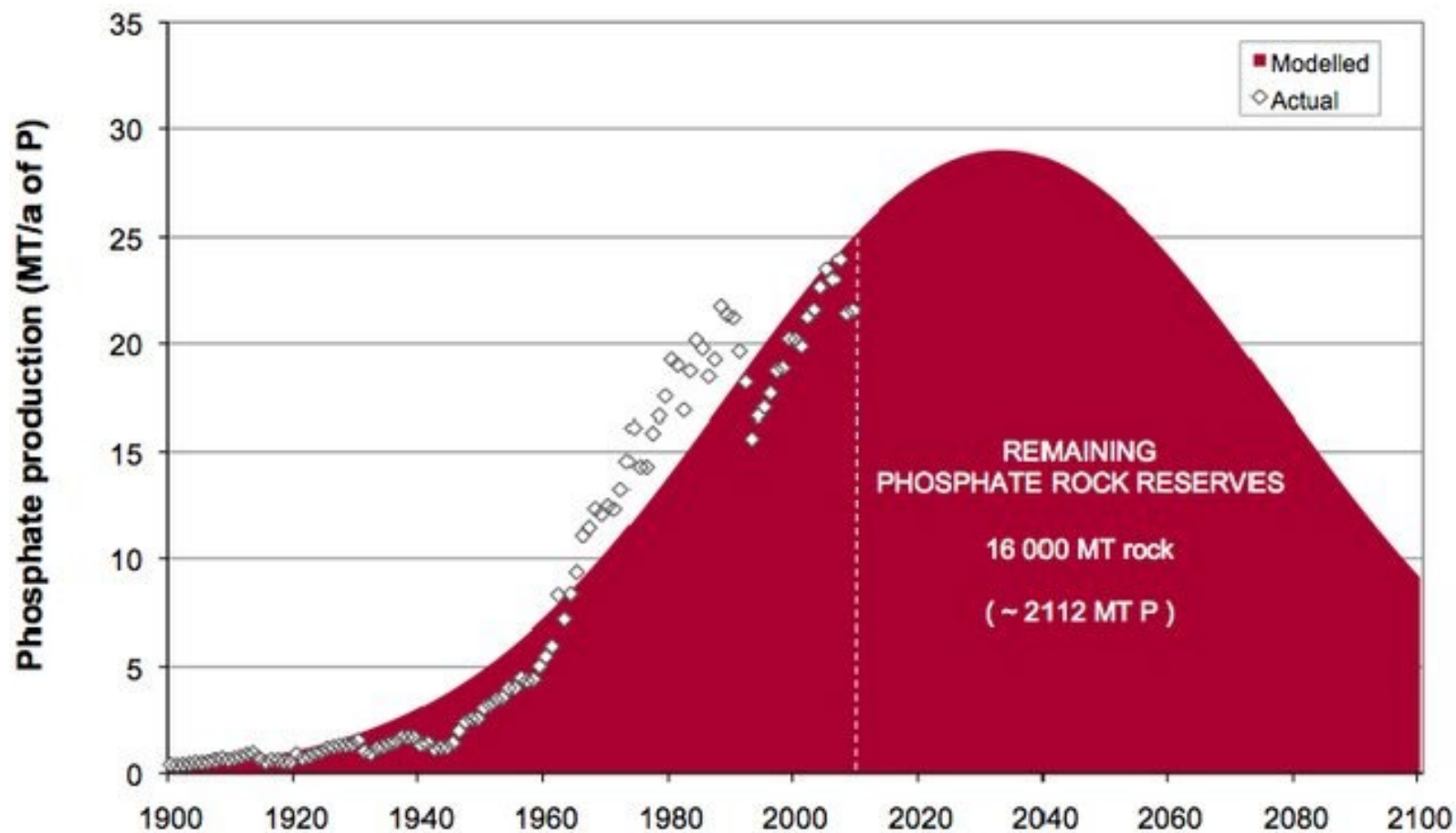


|                            | Mine production |                   | Reserves <sup>4</sup> |
|----------------------------|-----------------|-------------------|-----------------------|
|                            | 2015            | 2016 <sup>8</sup> |                       |
| United States              | 27,400          | 27,800            | 1,100,000             |
| Algeria                    | 1,400           | 1,500             | 2,200,000             |
| Australia                  | 2,500           | 2,500             | 1,100,000             |
| Brazil                     | 6,100           | 6,500             | 320,000               |
| China <sup>5</sup>         | 120,000         | 138,000           | 3,100,000             |
| Egypt                      | 5,500           | 5,500             | 1,200,000             |
| India                      | 1,500           | 1,500             | 65,000                |
| Israel                     | 3,540           | 3,500             | 130,000               |
| Jordan                     | 8,340           | 8,300             | 1,200,000             |
| Kazakhstan                 | 1,840           | 1,800             | 260,000               |
| Mexico                     | 1,680           | 1,700             | 30,000                |
| Morocco and Western Sahara | 29,000          | 30,000            | 50,000,000            |
| Peru                       | 3,880           | 4,000             | 820,000               |
| Russia                     | 11,600          | 11,600            | 1,300,000             |
| Saudi Arabia               | 4,000           | 4,000             | 680,000               |
| Senegal                    | 1,240           | 1,250             | 50,000                |
| South Africa               | 1,980           | 1,700             | 1,500,000             |
| Syria                      | 750             | —                 | 1,800,000             |
| Togo                       | 1,100           | 900               | 30,000                |
| Tunisia                    | 2,800           | 3,500             | 100,000               |
| Vietnam                    | 2,500           | 2,800             | 30,000                |
| Other countries            | 2,470           | 2,410             | 810,000               |
| World total (rounded)      | 241,000         | 261,000           | 68,000,000            |

**World Resources:** Some world reserves were reported only in terms of ore and grade. Phosphate rock resources occur principally as sedimentary marine phosphorites. The largest sedimentary deposits are found in northern Africa, China, the Middle East, and the United States. Significant igneous occurrences are found in Brazil, Canada, Finland, Russia, and South Africa. Large phosphate resources have been identified on the continental shelves and on seamounts in the Atlantic Ocean and the Pacific Ocean. World resources of phosphate rock are more than 300 billion tons. There are no imminent shortages of phosphate rock.

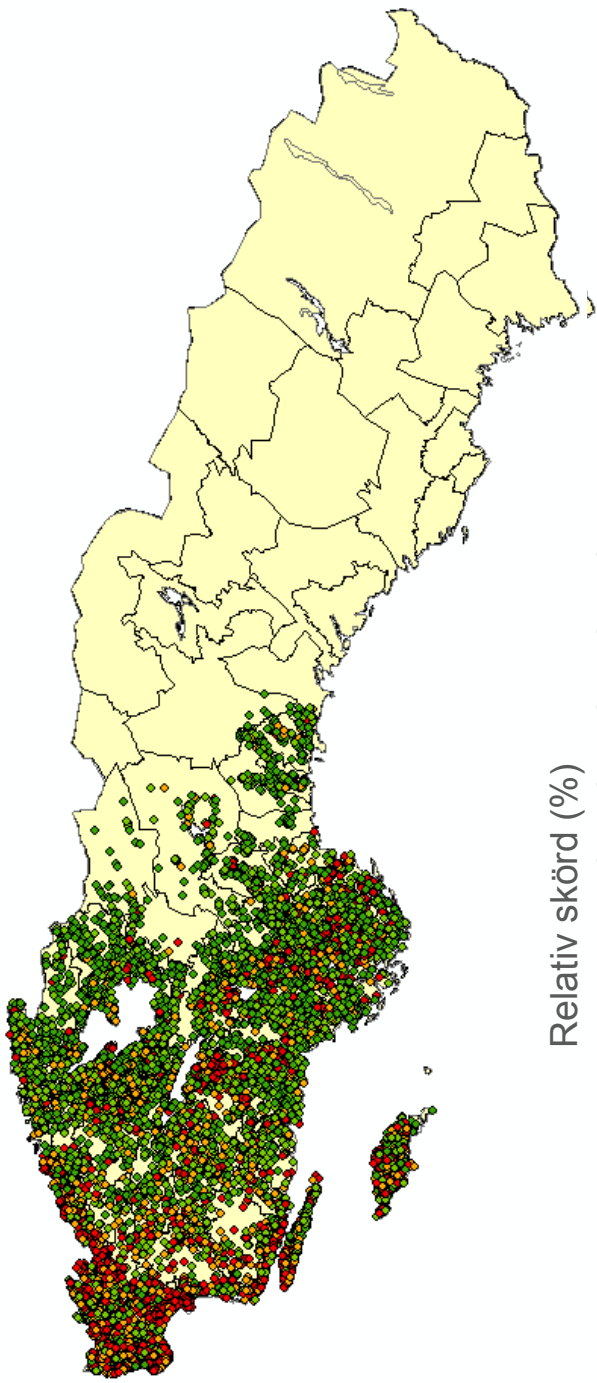
**Substitutes:** There are no substitutes for phosphorus in agriculture.

Källa: USGS

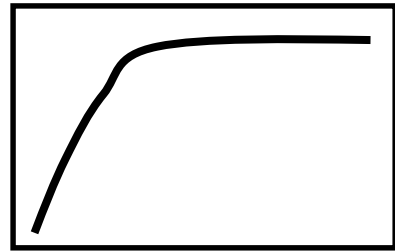


Källa: Dana Cordell

# Fosfor – ett viktigt näringsämne



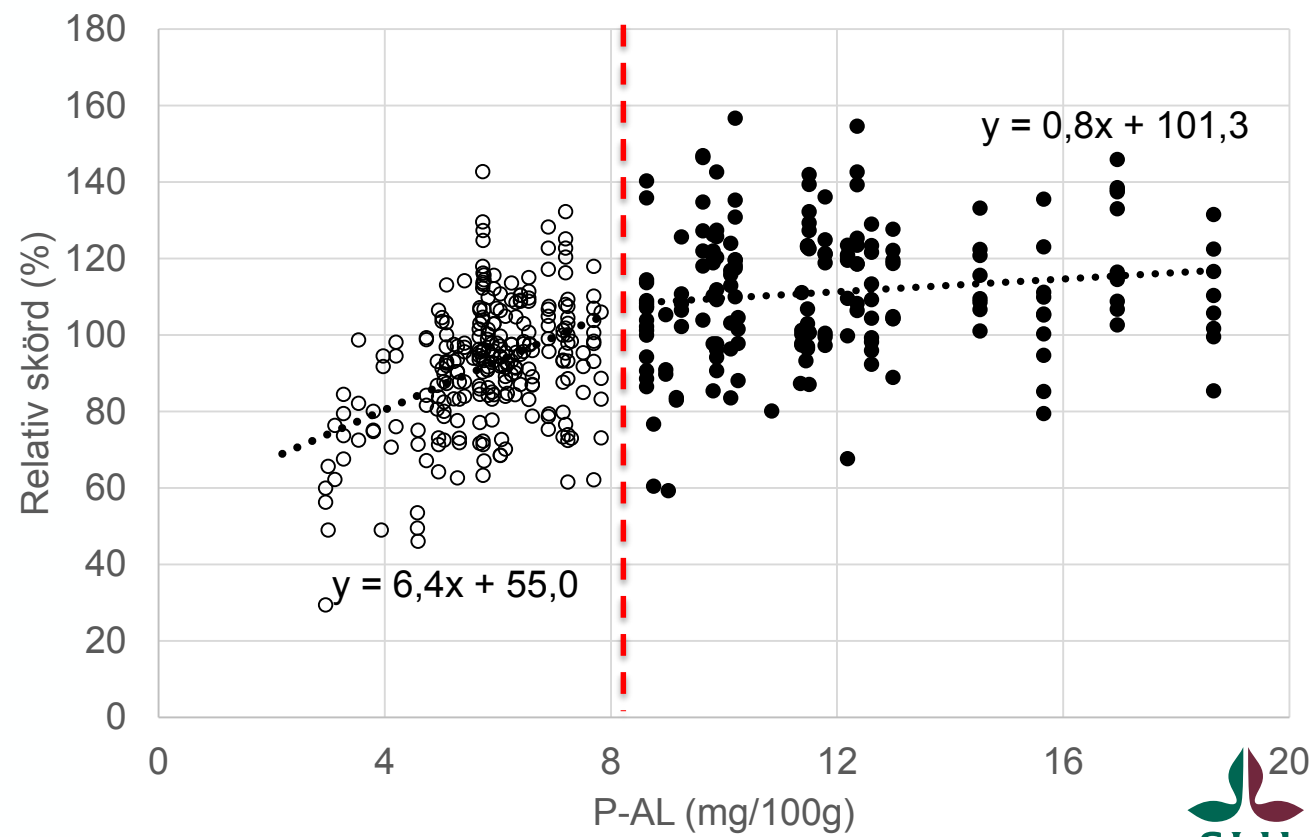
Skörd

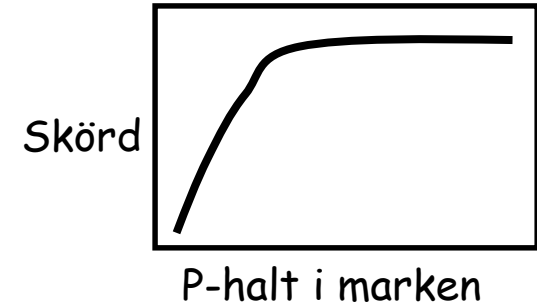


P-halt i marken

SCB → Skördeområden → Normskörd

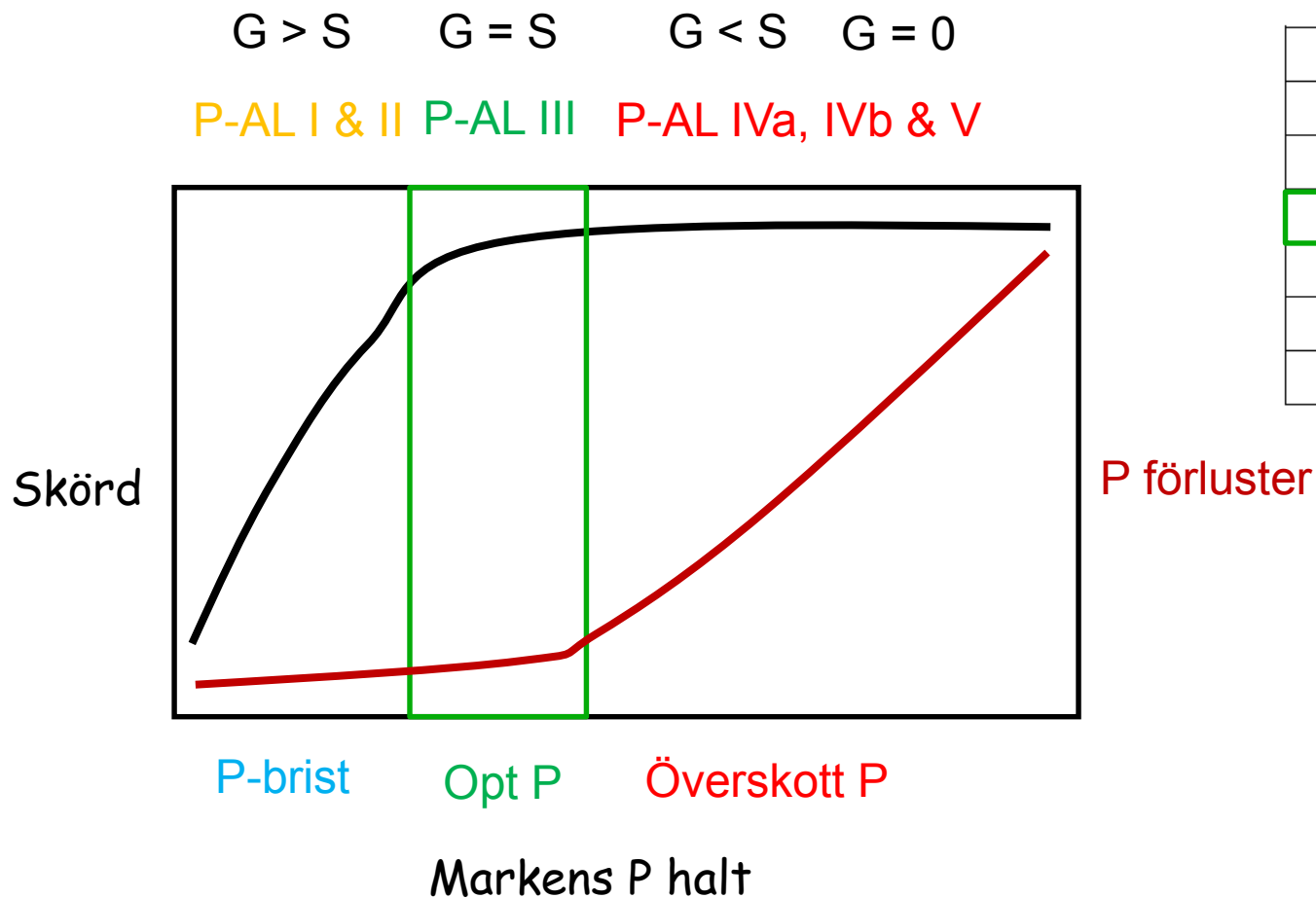
Jordbruksverket → Markundersökning → P-AL

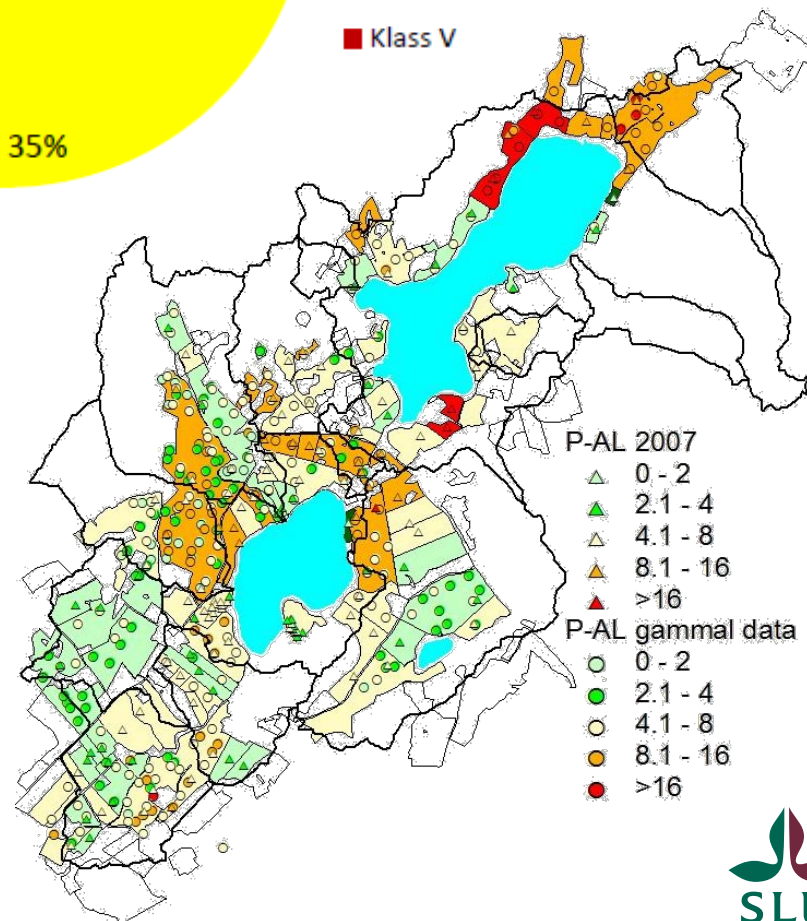
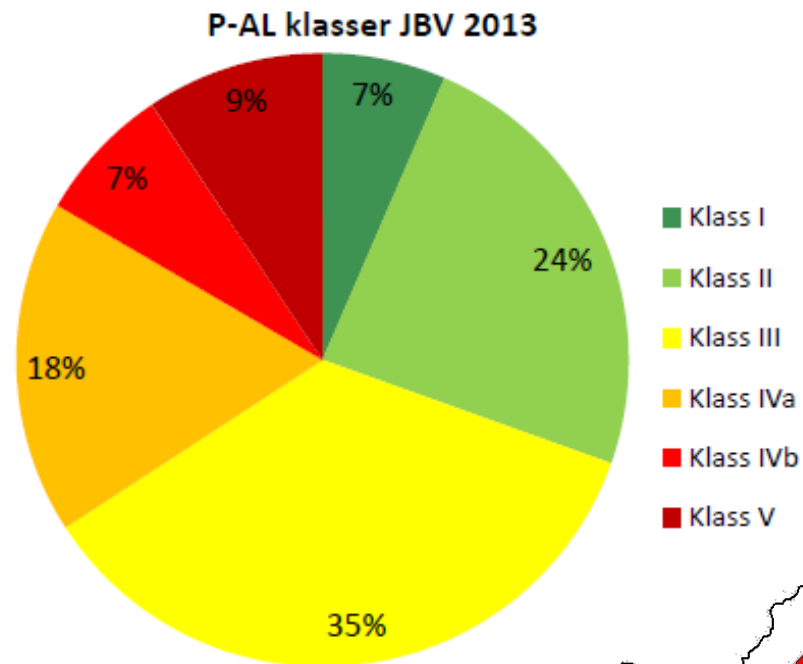
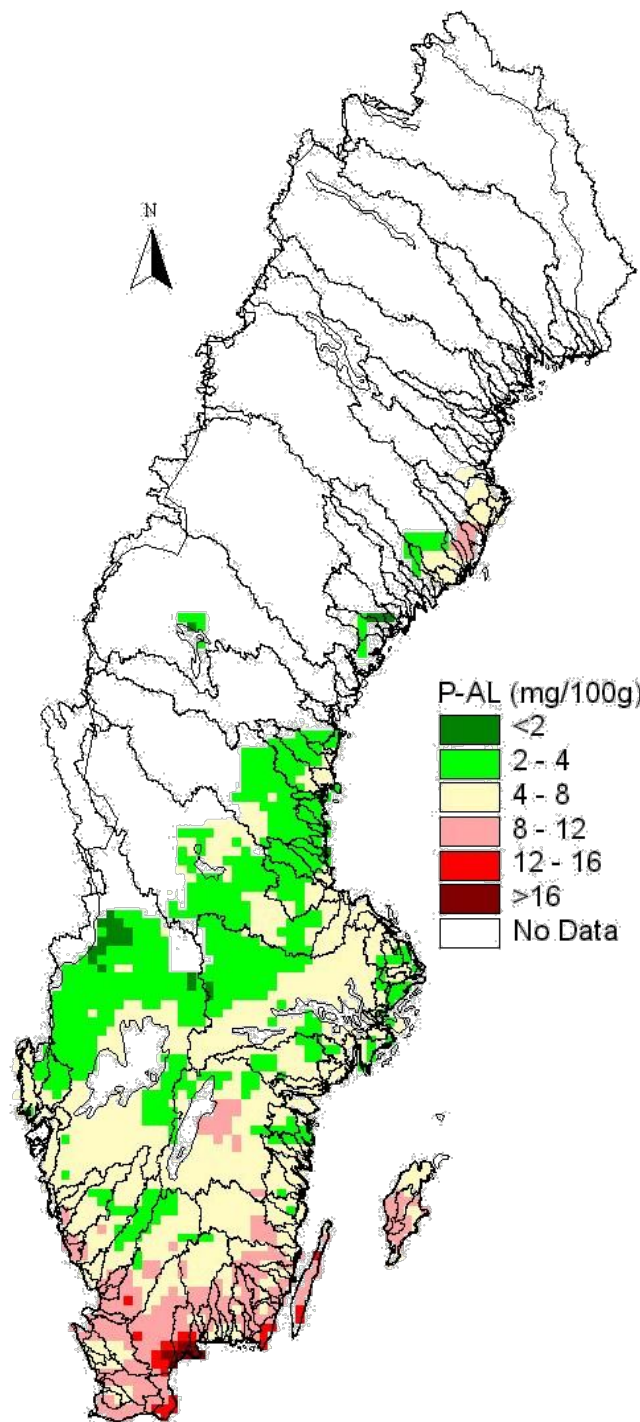


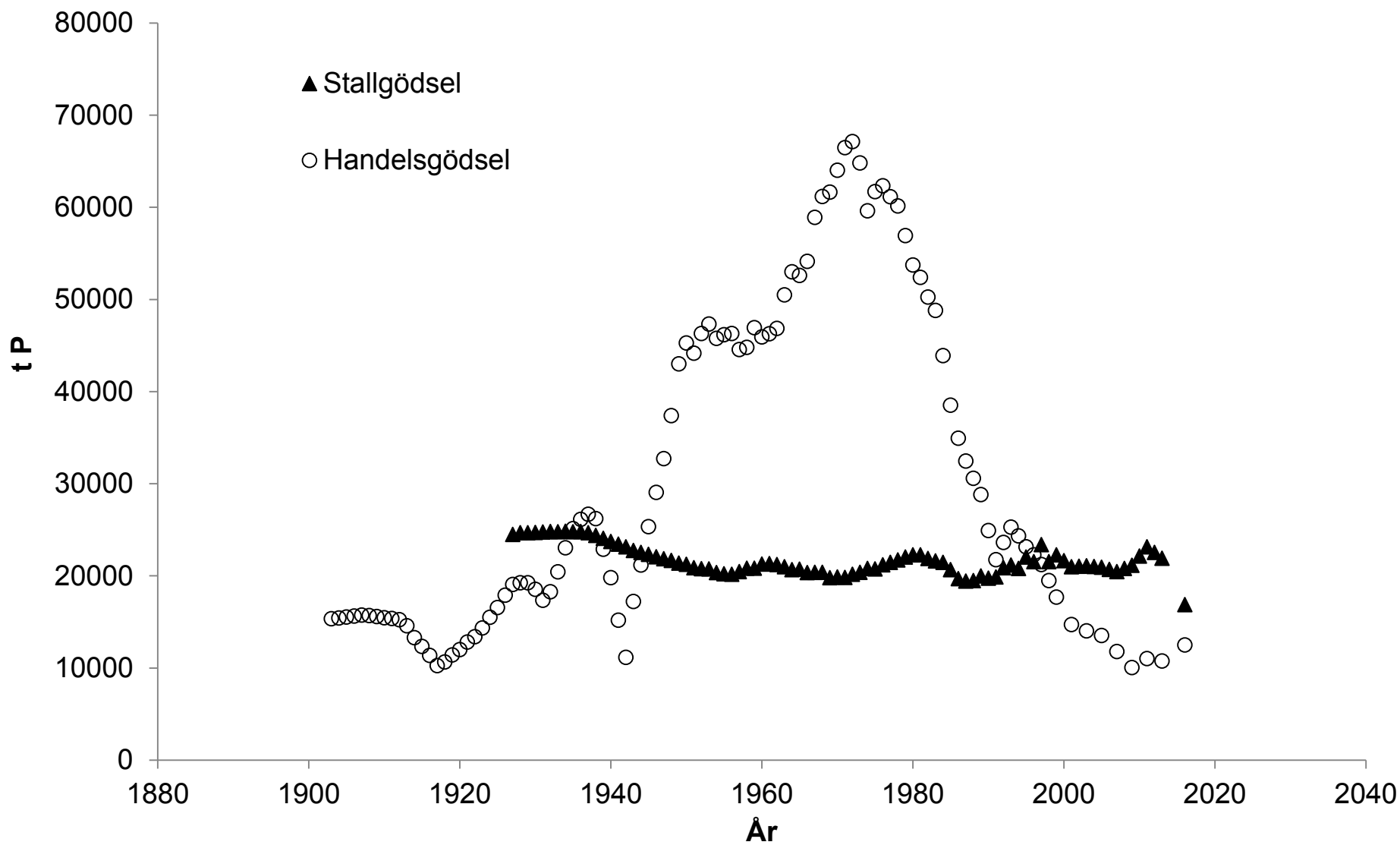


AL – ammonium laktat, pH 3.75

| Klass | P-AL      |
|-------|-----------|
| I     | <2        |
| II    | 2,1-4,0   |
| III   | 4,1-8,0   |
| IVA   | 8,1-12,0  |
| IVB   | 12,1-16,0 |
| V     | >16       |



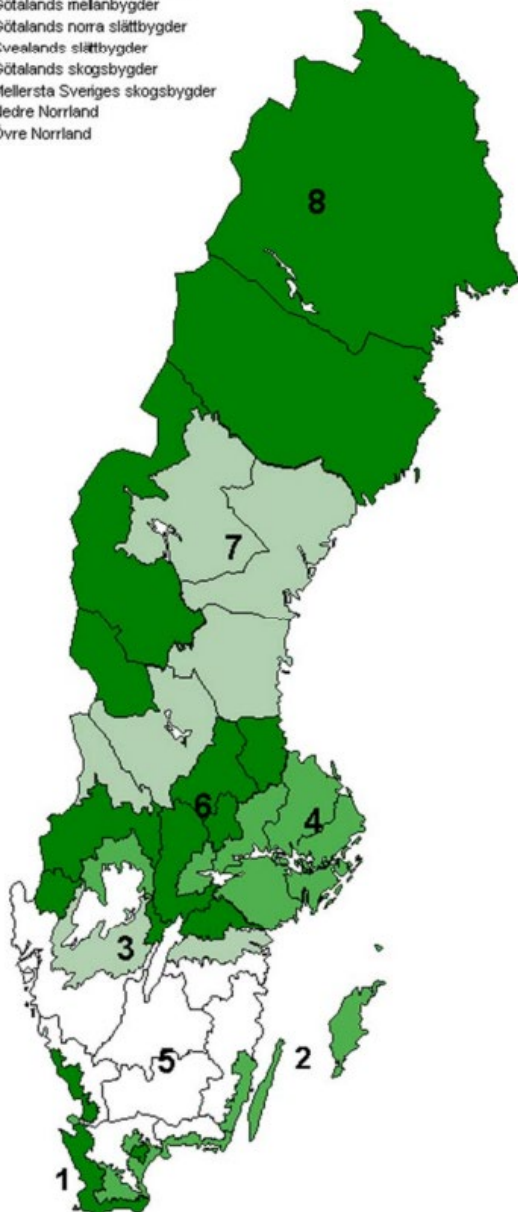




## Produktionsområden (PO8)

Agricultural production areas (PO8)

- 1 Götalands södra slättbygder
- 2 Götalands mellanbygder
- 3 Götalands norra slättbygder
- 4 Svealands slättbygder
- 5 Götalands skogsbygder
- 6 Mellersta Sveriges skogsbygder
- 7 Nedre Norrland
- 8 Övre Norrland



□ Riket

▲ PO2 Götalands mellanbygder

× PO4 Svealands slättbygder

— PO6 Mellersta Sveriges skogsbygder

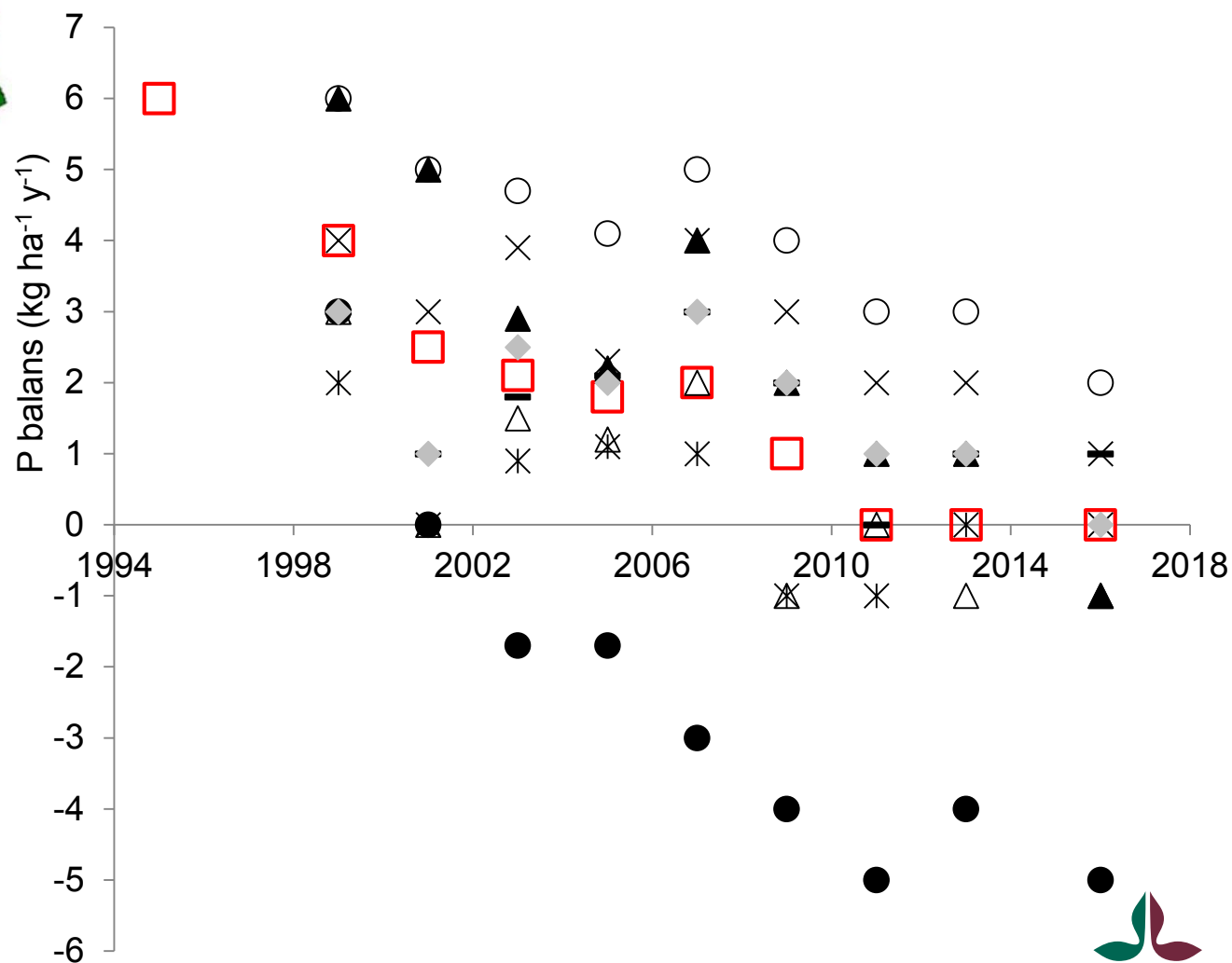
× PO8 Övre Norrland

● PO1 Götalands södra slättbygder

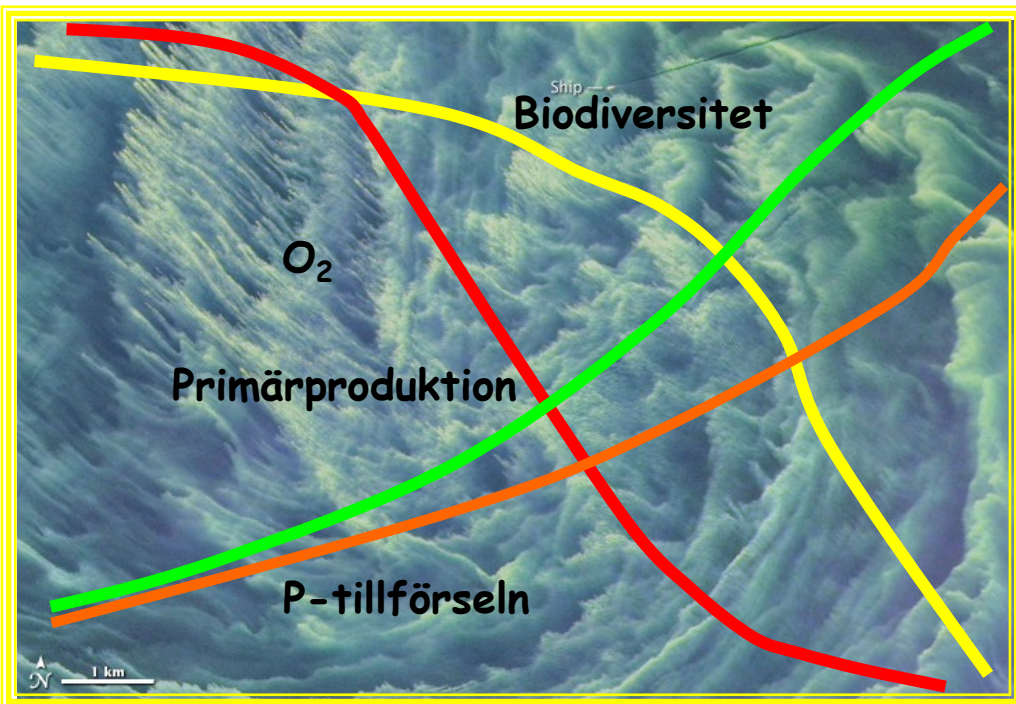
△ PO3 Götalands norra slättbygder

○ PO5 Götalands skogsbygder

◆ PO7 Nedre Norrland



# Fosfor – ett begränsande näringsämne



Oligotrophic      Mesotrophic      Eutrophic

Corell 1998,  
Eutrofication - koncept



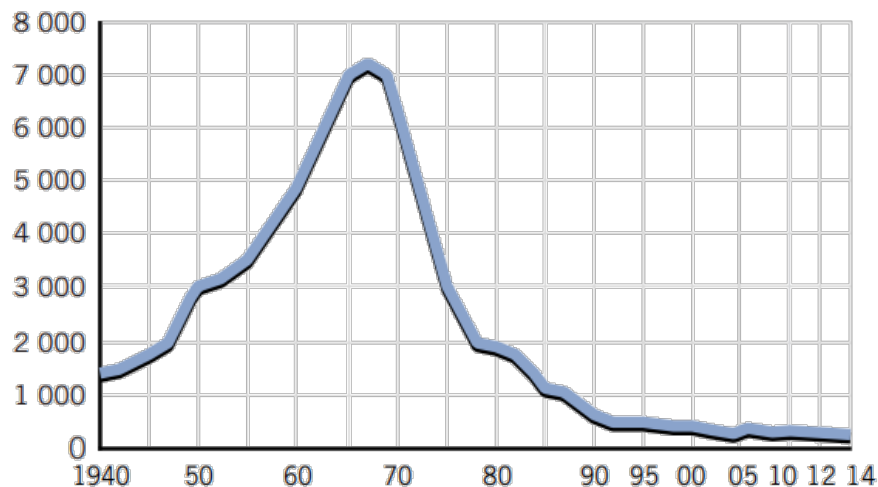
## PLC6 Resultat

Tabell 22. Antropogen nettobelastning av fosfor (ton/år). avrundat till närmaste 10-tal ton. Belastning lägre än 5 ton anges som <5. Avser år 2014, flödesnormaliserat för perioden 1994-2013

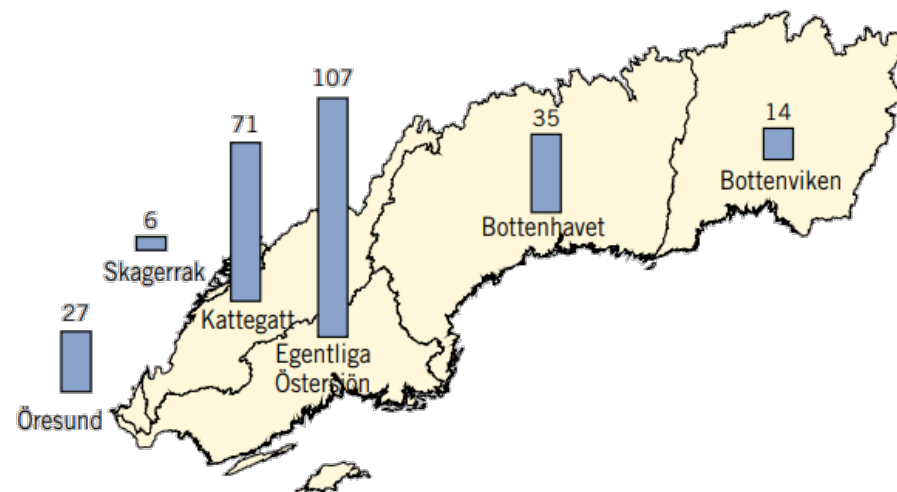
| Område                 | Jordbruk   | Hygge     | Dagvatten  | Små<br>avlopp | KARV       | Industri   | Fisk-<br>odlingar | Summa<br>Antropo-<br>gen<br>netto |
|------------------------|------------|-----------|------------|---------------|------------|------------|-------------------|-----------------------------------|
| Bottenviken            | 10         | <5        | 10         | 10            | 20         | 50         | <5                | 90                                |
| Bottenhavet            | 70         | 10        | 20         | 40            | 40         | 140        | 30                | 350                               |
| Egentliga<br>Östersjön | 170        | <5        | 40         | 70            | 90         | 40         | <5                | 410                               |
| Öresund                | 20         | <5        | 10         | 10            | 30         | <5         | <5                | 70                                |
| Kattegatt              | 150        | <5        | 30         | 50            | 60         | 20         | <5                | 310                               |
| Skagerrak              | 50         | <5        | <5         | 10            | 10         | <5         | 0 <sup>1</sup>    | 70                                |
| <b>Summa</b>           | <b>460</b> | <b>20</b> | <b>120</b> | <b>200</b>    | <b>240</b> | <b>250</b> | <b>40</b>         | <b>1330</b>                       |

<sup>1</sup> Det finns inga utsläpp rapporterade för dessa områden.

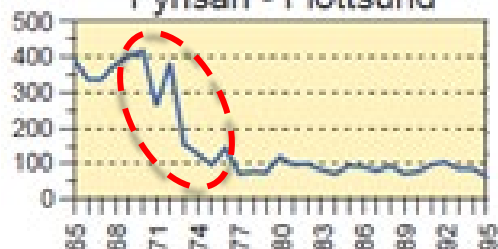
ton **Fosfor (Tot-P)**



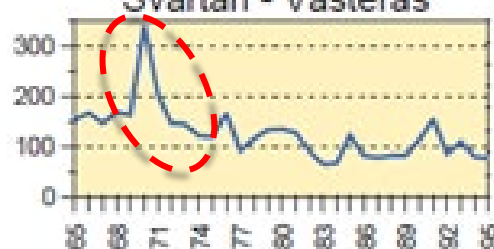
**Fosfor år 2014, ton**



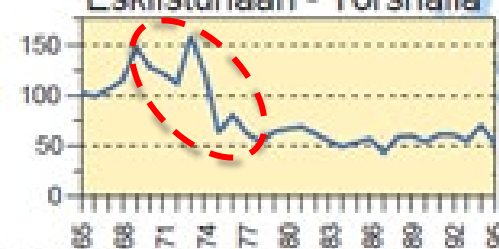
**Fyrisån - Flottsund**



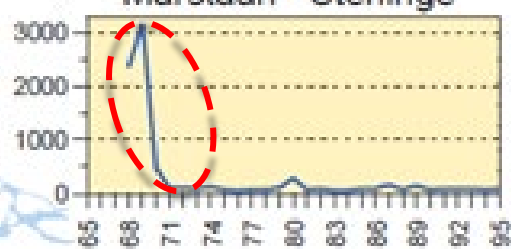
**Svartån - Västerås**



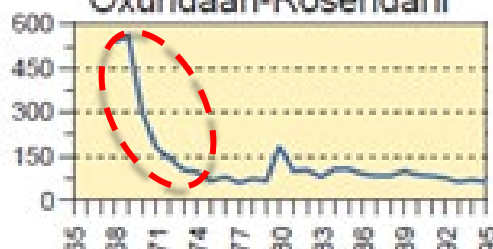
**Eskilstunaån - Torshälla**



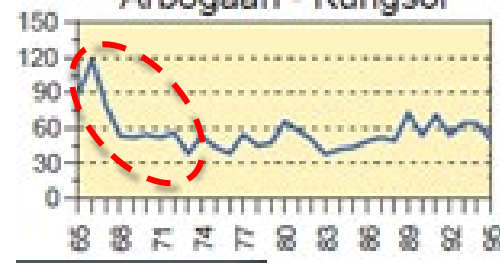
**Märstaån - Steninge**



**Oxundaån-Rosendahl**



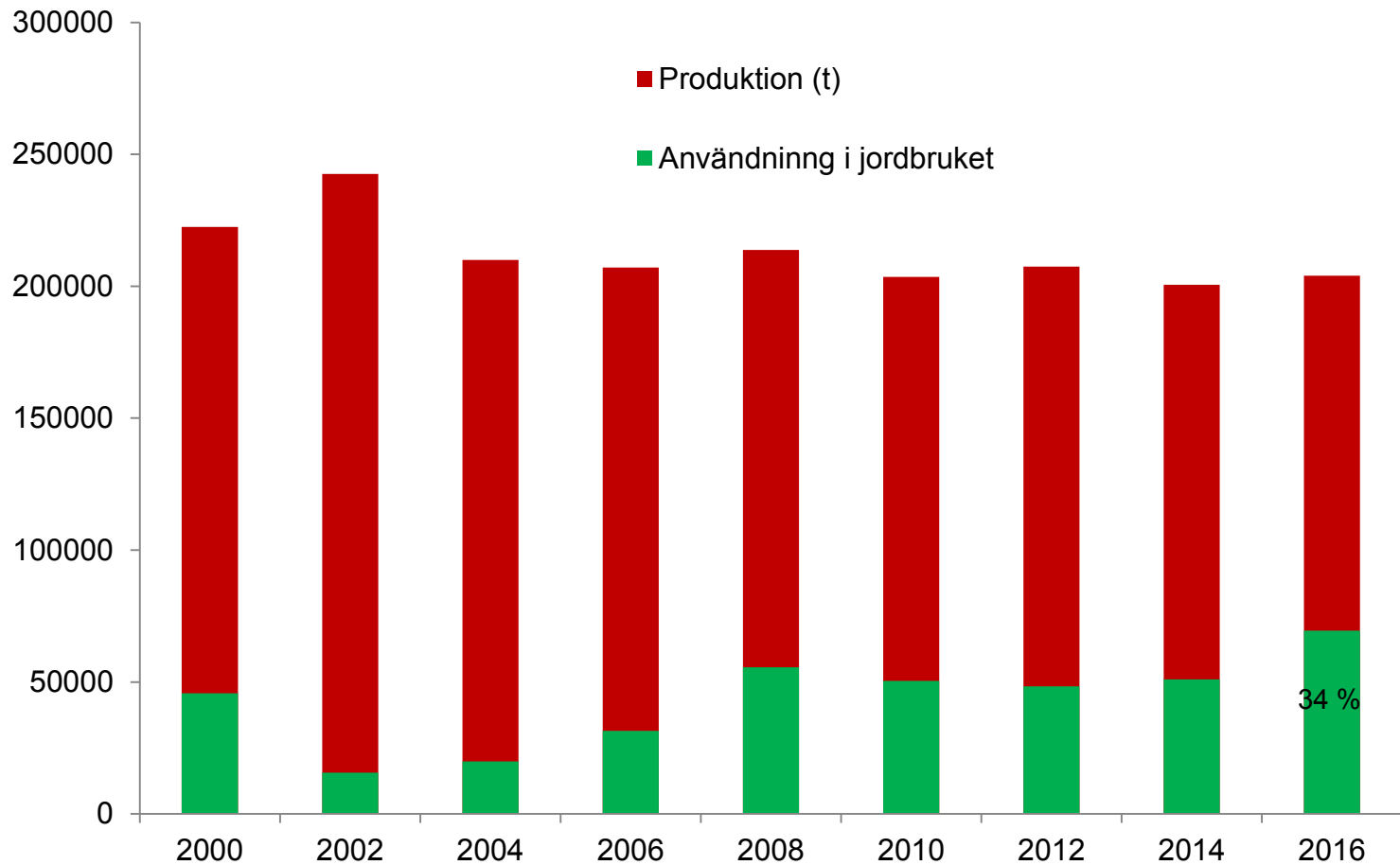
**Arbogaån - Kungsör**

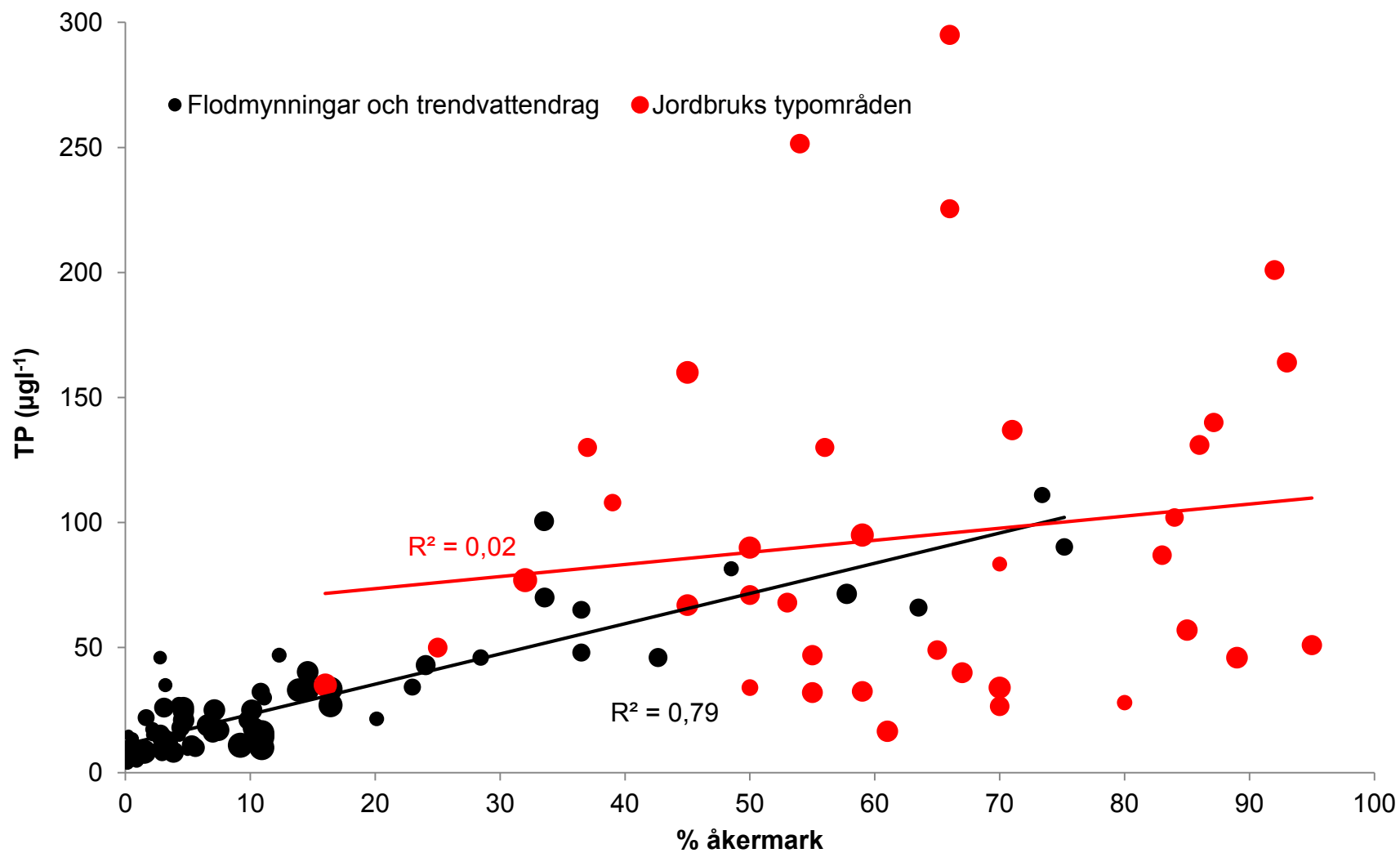


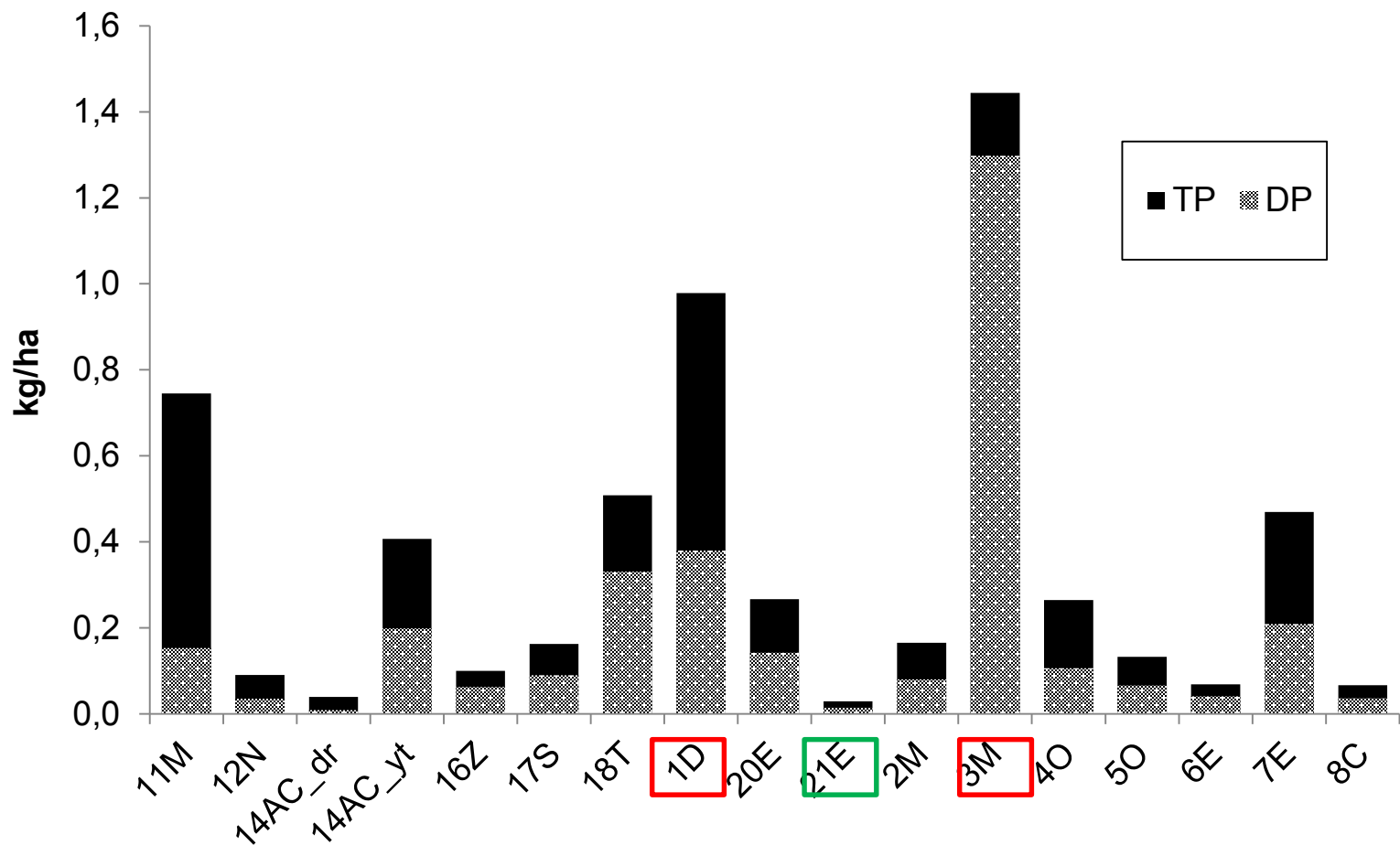
Persson, G. 2001.

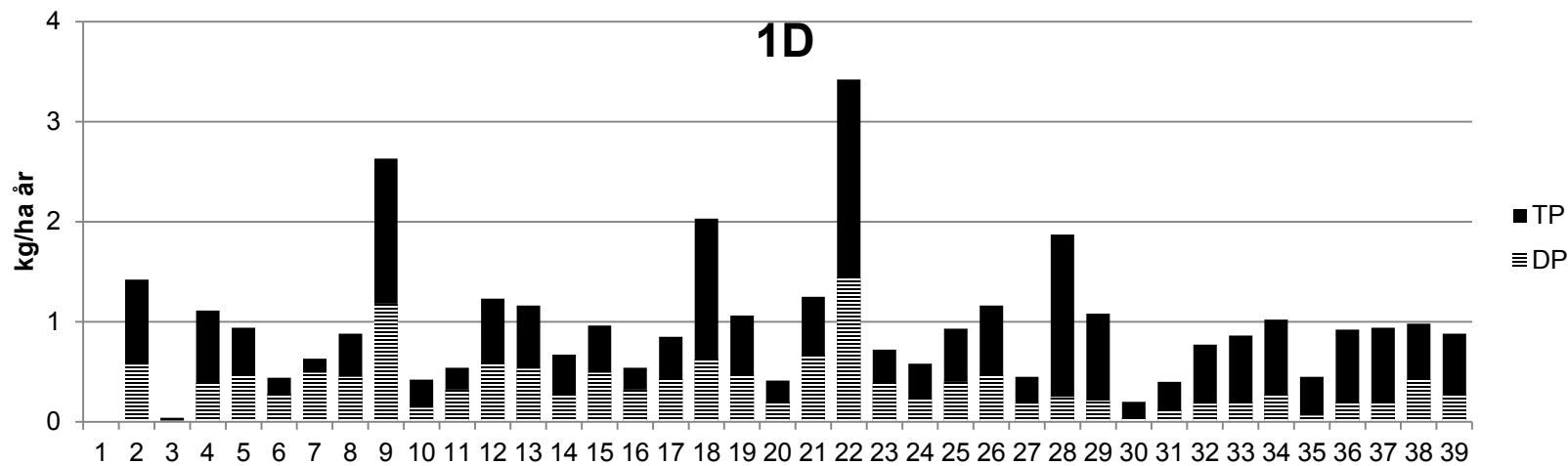
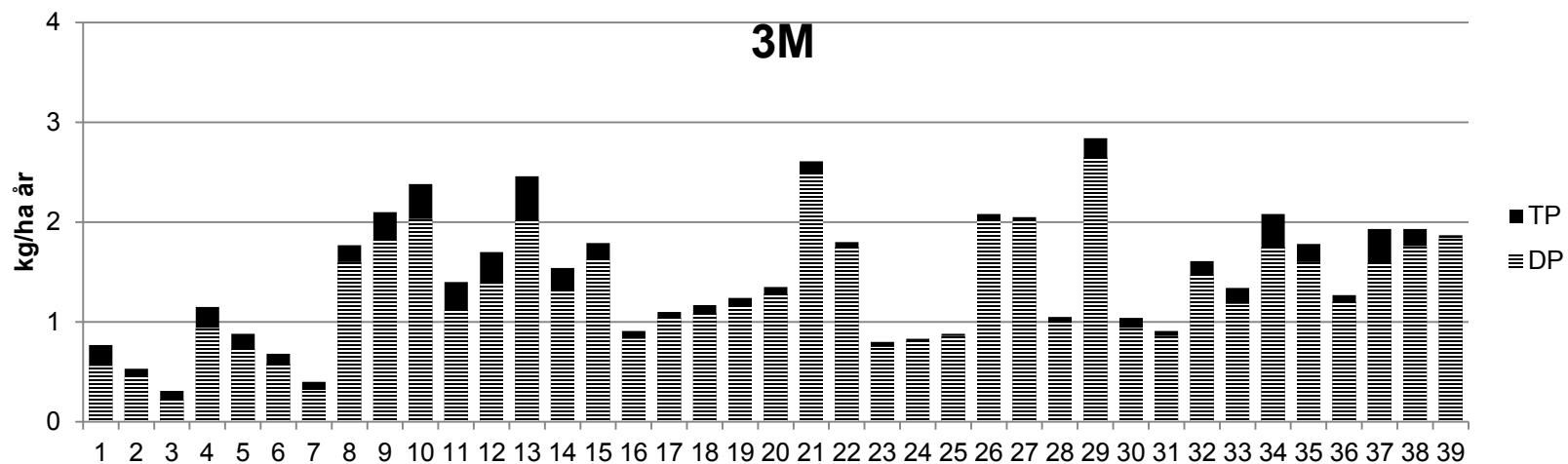
# Avloppsslam

Till 2018, minst 40 % av P i avloppsslam bör användas inom jordbruket

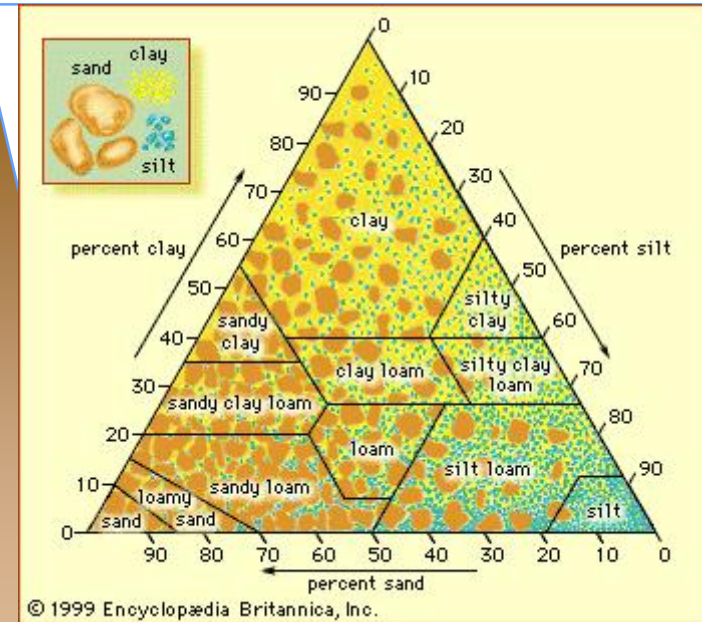
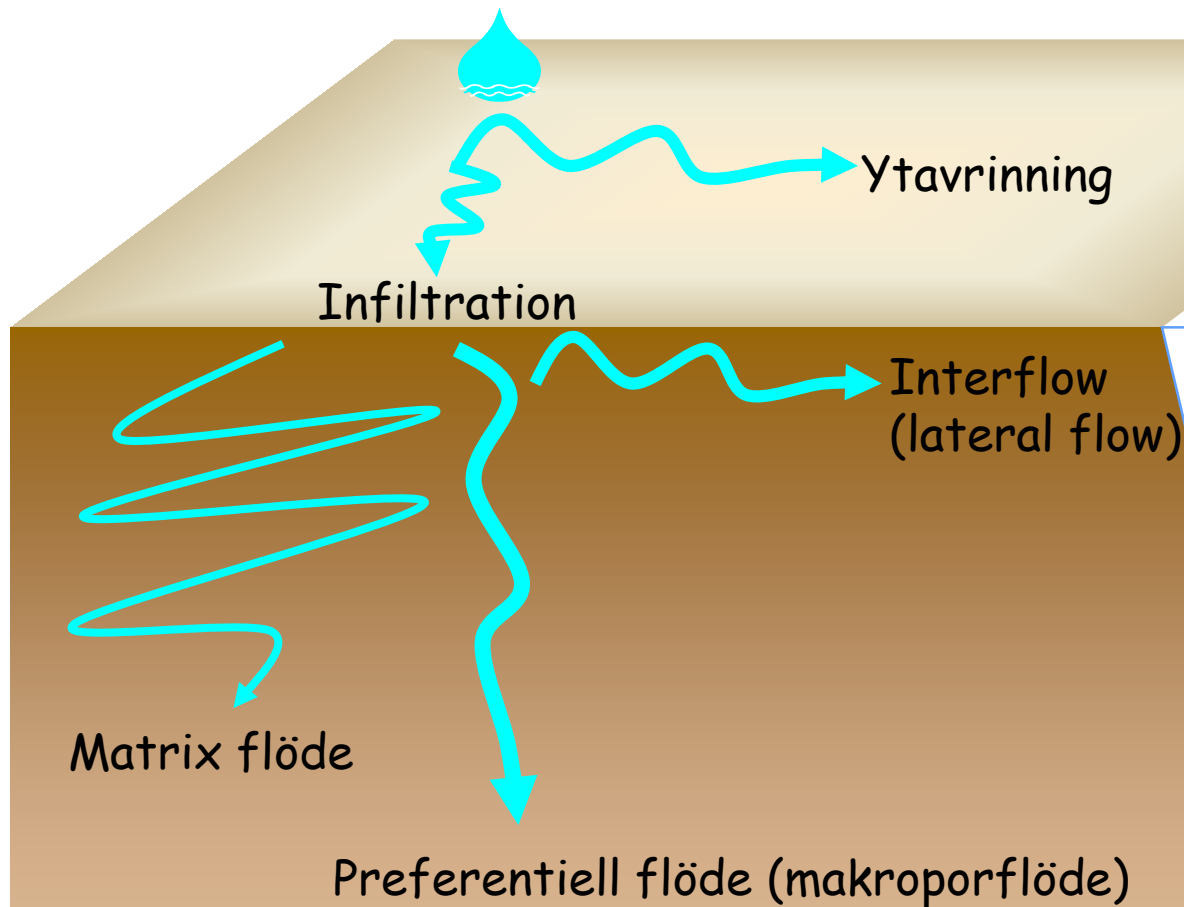








- Löst reaktiv P (fosfater)
- Partikulärt-bunden P (PP)
- Total P (TP)





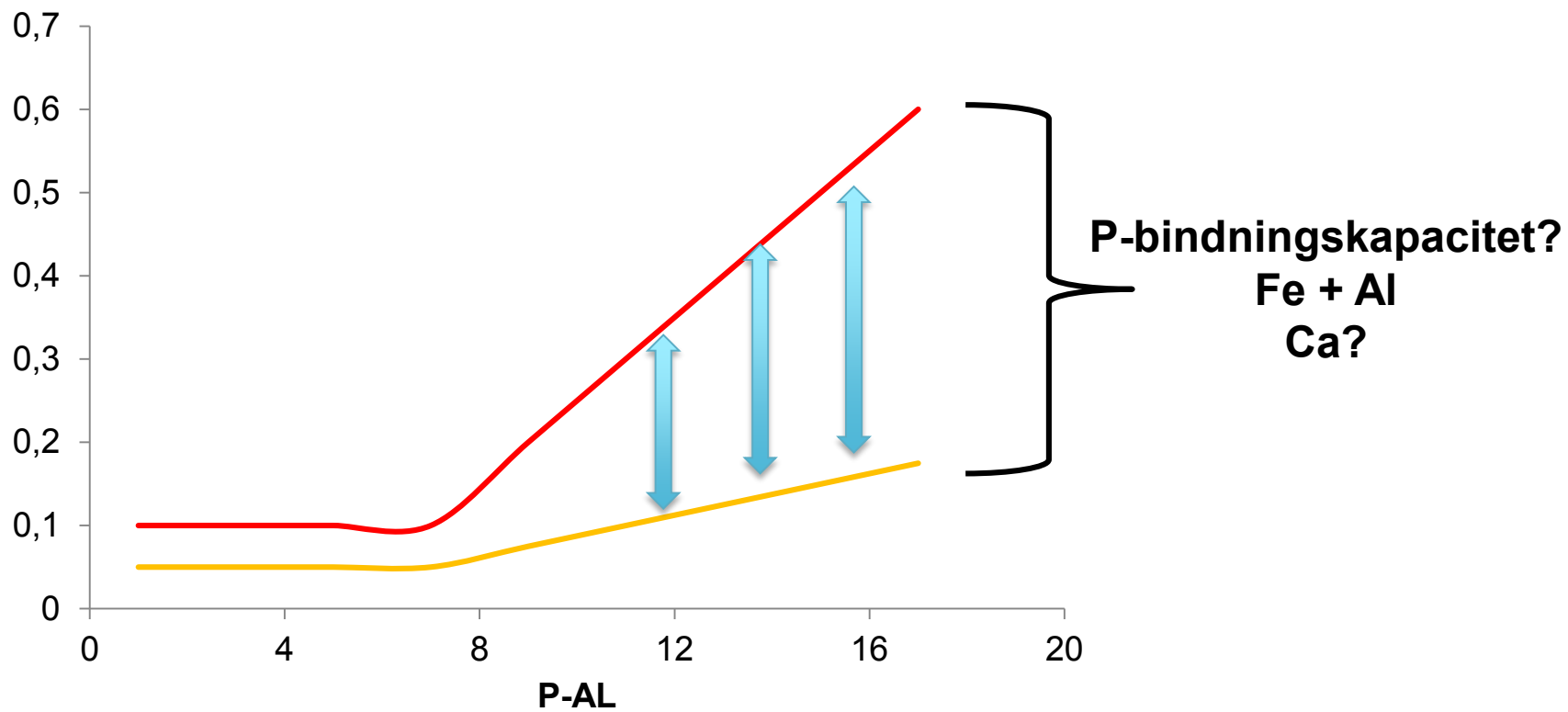
1. Dålig dränerade ler-mo-  
mjäla jordar, ytavrinning  
och erosion, makroporflöde,  
fokus på P-transport vägar

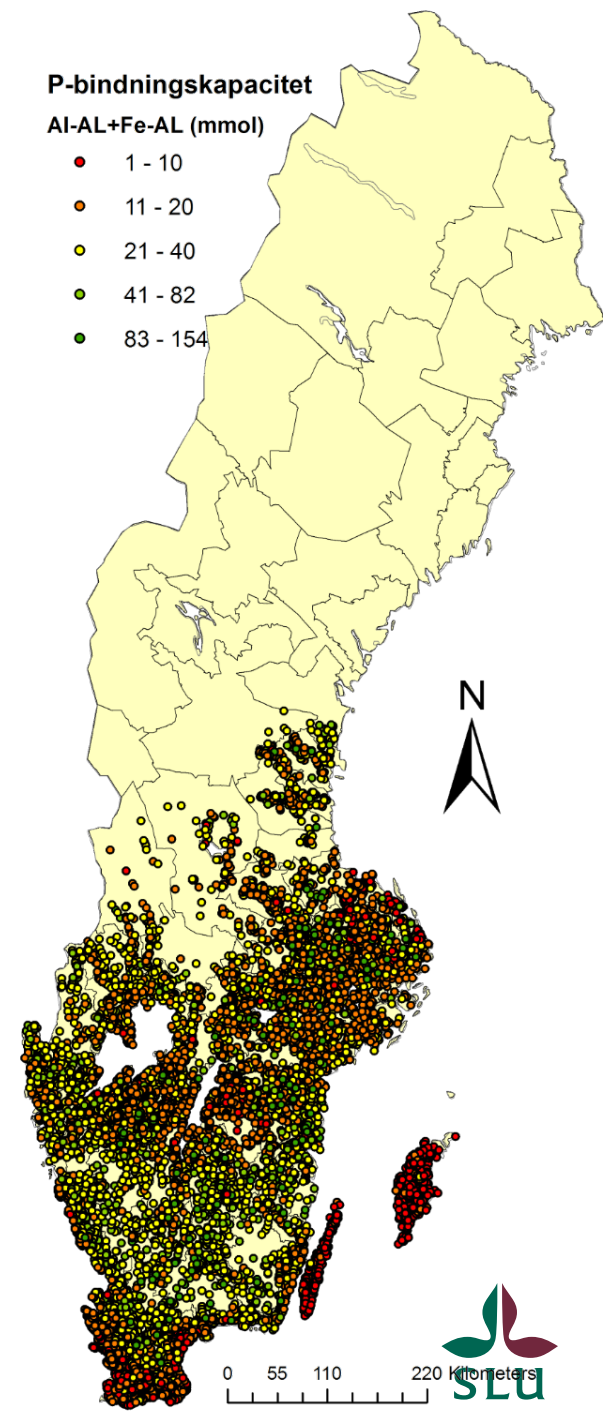
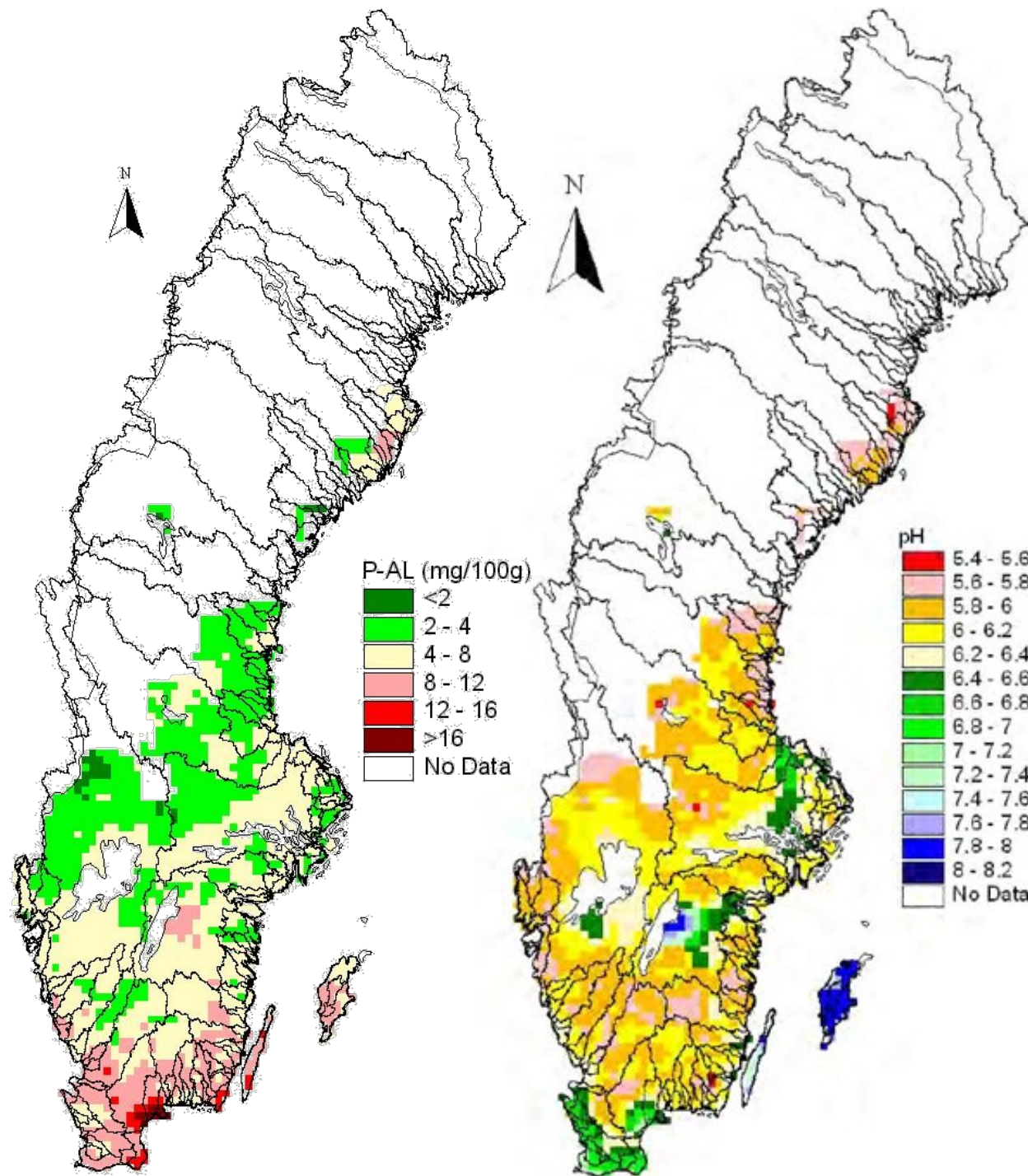
Erosionsskydd,  
anpassade skyddszoner,  
strukturkalkning,  
växtföljd

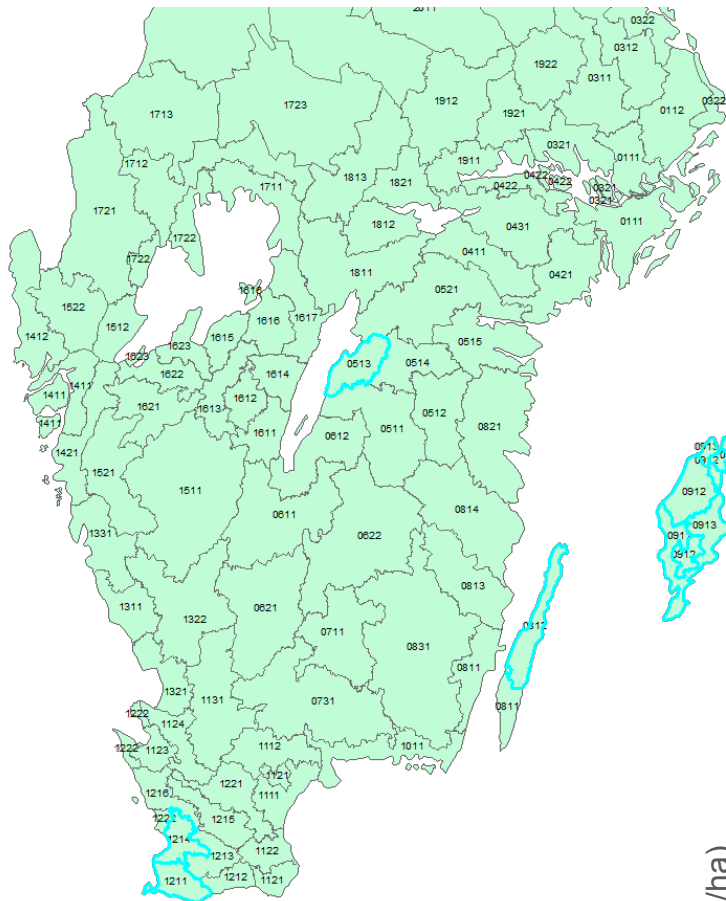
2. Väl-dränerade sandiga  
jordar, hög P-halt &  
djurtäthet, fokus på P-källor

4R,  
Markkartering av  
bindningsförmåga,  
våtmarker och/eller  
reaktiva filtrar

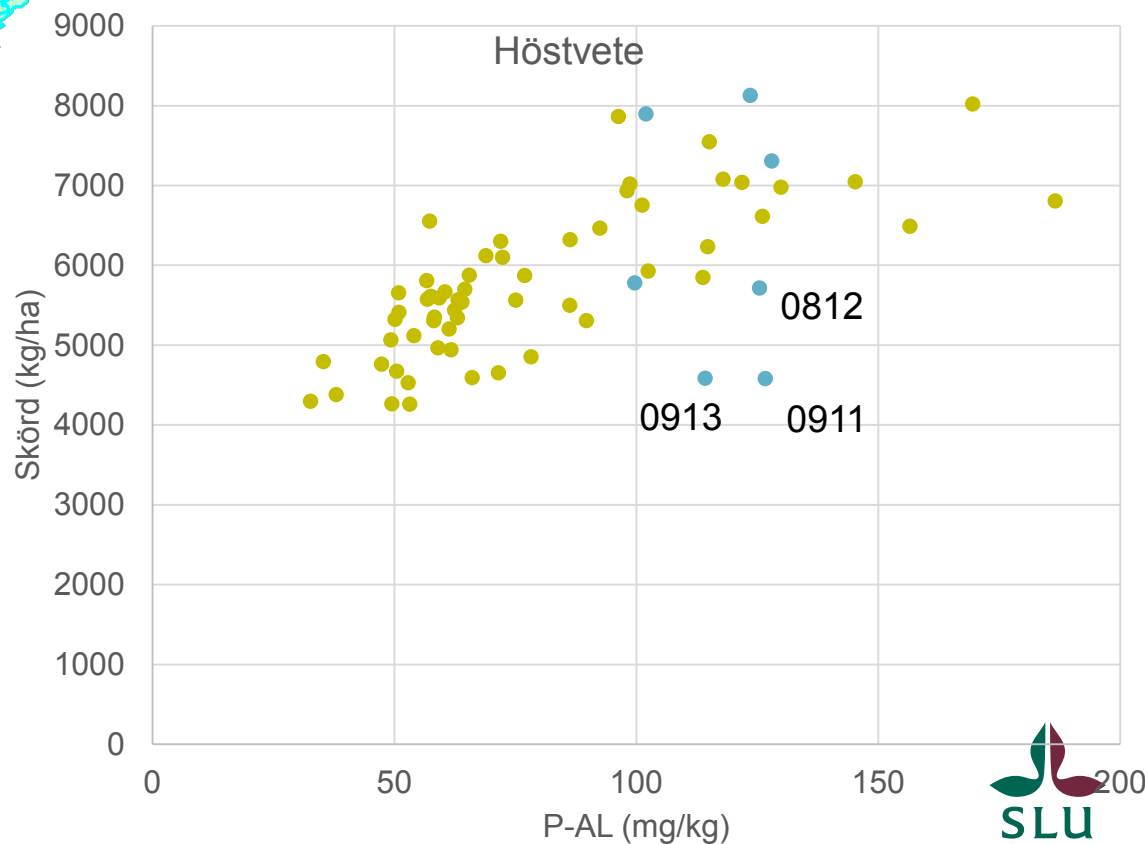
## P frigörelse







pH?  
 Alvens roll?  
 Ca?  
 Alternativa metoder att bedöma växttillgänglig P?



# Sammanfattning

- ✓ Fosfor är...
  - ✓ ...ett viktigt näringsämne i jordbruket
  - ✓ ...en ändlig resurs
  - ✓ ...ett begränsande näringsämne i akvatiska ekosystem
- ✓ P-halt i svensk åkermark - 1/3 (brist, optimum, överskott) \* 3
- ✓ Stora rumsliga variationer, regionalt och lokalt
- ✓ "Gamla synder"
- ✓ Bra balans nationellt, stora regionala skillnader
- ✓ Stora temporala och rumsliga variationer i P-förlusterna
- ✓ Ny kunskap och data som en väg mot "smartare" åtgärder



# Tack!



Stiftelsen  
Lantbruksforskning



Jordbruks  
verket

Havs  
och Vatten  
myndigheten

